

# Initiatives to Prolong Aging Assets Life Cycle: A Case Study in Royal Malaysian Navy

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**Abstract**— The research represents a case study on Royal Malaysian Navy (RMN) assets. Most of the assets are aging and were used more than its useful and economical life. The study demonstrates on initiatives used in maintaining and prolongs the life of aging assets in RMN. The asset life cycle stages were elaborates to allow the research of this area. The paper is based on review of literature and RMN experiences in managing aging assets. In additions, the study identifies new way of maintaining the assets for longer period without replacement. The paper also reveals that by applying these initiatives, RMN assets performance has increased and are able to be used extensively. The authors have recommended these initiatives to be the guidelines in the military and other sectors especially for logistics and transports industry in future.

**Keywords**— *Asset Life Cycle, Aging, Life Extension, Obsolescence, Replacement*

## 1. Introduction

The significant of assets were recorded as early as year 1760, which is the beginning of the revolution era. During this period, it was the time of transition from hand to machine manufacturing. The assets were managed and maintained effectively in order to produce efficient output especially in manufacturing industry. Subsequently after the industrial revolution, people were focussing on machines and assets management to maximise production. There are five (5) classes of assets namely infrastructure, mobile assets, plant and production, estates and facilities and information technology [1]. In order for the assets to perform its function in achieving its targeted output, the assets need to be managed systematically. Every asset has its life span, it is the responsibility of the organization to maintain the assets and fully optimise on its usage so that the owned asset is

value for money and it gives return of investment.

### 1.1 The Royal Malaysian Navy Challenges

Malaysia located bordering with 6 countries namely Singapore, Indonesia, Thailand, Brunei, Philippines and China. Malaysia is surrounded with seas. Its territorial sea extended up to 12 nautical miles and Exclusive Economy Zone up to 200 nautical miles. Therefore Malaysia is categorised as Maritime State. The country economic wealth comes from petroleum and fisheries.

Malaysia has manifested its ownership over dispute area which comprise of maritime boundaries and its resources with its neighbouring countries. Hence the Royal Malaysian Navy (RMN) were established to protect the Malaysia sovereignty, wealth, seabed resources and to safeguard the Malacca Straits and the South China Sea. This two waterways are heavily travelled by the maritime user such as the merchant ship. The Malacca Straits has become the important shipping route that connecting Pacific Ocean and Indian Ocean which become the main routes that bring resources such as oil and gas, raw material and other resources from Europe and Middle East to Japan and Korea [2]. With maritime security challenges for instance piracy attack, armed robbery, human trafficking and smuggling, it is important for RMN to play their role in protecting the interest of the country and the user state.

RMN progressively transform from the brown water to blue water navy with improvised assets. Currently there are 44 ships with varies size and function. However the development of the RMN still low, due to limitation of budget in procurement of new assets. With restricted amount of budget, the RMN plan their modernization by stages. The procurement of KD KASTURI and KD JEBAT in 1980s is the beginning of the transformation of RMN [3]. This was followed by procurement of

Laksamana Class Corvettes in 1990s, New Generation Patrol Vessel and the Submarine in 2000s.

Although there were new assets in RMN inventory, nonetheless the RMN were still very limited in their operational capabilities since most of the current assets were aging and used for more than 20 years. With budget constraint in replacing new assets, it is high time for the RMN to find new strategies and initiatives to prolong their aging asset life cycle in order to successfully operate and play their roles in protecting the country sovereignty.

**1.2 Objectives of the Study**

Generally this study embarks on the objectives as follows:

- a. To develop the definition of aging asset and cause of aging.
- b. To determine the initiatives to prolong the aging asset life.

**2. Literature Review**

According to Australia Department of Treasury and Finance, optimal asset management [4] can be achieved through:

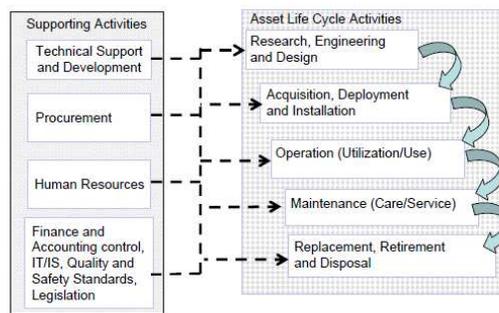
- a. Asset performance that facilitate its service delivery.
- b. Considering asset life cycle before investing on new assets.
- c. Managing asset holistically.
- d. Continuous improvement in managing asset.

Asset management is a lengthy process which involves four (4) levels of assets life cycle [5]. The asset life cycle begins with acquisition and ends with disposal [6].

