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THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

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Abstract:

The life cycle cost (LCC) concept consists of adding all the costs of activities (stages) that occur in the life cycle of a produc,from conception to abandonment or withdrawal (disposal) of the product by the manufacturer or beneficiary.

Control costs can become or is a particular problem (primary) for those are responsible, here entering and military decision makers (when is talking about required products for national defense), especially when the allocated resources are limited (both annual budgetary resources, and those that may be intended, in their entirety, for a particular type of product)

Cost analysis is not simply a matter of accounting, becomes a management problem that involves many factors responsible, we must concern us both costs that may arise in the future, and those who are somehow,"unexpected", especially in terms of military capabilities in which the benefit can not measure directly (eg income),

Key words: Life Cycle; Life cycle cost; Reliability; Availability; Maintenance and Maintainability.

1. Introduction

The concept based on the cost of the product life cycle or in other words LCC is not the recent concept. It was developed in the 60s by DoD (MoD of USA) which was controlling the entire process of life cycle of weapons, the total cost of the R&D, investment, O&S and, where applicable and disposal, ie as many stages that generate costs often independent among them and related to different laws of evolution.

Need to apply LCC is given by the following aspects:

- vision of the entire life cycle provides information about the costs which are not visible in the annual periodization;
- is impossible to compare a year of a new product with a product in the maturity stage, making impossible to manage the products using traditional instruments;
- LCC allows this entity or the manufacturer's compliance commitment, throughout the lifecycle, providing information about activities and resources;
- help identify the average cost.

2. Life cycle cost definitions

Before define what life cycle cost is, we must define the life cycle term.

In what follows, I will try to see what the life cycle is with the following two definitions.

"The life cycle includes the following phases: conceptualization, development of project ideas, study engineering, process planning, manufacturing, operation, maintenance (repair) and withdrawal "[1].

Life cycle is "consecutive and interlinked stages of a system-product, from raw material acquisition or generation of natural resources to post-use "[2].

With previous definitions we can now see and say what life cycle cost means.

Life cycle cost (LCC) is the sum total of the direct, indirect, recurring, non-recurring, and other related costs incurred, or estimated to be incurred in the design, research and development (R&D), investment, operation, maintenance, and support of a product over its life cycle, i.e. its anticipated useful life span. It is the total cost of the R&D, investment, O&S and, where applicable, disposal phases of the life cycle. All relevant costs should be included regardless of funding source or management control. [3].

Life cycle cost. The total cost to the tasking activity of acquisition and ownership of an item over its life cycle.

As applicable, it includes the cost of development, acquisition, support, and, disposal**.** [4]**.**

Life cycle cost is the total cost of ownership of machinery and equipment, including its cost of acquisition, operation, maintenance, conversion, and/or decommission (SAE 1999).

3. Criteria used for military acquisitions and LCC in acquisition processes

In NATO, military specialists conclude that life cycle stages should by divided, estimated, and analyzed separately. Through the AAP-48 Life Cycle Stages and Processes [5] there has been adopted ISO 15288 System Engineering – System Life Cycle Process[6] for dividing the life cycle stages, as presented in Figure no 1

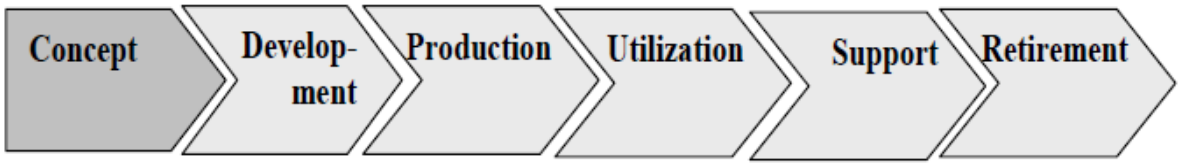

Fig.1 Life cycle stages

Studies of weapons systems and other procurements revealed that the acquisition costs were typically smaller than cost of ownership such as the cost of labor and materials requirea to operate and mantain the system.

The goal to reduce life-cycle cost (LCC) through use of concurrent engineering duriug the systems acquisition phase. has the potential for generating large returns on DoD's and industries investments [7].

The techniques of LCC are used to assist the project managers and various levels of decision-makers in making the most cost-effective decisions based upon data, which has been collected and analyzed in a logical and coherent manner. The data from the LCC analysis is used for:

- Long Term Defense Planning,
- Comparison of Competing Projects,
- Comparison of Logistic concepts,

- Decisions About Replacing Aging Equipment,
- Selection Between Competing Contractors.

