Chapter 10
Obsolescence Management for Sustainment-Dominated Military Systems:
Multiple Criteria Decision-Making Approach Using Evolutionary Algorithms

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ABSTRACT

As more and more Commercial Off The Shelf (COTS) parts are being used in sustainment-dominated systems where average product lifecycle is above 25 years, obsolescence management becomes a greater concern for program managers. The lack of management and poor planning for obsolescence cause companies, governments, and military organizations to spend progressively more to deal with aging systems. For a successful obsolescence management, program managers should consider both the cost-effectiveness and system availability issues simultaneously and should implement appropriate solution approaches. In this chapter, the authors first define the obsolescence management in sustainment-dominated systems and then give a brief summary of the related literature. They finally discuss and propose multiple criteria decision-making methodologies and evolutionary algorithms to tackle the management problem.

INTRODUCTION

Ever since the end of cold war, consumer electronics, and integrated circuit market became dominant and higher market share moved from military products to small-scale consumer products due to the advances in the consumer markets and fast-changing nature of the dynamic consumer market.

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Fast technological advances created new consumer markets for which the needs are constantly being changed by either producers or consumers; thus, the life cycle of consumer products have become very short. This fact created a new type of product, called Commercial Off The Shelf (COTS). COTS stands for software and hardware products or services available in the market for public use that are free of charge or that have a cost associated with them. These products are attractive with their low cost and availability within their life cycle time. Additionally, they are available for use in any system design.

Following Perry Notice (Defence, 1994), as many nations, regardless of the proportion of the military budget, have placed as much emphasis as possible on the use of COTS products, we had experienced more COTS products in the military systems. Many state acquisition agencies and departments now strongly advise a policy that focuses on a gradual withdrawal from military specifications (Mil-Specs) and the use of COTS systems if applicable.

While there are numerous advantages to using COTS products, there are also a number of disadvantages as well. Some of those disadvantages include product volatility, obsolescence, and security. Even though reduced maintenance costs and vast availability are considered one of the advantages of using COTS products, they have turned into a barrier for maintenance agencies of systems with longer life cycle periods when we consider the disadvantages mentioned above. Normally the life cycle of a COTS part is typically 2-5 years. However, using such parts in systems with 25+ years of life cycle creates a big problem for maintenance agencies. Those systems with longer life cycle periods are not fully ready to adapt itself to the new phenomenon. In addition to that, legacy acquisition systems are also not ready for such a change.

Industries including military, aerospace, nuclear energy plants and railways still have life cycles of 25+ years. Due to high investment, testing and certification costs these systems seem to remain within their long life cycle periods. These systems are considered to be “sustainment dominated systems”.

Obsolescence is a major problem for such sustainment-dominated systems. In certain cases, obsolescence of a COTS part in a sustainment-dominated system requires a change in the original design. Due to the high complexity and environment in which they are used, they have higher standards for requalification and recertification for a design change. Sometimes, certain COTS products go obsolete even before production starts. Therefore, obsolescence is a major problem for systems with a long life cycle and this problem has to be addressed by an Obsolescence Management Plan (OMP) as early as possible. The lack of management and poor planning for obsolescence cause companies and governments to spend progressively more to deal with aging systems.

In order to underpin the severity of the obsolescence problem, here are a few of the examples with figures: A US Navy shipboard sonar system development project experienced the obsolescence of 70% of the parts listed in Bill Of Material (BOM) even before the system had completely developed. Also, the US Air Force spent $81 million USD to change and redesign the electronic parts for the F-22 program. The redesign of a system used in F-16 fighters radar systems costs $500 million USD for the US Air Force. The Electronic Industries Alliance (EIA) Manufacturing Operations and Technology Committee reported that the cost for the redesign of an obsolete electronic part is between $26,000 and $2 million USD. In 1997, the US DoD (Department of Defense) spent $264.000 USD for Life-of-Type Buy for an obsolete part. The US DoD is reported to have spent $10 billion USD to manage and to mitigate obsolescence problems.

As each study draws attention to obsolescence, the proposed methods, methodologies and models for obsolescence are ultimately formed around strategies forming a three-tiered solution: