Comprehensive Life Cycle Approach to Obsolescence Management

ABSTRACT

Obsolescence is inevitable and affects all systems, especially military systems which are designed for a long product life.

Military systems typically outlive most of their internal components, giving rise to parts obsolescence. In the past 10 years, parts obsolescence is accelerated by the wave of progress in electronics and material innovations. Thus, it has become a greater challenge for military agencies to sustain their systems.

Obsolescence affects system supportability, safety and mission readiness. In order to overcome obsolescence, high costs and significant efforts may be incurred. Existing methods of obsolescence management are inadequate to ensure cost-effective continuity of support for the system.

A new approach is required to maximise the value of the military system throughout its life cycle. This article presents the principle, framework and measures to address obsolescence issues in military systems.

Angela Lua Yali
Xiao Yu Guang
Zee Sow Wai
Loo Jang Wei

INTRODUCTION

Obsolescence is increasingly affecting military systems at an early stage of their life cycles. Availability of replacement parts is critical for operational readiness, but the wave of progress in electronics and material innovations in the past 10 years has accelerated parts obsolescence. Traditional support options are no longer effective in minimising the risk of obsolescence and impact to the system's cost and availability.

It has become evident that a more comprehensive approach is needed, where obsolescence management is carried out from the planning to retirement phase. During front-end planning, measures can be taken to pre-empt obsolescence issues and delay their onset in the life cycle of the system. Proactive measures can also be put in place through contracting mechanisms.

This article presents the principles and measures of a life cycle approach to obsolescence management. It explains a framework which can be used to address obsolescence issues proactively and holistically throughout the system's life cycle.

KEY PRINCIPLE AND MEASURES

The key principle of obsolescence management is to manage obsolescence throughout the project or system's life cycle – from front-end planning, acquisition, to the operations and support phase – in order to execute the most cost-effective strategy. Depending on the project phase, pre-emptive or proactive measures can be adopted (see Figure 1).

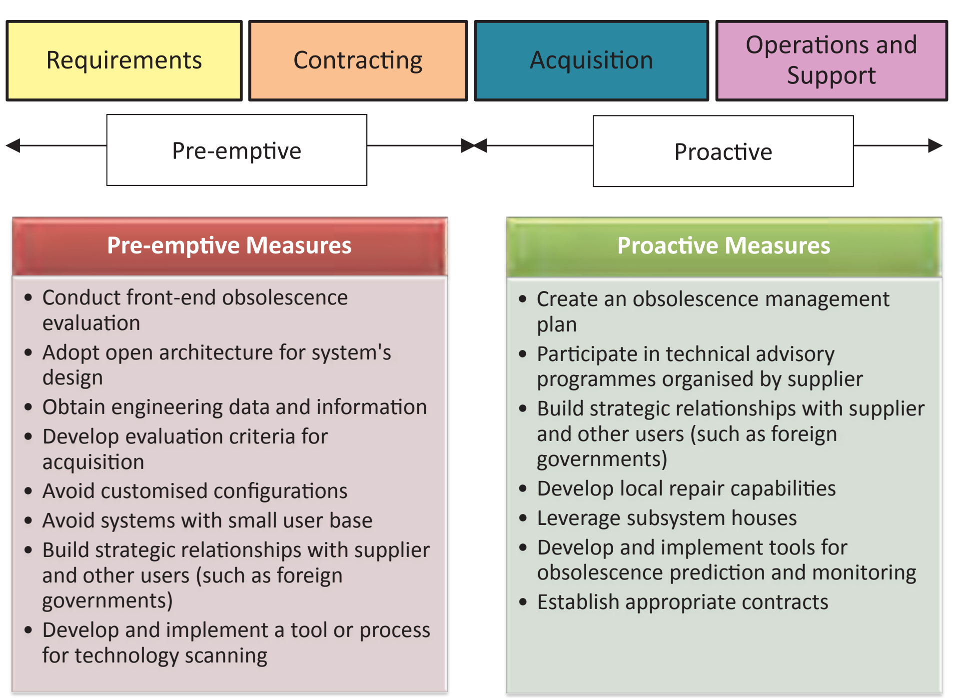

Figure 1. Measures to manage obsolescence

Pre-emptive Measures

Pre-emptive measures should be adopted in the early phase of project implementation. Any risk of obsolescence should be identified early to avoid problems downstream. One option is to explore adopting open architecture systems which can be modified more easily if the need arises. Due consideration has to be given to the selection of the system and the contractor. Conducting market surveys and risk assessments are suitable methods to aid the selection process.