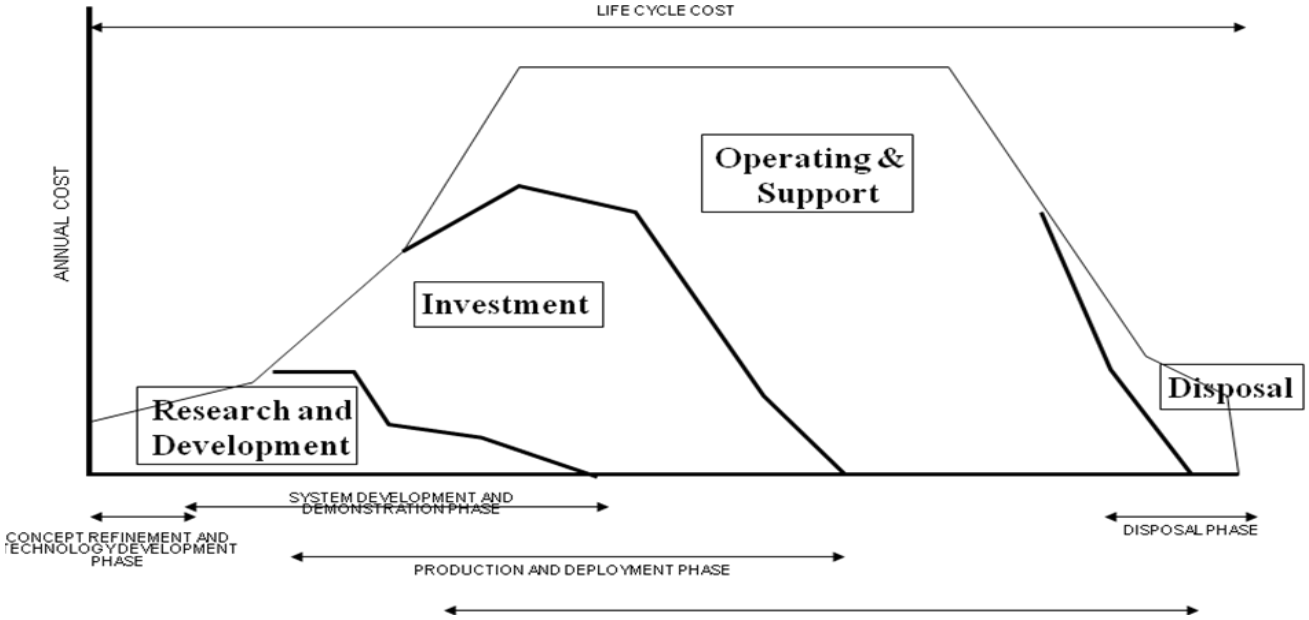

Fig.2 Illustrative Program Life Cycle [8]

In in Figure No 2 is better illustrated what has been presented in Figure No 1 in terms of overall costs in the various phases of the life cycle of a product

Now we can see in general about how it spends for a product in different stages of his life from conception to retirement

Cumulative overall life cycle cost of a product looks like in the following figure

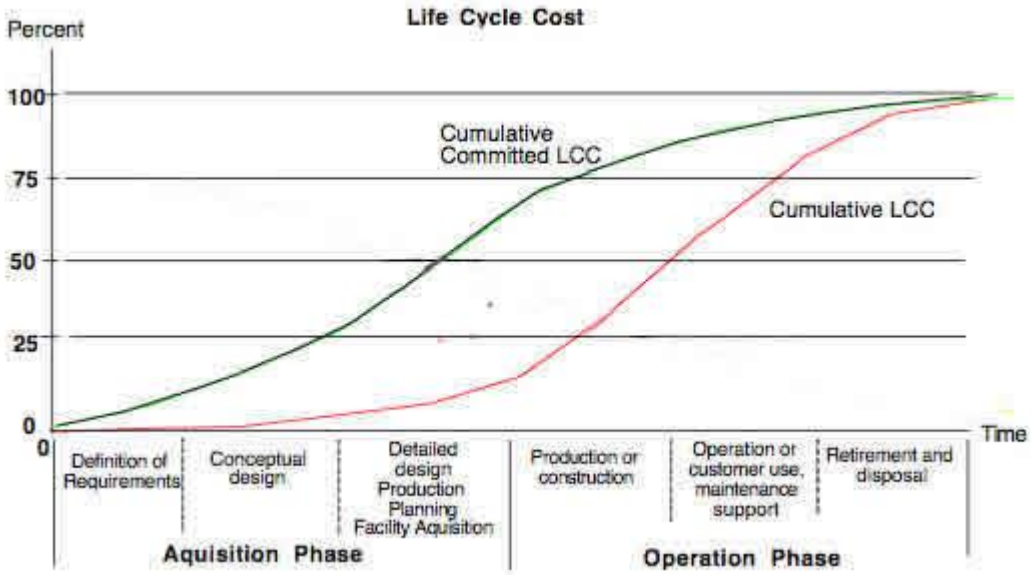

Fig.3 The life-cycle-cost (LCC) diagram [9]

A series of studies by the Westinghouse Corporation showed the percentage of a product's life cycle cost (LCC) that could be affected by decisions made at various points

in the defense acquisition cycle. For example, by the time a new product's operational scenario has been defined, decisions affecting 20 percent of its LCC have been made. By the time a prototype design has been developed, 75 percent of the product's LCC have been decided. And, once a product goes into production, only about 10 percent of its LCC remains to be influenced.

Usually the cost of operation, maintenance, and disposal costs exceed all other first costs many times over (supporting costs are often 2-20 times greater than the initial procurement costs).

The greatest opportunities to reduce LCC usually occur during the early phases of the programme. It follows LCC is used as a decision and optimization criterion in the search of the best compromise between time, cost and performance.

As it can see the maintenance system is one of the important stages in LCC (Life Cycle Cost) which can save a lot of financial resources simultaneous with increasing of military capabilities and, for this reason, the military leaders must be more concerned about it. The expected savings of money are justified.

LCC may consider non-cost related factors, which may influence decision. These factors include political decisions based on socio-economic benefits; safety related decisions, which may preclude using certain cost-saving material procedures; and legal requirements imposed upon the use or maintenance of a system.

However it would be these decisions, must keep in mind the cost of each phase of the life cycle, and to see costs per phases, must see the composition of phases and the costs of each of them

In the following, I used LCC tree vision of two different authors , but large differences can not be observed that there

4. LCC – components (Life cycle cost tree)

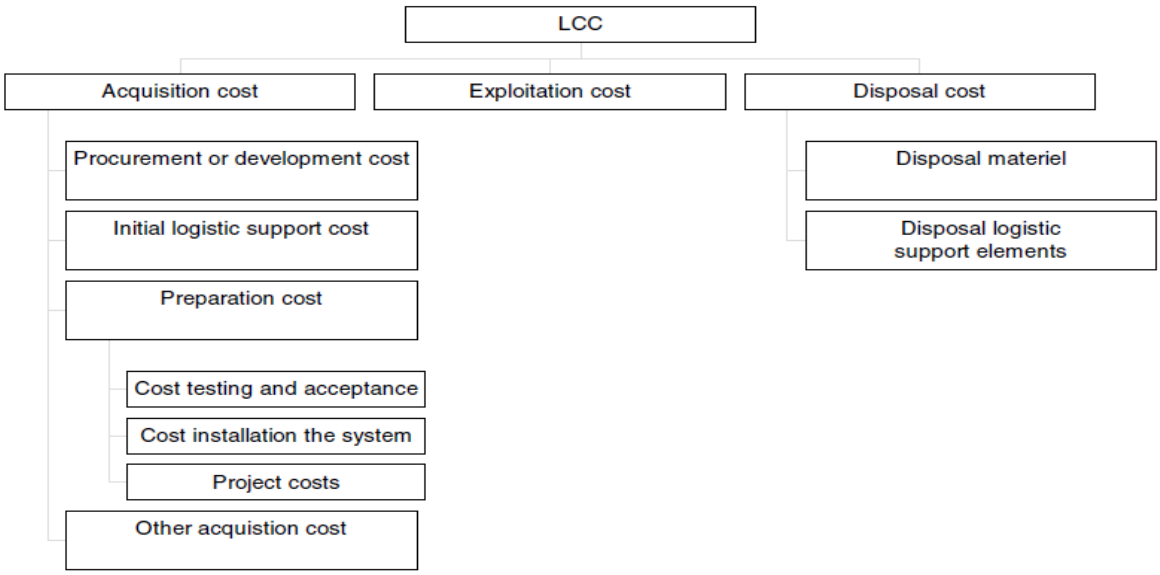

Fig.4 Common cost tree for the acquisition and disposal costs [10]

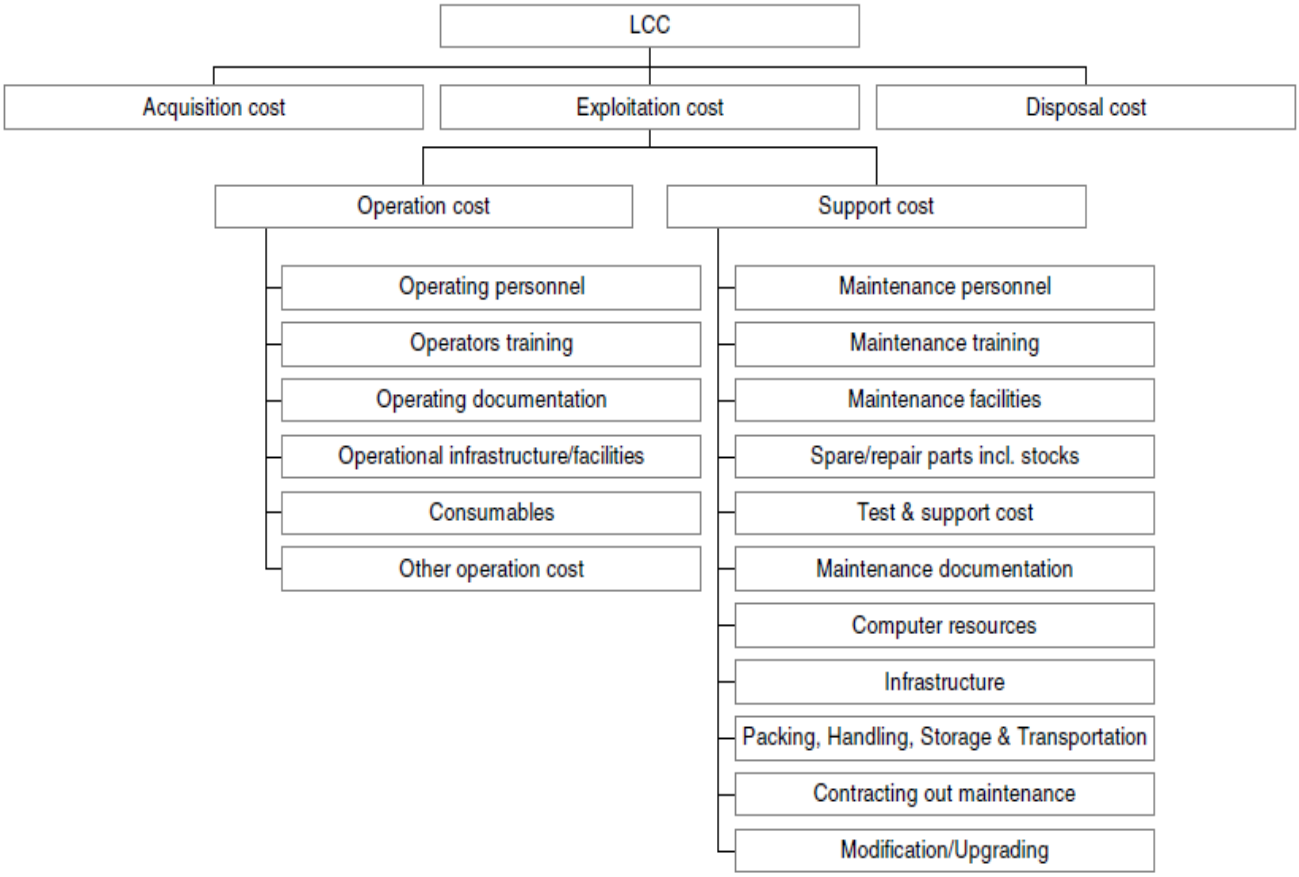

Fig.5 Common cost tree for the exploitation costs [10]

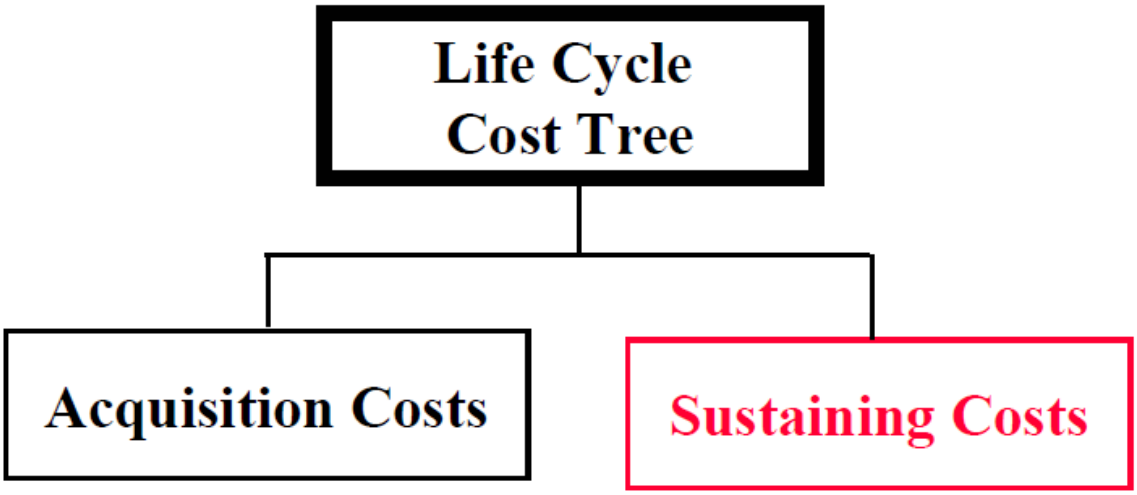

Fig.6 Top Level Of LCC Tree [11]