**Table 1.** Stages and Process involves in Asset Life Cycle.

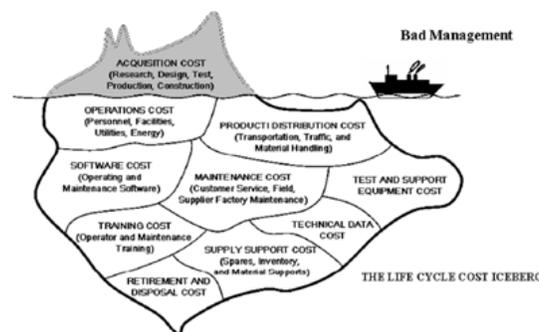
Stages	Processes
Acquisition	Process of acquire the assets by analysing the technical and financial factors.
Deployment	Activities involving installation, testing, acceptance and commissioning of assets.
Operations	Availability and operationability of assets by going through the asset maintenance process for maximum usage.
Retirement	End of asset life and disposal process.

Assets life cycle stages, involve other elements in supporting the whole processes which had been introduces in the Asset Related Models [7]. These elements are varies, multi discipline and interrelated in every stage of asset life cycle. There are strong relations between asset life cycle activities and supporting activities as illustrated in Figure 1.



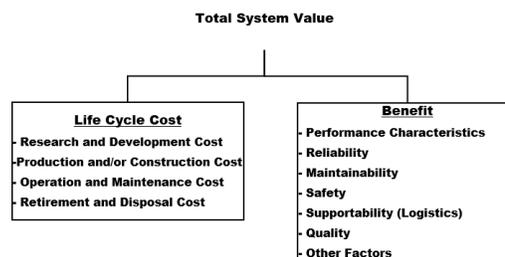
**Figure 1.** Asset Related Models

Many organisation does not realise that when procurement of an asset, it does not only involve acquisition cost, cost associated with operation, maintenance and support are the highest cost when an asset is in-service. The cost involved are only visible when the asset is already in use. The total cost involve are consider as the Total Life Cycle cost of an asset [8]. Therefore the Total Life Cost constitutes of initial cost, current operation cost and the future cost as shown in Figure 2.



**Figure 2.** Cost of Operating Asset

The cost spends for operating the asset will give implications on effectiveness of the asset. In return, the money spend on the asset will give the benefit to the organization [9] as shown in Figure 3.



**Figure 3.** Total System Value

As discussed earlier, asset life cycle involve four (4) stages which many organization has to go through this processes. However this paper will focussing on the third stage of assets life cycle. The Operations Stage is the

longest stage of overall asset life cycle and involve high costs [10] and it is the most challenging stage for the organization that used assets for a longer period of time [11].

Assets that has gone through the tests, commissioned and acceptance processes in the deployment stage will be fully operational. During the Operation Stage, organization has to maintain the assets at the highest standard of readiness which the cost of operating the asset may reach up to 70% of total ships acquisition cost. During this stage, the asset will be used to maximum level in order to achieve the output as desired by the organization. It is most challenging tasks to remain the asset to be available for operation without any failures on the parts and components [12]. Therefore the sustainability of assets is much dependent on logistics support. Hence, it is important for the organization to manage their asset comprehensively especially organization that owned aging assets.

On the hand, systematic and consistent asset maintenance are crucial for the organization in order to prolong the asset lifespan. Maintenance can be defined as to upkeep the asset to operation by repairing and replacement of the components of the asset [13]. Moreover, maintenance is the key to asset reliability. There are two (2) types of maintenance; planned and unplanned maintenance.

## 2.1 Planned Maintenance

Planned maintenance consist of preventive maintenance and schedule maintenance. This type of maintenance performed periodically according to Original Equipment Manufacturer (OEM) recommendations based on running hours or calendar period to avoid asset failure or low performance. It is the initiatives of the organizations to schedule its maintenance to avoid interruption while operating the assets.

### 2.1.1 Preventive Maintenance

Preventive maintenance is conducted to pre-determined in order to identify the possibility of asset failure, defect or performance degradation. The main objectives of preventive maintenance is to anticipate faulty before the asset breakdown. Consequently, many organization will plan scheduled maintenance in order to maintain their asset systematically.

### 2.1.2 Scheduled Maintenance

Scheduled Maintenance is a complete maintenance program that are pre-planned to maintain the asset in order to ensure the availability of the asset. This schedule maintenance is to ensure the asset is functioning correctly to avoid breakdown. In scheduled maintenance different types of maintenance are carried out during different scheduled as pre-planned in maintenance programs.

## 2.2 Unplanned Maintenance

Unplanned maintenance also known as corrective maintenance is performed on the parts and components. This breakdown in unpredicted and happen which need the organization to take action by implementing corrective maintenance. The corrective maintenance were based on the inspection on the defect that caused the asset to breakdown.

## 2.3 Challenges in Managing Aging Asset

Military assets are expensive [14]. This type of asset must be maintained throughout its life since the asset is used to fight for war. When a military asset breakdown, decision to dispose the asset is impossible moreover it is expensive and hard to be replace since budget constraints. Maintaining aging asset is always imperfect. Maintenance of asset will only make the asset younger [15] but the performance of the asset is low and the downtime is high [16]. Although the military has to faced many problem in managing aging asset, however they will continuously use and keep the asset serviceable.

On the other hand, looking at the problem of managing aging asset, most organization discontinue using their asset when some of the parts of the asset were no more in market [17] and technology used were outdated and the asset has reached the end of life cycle [18] to avoid disruption on their operation and business.

## 3. Methodology

This paper presents on empirical experience in managing and maintaining the Royal Malaysian Navy (RMN) ships. The age of RMN ships were between 10 to 30 years old and some of the parts and components onboard the assets were obsolete.

Based on criteria selection and focuses on maintenance activities, a single case study methodology is used to support the study. Case study is a methodology of analysing a phenomena, that bound by pace and time [19]. The data were collected through interviews conducted from 21 research participants that involves directly in asset management. The literature review on previous study were also used to support the key findings on the research.

## 4. Discussion and Findings

Many big organizations that uses high value asset will maintain their asset thoroughly. Since a good maintenance will prolong the life cycle of the assets. Most organization such as military used their assets for decades [20]. There are many reason that hinder the process of procurement of new asset such as holding high stocks of spares [21] and limitation of budget [3]. Therefore military organization in many countries holding and constantly using their asset even though their assets are

aging and faced with obsolescence problems. Hence maintenance activities are crucial in order to continuously using these aging assets.

Dealing with aging assets, maintenance activities involved several activities such as scheduled maintenance. Since the assets has been in-service in a very long period and most of the assets were used over its estimated useful life which the probability of failure become much higher. In military organization, most of the assets are expensive and aging since the assets has been in-service in a very long time [14]. The decision on replacing the breakdown assets are almost impossible since to procure new assets are very costly. Therefore the military will continue using the asset even it has reached the end of life cycle and recorded as zero value assets [21].

It is observed that the definition of aging asset was not cited anywhere and not clearly defined. Thus, the definition of the aging assets is first to be established prior venturing the asset maintenance process. Aging can be defined as grow older or cause to become older [22]. Although there are no exact definitions on aging asset especially in term of maintenance, this paper defined aging asset as the asset that has been used overtime and having higher possibility to breakdown. Asset aging is caused by:

a. Aging caused by performance. When the asset is deteriorating it becomes aging which will give impact on the asset performance [15][23] and subsequently the downtime of the asset will be very high [16][24].

b. Aging caused by over usage. This type of aging was based on running hours or operating hours. Replacement are require when it reaches certain period of time or when it breakdown, whichever comes first [25]. Most OEM will estimated the useful life of asset, however organization that used the high cost assets will usually use the asset over its recommended period that implies cause of aging.

Although based on Asset Life Cycle theory, the final stage of the life cycle would be the end of life where disposal of assets were take place in this stage, however for RMN that used an expensive assets will not simply decommissioned their assets when failure occurs. Even though cost of operating an aging assets cumulatively high, however the RMN has maintained their ships systematically which not only focuses on planned and unplanned maintenance, on the other hand many initiatives have been introduced with the aim of continuously making the aging asset available and operational. Some of the initiatives are:

a. Operational Reserve Equipment. RMN has used the strategies of having additional critical main component for example the air compressor, main engine, gear box and the weapon system kept as pool or floating equipment. This Operational Reserve Equipment are very crucial in replacing the main component which breakdown during operation. The Operational Reserve Equipment strategies have solved the logistics support challenges by resolving long lead time delivery issue.

b. Obsolescence Management. Since the RMN maintaining aging asset which most of the asset has reached more than 20 years old, the problem of getting spare parts in the market become most challenging task. Therefore the RMN has identified the parts and components that are crucial to be replaced immediately.

c. Ship Life Extension Programme (SLEP). These initiatives were used to modernise, refurbish and extend the life the assets. During the SLEP process, the parts and the components that usually classified as wear and tear were replaced. It also involved the replacement of main component of the assets, however it does not involved modification of the ships structure. By implementing SLEP, the RMN has extent the asset life by 15 years.

All these initiatives were subject to decision made by the Capabilities Management Board and Modernization Equipment Committee. This committee will having the quarterly meeting every year to discuss and monitor the performance of the RMN assets.

## 5. Conclusion

The RMN has moving forward in maintaining their aging assets by implementing more than planned and unplanned maintenance program. By implementing these initiatives, the RMN has improved their level of operationability and sustainability of their aging asset. Casualty in terms of logistics support such as spares and component to be replace, the maintenance services of the asset and performance of the aging asset were solved.

The RMN asset were still in-service even though most of the assets has reached more than 20 years of usage. The initiatives taken are the interim approach in order to have the budget of replacement in obtaining the new assets. Although defence sector is highly important for the country in protecting its sovereignty, however the limitation of budget has discontinue the effort of acquiring the new RMN assets[3].

As conclusion, although assets are aging or breakdown, there are still solutions to continuously using the assets

rather than disposing it or replacing with new asset. Therefore there are other initiatives that can be consider for organization that deals with expensive aging assets and have limitation on budget for replacement of assets. Hence, by exploring the initiatives on how to remain the RMN ships operational, the best way is to manage aging assets as suggested. This paper is not only important to the defence sectors, but also to other organization that involved in managing and maintaining the transportation and logistics sectors.

### Acknowledgments

The authors would like to thank the Royal Malaysian Navy for supporting the research.

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