Proactive Measures

Proactive measures should not only be adopted during the contracting phase but also while transiting to the operations and support phase. The project team should engage the contractors constantly to monitor any obsolescence issues. Establishing depot level maintenance capabilities (i.e. local repair capabilities) would help to alleviate the impact of obsolescence. Such measures would help to establish through-life support for the acquired system and achieve the maximum benefit for end users.

OBSOLESCENCE MANAGEMENT FRAMEWORK

A framework has been derived based on the collective experience of project teams in DSTA. As shown in Figure 2, it is a two-by-two matrix consisting of two variable factors: size of user base and the technologies used within the system.

Size of user base can be large or small depending on the number of international operators. Technologies used in the components and hardware of the system can be proprietary or commercial off-the-shelf (COTS) products.

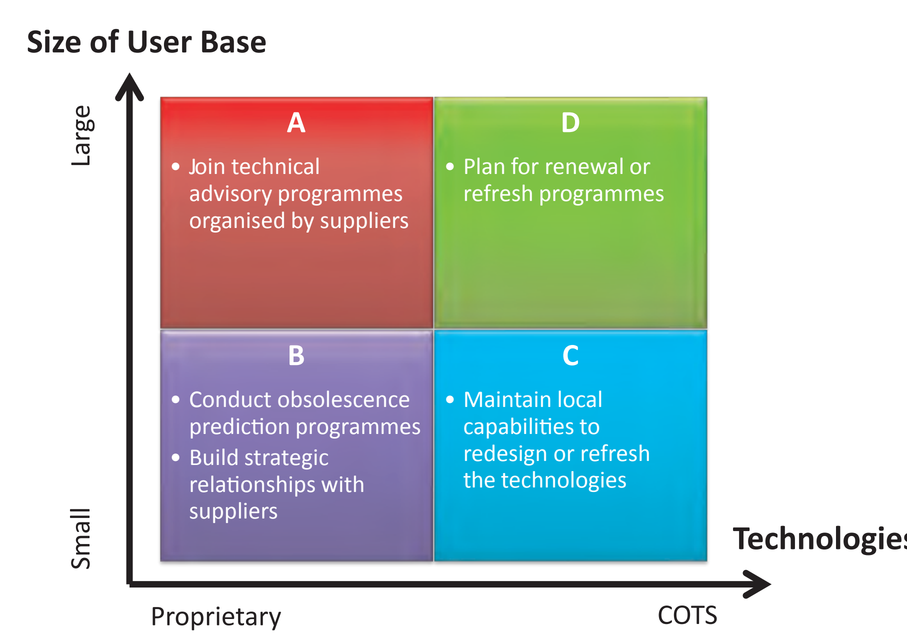

Figure 2. Obsolescence management framework

Using this framework, the project team can identify the quadrant applicable to the systems and employ the relevant measures for obsolescence management. Measures include obtaining user group membership for the technical advisory programmes, developing local capabilities and using obsolescence prediction programmes.

Large User Base – Proprietary Technology (Quadrant A)

Military systems in this category have a large user base and are likely to have a funded, sustainable and formal process by the suppliers to deal with obsolescence issues. By joining the technical advisory programmes, project teams can gain access to direct operational assistance and consultation with the suppliers.

Small User Base – Proprietary Technology (Quadrant B)

Military systems in this category are likely to face the most challenging obsolescence management issues. Due to the small user base, the suppliers may not invest in resources to track or manage obsolescence. Although COTS is used to lower costs in many instances, the suppliers will have built-in proprietary firmware. Thus, it is necessary to have specially tailored obsolescence management programmes – such as using obsolescence prediction programmes for planning and mitigation, as well as establishing appropriate contracts and building strategic relationships with the suppliers.

Small User Base – COTS Technology (Quadrant C)

This category is populated by customised and specially developed products or systems. For example, the command and control (C2) system software is developed in-house while hardware systems are mainly bought off the shelf. Although the software is proprietary, developing it in-house reduces the risk involved during migration to a newer COTS hardware. Thus, maintaining local capabilities to redesign or refresh the technologies is the key requirement for this category.

Large User Base – COTS Technology (Quadrant D)

Military systems in this category are characterised by short product life cycles (PLC) and lower acquisition costs. Similar to consumer electronic products, the approach is to plan for fleet renewal at every PLC. Some examples of this category include computers, communication sets and optics equipment. Other systems that fall in this category are commercially produced aircraft used for training purposes. Fleet renewal of such systems has to be planned carefully as it can involve substantial budget and effort.

The project team has to use the framework to review and evaluate the relevance of the adopted measures and options in the various phases of the system's life cycle (see Figure 3).

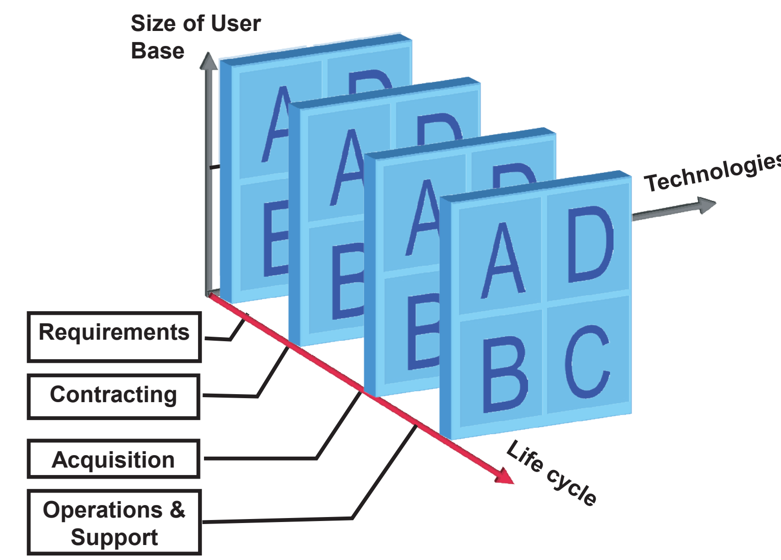

Figure 3. Using the framework in various phases of the life cycle

CASE STUDIES

The following section of the article highlights three case studies to demonstrate how the obsolescence management framework and relevant measures can be applied.

Case Study 1: System X is an avionics system

System X was chosen to follow mainstream operators resulting in a large user base. The entire avionics suite falls under Quadrant A but the subsystems, which are COTS products (e.g. radio), fall under Quadrant D.

The following pre-emptive measures were undertaken:

a) The technology of System X was developed based on the Avionics Architecture System, which is an open architecture system. Thus, it allows the project team to better manage software reuse and obsolescence. Furthermore, the system was designed using the modular open systems approach. In the event of obsolescence, minimal changes to the system are required as replacement is only made for peripheral components.

b) Annual meetings were conducted with System X's supplier, including senior management meetings. These meetings help to establish a strategic relationship with the supplier, leading to better after-sales support that also encompasses obsolescence management. The customer receives updates on the obsolescence review of System X and learns about relevant mitigating strategies. The customer also obtains insights into the supplier's development roadmap for the Avionics Architecture System, and gains some influence over the development of the architecture redesign.

The following proactive measures were undertaken:

a) Participation in the operators' technical advisory groups, which enabled the project team and other group members to share development costs for upgrades to the Avionics Architecture System. As each member only has to pay for his own integration costs, significant cost savings are achieved.

b) Efforts were made to maintain a strategic relationship with the supplier, which provides a channel to obtain information on obsolescence in advance. Thus, the proposed solutions are evaluated and implemented early to mitigate the impact of obsolescence on fleet availability, avoiding high costs of maintaining continuity of support.

c) The contract specifies the supplier's obligations for obsolescence management. For example, whenever obsolescence of a component is identified, the supplier is obliged to keep the customer informed and provide suitable solutions. This ensures a continuity of supply of components for System X.

The practicality of the life cycle approach to obsolescence management is illustrated through an incident on the processor. System X's supplier announced that one of the processors for the avionics would become obsolete and there were plans to replace it with a new processor. This replacement would affect all aircraft variants equipped with the processor. However, System X is an open architectural system and any modification impact would be minimal.

The change in processor would not require an extensive testing and recertification effort as the common software could be hosted in the new hardware processor. The non-recurring engineering cost of the retrofit would be shared among the large user base. This would minimise the impact to system availability and reduce the high costs due to obsolescence, leading to better operational readiness and increased value of investment.

Case Study 2: System Y is a radar system

System Y was customised to meet specific requirements for a radar system. With a small user base and the use of proprietary technology, this system falls under Quadrant B.