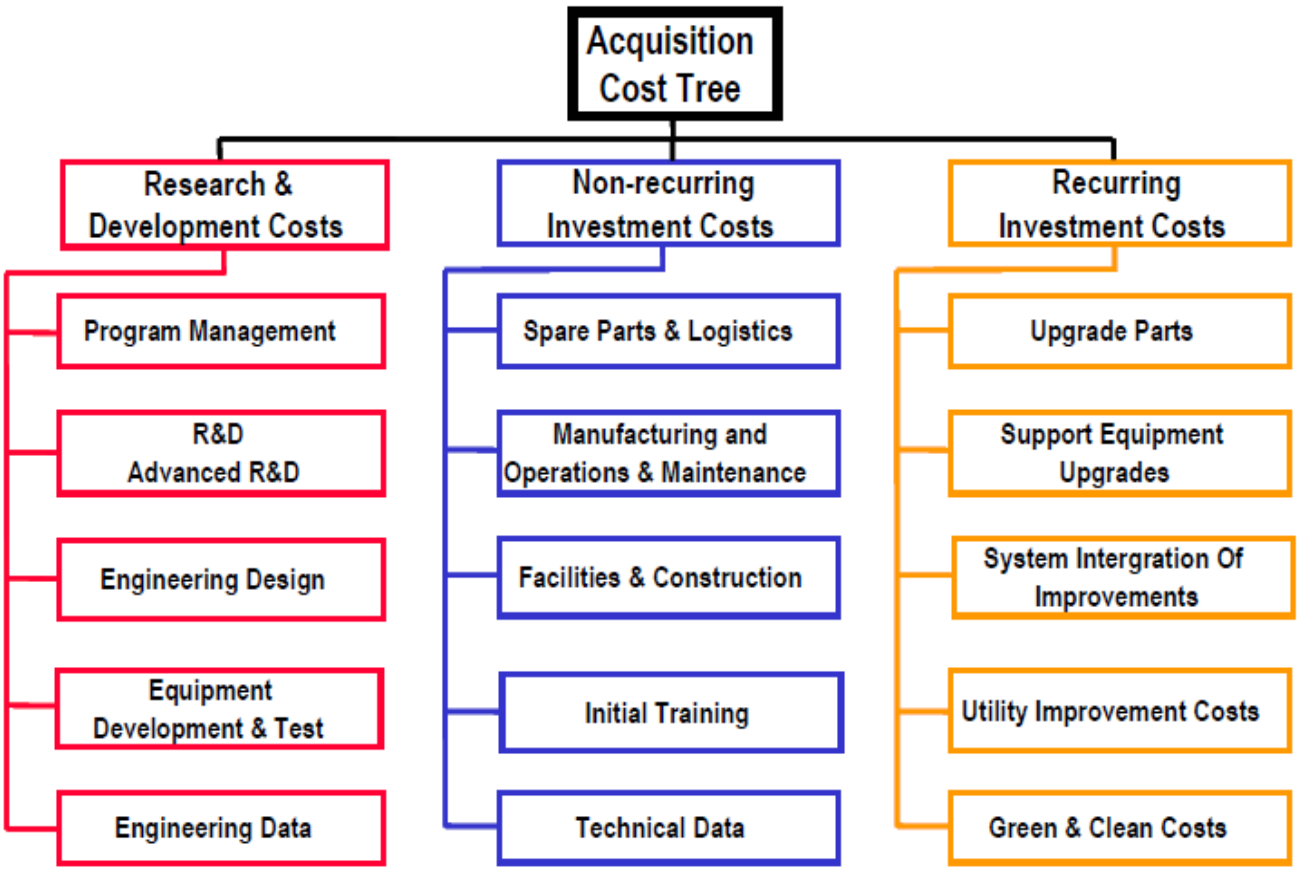

Fig.7 Acquisition Cost Tree [11]

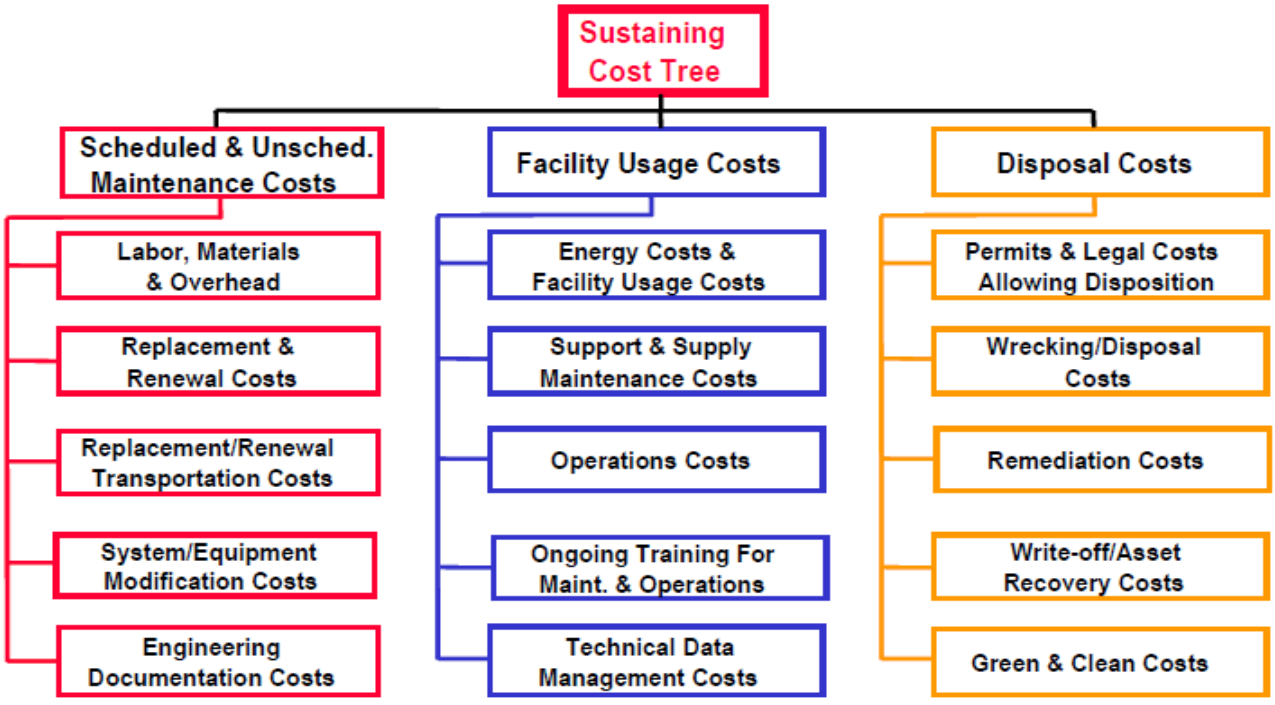

Fig.8 Sustaining Cost Tree [11]

What I have presented above is given by two different approaches of different authors regarding the components of LCC and implicitly the costs on different parts of LCC tree

Anyway I see that things (parts of LCC), and how I should consider the LCC tree (any authors have considered), it can be seen these costs relate to many parts and must optimize their costs (different branches of the tree), so after the expiration of the life cycle, after disposal, to have, if possible at the lowest possible cost

5. The relations between fiability, availability, maintenance and maintainability and the importance of these for LCC

Generally, the life of a product shows like in the following figure.

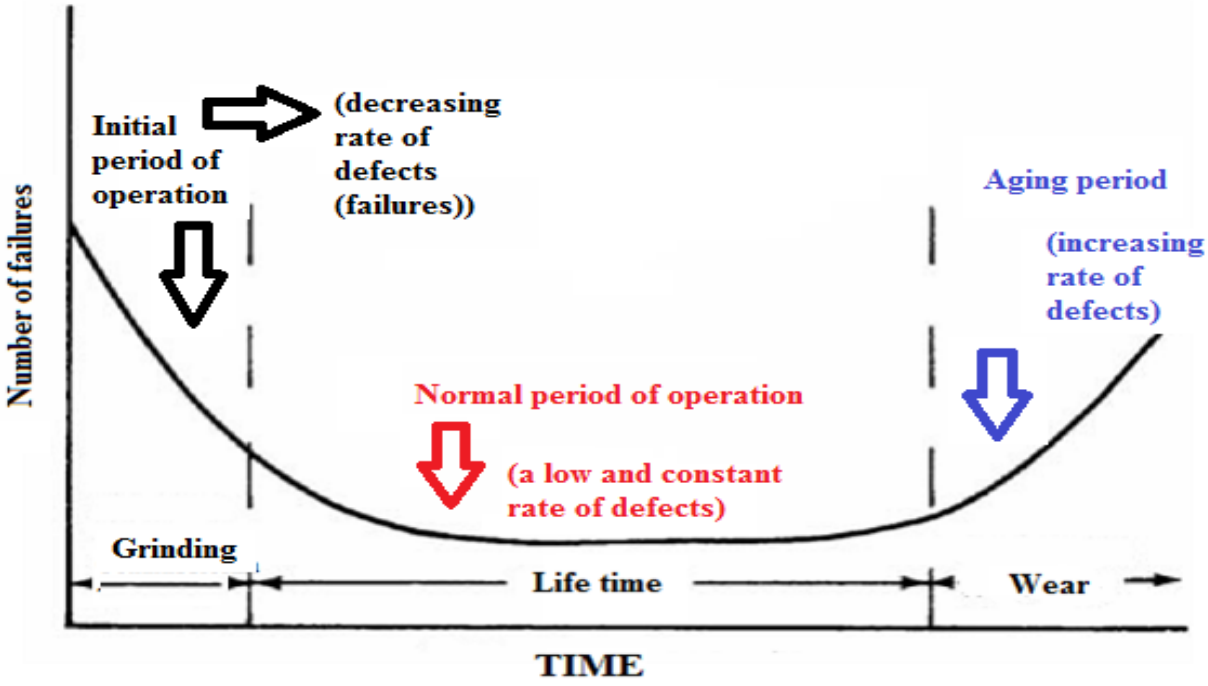

Fig.9 Life cycle of a product generally

This figure is called, „The Bathtub Curve"

The bathtub curve is a probability curve. When we start out, we have a high risk of failure, this risk is known as infant mortality. The risk comes down very rapidly. For most of the life of any product, there is a low and constant failure rate. At the end of the product life, because, the probability of failure increases rapidly we have the wear out phase .

In what follows I will analyze only the operation and maintenance, the part of figure number 7 (Acquisition Cost Tree - Operations & Maintenance) and part of figure number 8 (Sustaining Cost Tree – Support & Supply- Maintenance Costs), in agreement with the fact that I will refer only to the normal period of the life cycle of a product.

Maintenance is defined as the set of all technical and organizational actions necessary to maintain or restore made a product (system) in a condition to fulfill the required function

From the same frame are part the preventive actions, such as revisions work, adjustments, checks and repairs planned, executed in order to avoid future failures

Maintainability is a quality of systems and it refers to the period of actual operation, ie how operating and maintaining it in working order and is in close contact with reliability.

Synthetic availability is the ability of a product (equipment, systems) to perform the function specified in the aspects of reliability, maintainability and organization of maintenance actions at a time or in a specified time interval

The main objectives of maintainability are:

- Reduction of unavailability of the system by shortening the duration of maintenance;
- Policy learning and choosing an optimum maintainability;
- Reduce maintenance costs;
- Increased reliability and security system to determine a proper maintainability and availability.

The following figure presents the relationships between the various concepts used.

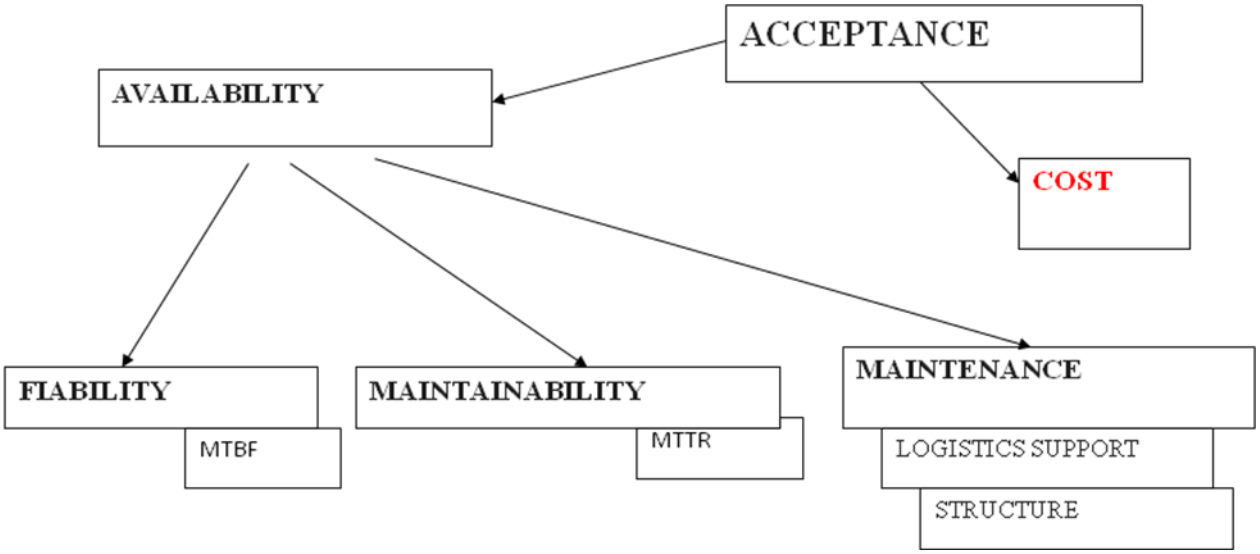

Fig.10 The relations between fiability (reliability), availability, maintenance and maintainability

In the previous figure, there are terms: MTBF – mean time between failures;
MTTR – mean time to repair.