Obsolescence began to set in during the operations and support phase. Components such as transmit-receive modules, CPU cards, electro-mechanical parts and computer hard disks were identified to be obsolete. Alternative parts with similar functions were stocked up for use in place of the obsolete parts. However, for some parts, the obsolescence notifications were given at late notice. Hence, the option to stock up the parts was not available. This affected system availability significantly.

To ensure supportability of System Y, a proactive measure was undertaken by contracting the supplier to perform obsolescence prediction studies. The supplier has access to the information database and updates the component obsolescence status on a regular basis. Thus, component obsolescence will be an anticipated event accompanied by recommended solutions. This minimises the impact to system availability, leading to better operational readiness.

Case Study 3: System Z is a command and control system

System Z was developed locally, based on a common C2 reference architecture. With a small user base and the use of COTS technology, System Z falls under Quadrant C.

The project team adopted a pre-emptive measure, which is to develop System Z based on an open architecture. Thus, modular designs were selected. In addition, open standards and open source solutions were adopted, while product-specific features that deviated from architecture requirements were avoided.

The resulting architecture enables System Z to be plugged seamlessly into the existing network on many new platforms. Furthermore, the use of COTS products in System Z's design means that more hardware options are available in the market. This prevents reliance on a single supplier, leading to a more cost-effective maintenance support and better system availability throughout the system's life cycle.

As a proactive measure, the project team engaged a local defence contractor to build up the local technical capability to maintain and provide future system development and upgrades. Thus, the risk of obsolescence occurring downstream is minimised, enhancing system availability throughout the system's life cycle.

CONCLUSION

To maximise the value of a military system, obsolescence should be managed throughout the system's life cycle. Using the principle, framework and measures presented, the project team can review and formulate the most cost-effective strategy for each of the different phases in the system's life cycle.

BIOGRAPHY

Angela Lua Yali is a Senior Engineer (Naval Systems). She is working on a new concept of mission modularity for the acquisition of a new naval platform. When she was Involved in the Operations and Support for naval guided weapons previously, she had participated in a live firing exercise to validate the performance of the system after the upgrade of the naval platform. Angela obtained a Bachelor of Engineering (Mechanical Engineering) degree with First Class Honours and a Master of Science (Industrial Systems Engineering) degree from the National University of Singapore (NUS) in 2007 and 2011 respectively.

Xiao Yu Guang is a Senior Engineer (Systems Management). He is responsible for ensuring the high state of operational readiness for various radar and electro-optics sensors. Yu Guang was previously with the Aeronautical Systems Division. He worked on the acquisition of unmanned air systems and the integration of airborne sensor systems into maritime patrol aircraft. He was involved in the modernisation of the C130 Hercules transport aircraft and provided technical assistance to define the system architecture. He graduated with a Bachelor of Engineering (Electrical Engineering) degree with Honours from NUS in 2004. Under the DSTA Postgraduate Scholarship, he obtained a Master of Science (Aerospace Vehicle Design) degree with a specialisation in Avionics Design, from Cranfield University, UK in 2009.

Zee Sow Wai is Head Capability Development (Transport/Tanker) for air systems. He oversees capability development for the transport and tanker fleet, ensuring coherency in various aspects such as systems architecture, interoperability and capability build-up. Sow Wai has extensive experience in developing engineering capabilities for failure investigation and analysis, advanced composite material repairs and finite element analysis. He also spearheaded structural life extension programmes for the E2C, A4SU and S211 aircraft and managed the C130 Avionics Upgrade project. Sow Wai graduated with a Master of Science (Industrial and Systems Engineering) degree from NUS in 1987.

Loo Jang Wei is Deputy Director (Operations and Support, Army). He oversees the systems management of Army's armaments, guided weapons, sensors and comand and control systems. Jang Wei also heads the Obsolescence Management Working Group in DSTA, which drives the development of framework and processes to address obsolescence issues faced in system life cycle management. From 1983 to 2004, he was an Air Engineering Officer in the Republic of Singapore Airforce. Through various appointments, including Commanding Officer of Air Logistics Squadron and Deputy Head Air Logistics (Aircraft Systems), he gained valuable experience in aircraft engineering, systems management and logistics operations. As a recipient of the Defence Technology Training Award in 1989, Jang Wei graduated with a Master of Science (Aircraft Structural Design) degree from Cranfield Institute of Technology in UK. In 1998, he attended the International Executive Development Programme at INSEAD, France, under a sponsorship from the Ministry of Defence.