These terms are specific to the reliability, respectively to the maitainability the diagram of the previous figure is important because gives us a picture about of balance between the availability and cost, from the point of view of acceptance or not of the cost

Should be aware that the whole life of a product should be managed, and for this requirement, the costs must be well thought

A similar approach, but this time it refer to a particular product, is that of the following figure.

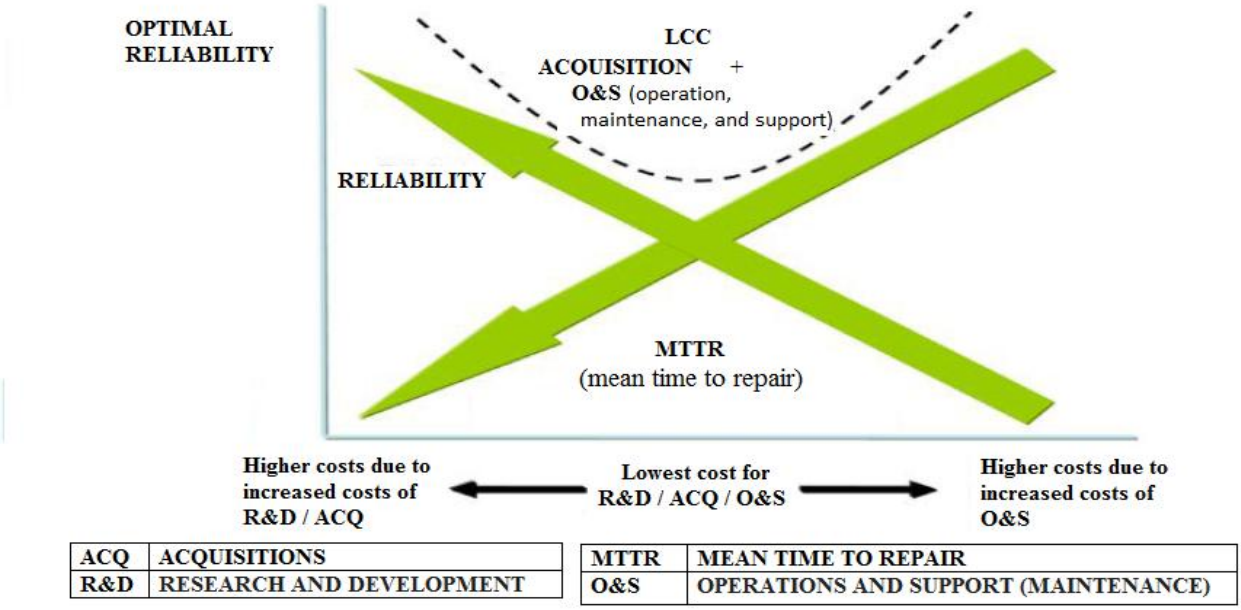

Fig.11 Optimal life-cycle cost of military equipment [12]

I did not take into account the waiting logistics time and the waiting l administrative time

If we want to reduce the costs of failure, implicitly the cost of availability it is necessary to reduce the probability of failure. For this reduction, the manufacturer can improving the structure, or the beneficiary must intensified the inspection and maintenance, which increases the investment costs and the maintenance costs.

Whatever be the way chosen in the final the cost must be the lowest possible, with an exception that I will present further.

So it is acceptable to increase the cost of maintenance and maintanability if with these increasing can be obtained an increase of safety for the people who exploits the product. It is a very important point of view, and here is required another discussion about how much to increase the safety and how much to increase costs in agreement with this gain in security.

6. Conclusion

The Maintenance System is a very important part in Life Cycle Cost and if this system is right managed it can save a resources annually or (not just financial resources).

In the same time, we can increase the military capabilities reducing Life Cycle Cost and, for this reason, the military and the civilian leaders must concerned and also worried about it, especially when resources are limited

The value of LCC concept and the fact that has been validated recommend using this concept in non - defense as well as defence industries.

The principle is simple, it determine not only the acquisition cost but also the costs involving operating and maintaining the systenduring its lifetime before deciding to acquire or not the system

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