



The 12th International Scientific Conference
**“DEFENSE RESOURCES MANAGEMENT
IN THE 21st CENTURY”**
Braşov, November 9th-10th 2017



THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

Sorin CHERECHEŞ

Ministry of National Defense/ Bucharest/ Romania

Abstract:

Precise cost estimation of military equipment plays an essential role in all military acquisition plans. The best opportunities to achieve significant cost benefits occur during the early concept development and design phase of any project. The concept of the life cycle of an asset provides a framework to document and compare alternatives.

The framework for using LCC as a tool throughout the Romania MOD military acquisition phases exists. Nevertheless the experience in major acquisition programme and LCC estimates is yet very young to transform the results and data collected into statistics.

Key words: life cycle cost, acquisitions, estimations, decisions

1. Introduction

This paper will centre on 4 specific questions:

1. Why do we need reasonable cost estimates?
2. How we build and use the cost estimates?
3. How well are we doing?
4. Is there a light at the end of the tunnel?

My intention is to answer those questions from my perspective on how the actual cost estimate is managed inside Romania integrated defence acquisition management system.

Why do we need reasonable cost estimates?

The Romania MOD experience in major acquisition programme and life cycle cost estimates is yet very young to transform the results and data collected into statistics. Instead, according to David Petrucci in the paper *Improved Affordability in DoD Acquisitions through Strategic Management of Systemic Cost Risk* „*For almost 70 years, actual costs of Major Defense Acquisition Programs (MDAPs) in the Department of Defense (DoD) have exceeded on average between 20% and 506% of their life cycle cost estimates*”.

The eight program managers inside Romania PPBE system are requested to make realistic forecasts of their costs for the current and 3 more years in advance to justify their short and medium term budgets. So why such concern for estimating the costs 10, 20, or 30 years in the future?

First, considering the major military acquisition programmes in terms of budget planning, the decision taken today influences funding requirements for many years to come after. Precise cost estimation of military equipment plays an essential role in all military acquisition plans. Military assets are generally evaluated during the acquisition stage on the basis of their total life cycle costs (LCC). Life cycle cost is an economic consideration that

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

looks beyond the initial purchase cost. It also includes the cost of operating and maintaining the item over its entire operational life, the research and development costs and also disposal costs.

Second, the future costs associated with the use and ownership of an asset are often greater than the initial acquisition cost and is a major concern of many organizations, including MOD, especially the latest years due to the world economic crisis. The best opportunities to achieve considerable cost benefits occur during the early concept development and design phase of any acquisition. The concepts of the life cycle of an asset provide support to fundament and compare alternatives.

Third, a fine awareness of the actual operating costs of in-service equipment is key not only for improving the cost-effectiveness of the equipment in question, but also to improve the specifications for future equipments to be purchased. So lessons learnt may be applied in acquisition process also.

2. Terminology

In order to prevent ambiguities and in interpreting LCC concepts, Romania MOD^[1] adopted the NATO terminology [3].

2.1. Cost's classification

NATO terminology, according to *RTO Technical Report TR-058 SAS-028 – Cost structure and Life cycle costs for military systems*, defines the following costs types:

2.1.1. linked and non-linked costs

Linked costs refer to activities or resources that can be associated to the procurement, operation, support and disposal of the system. Examples of these costs include items such as operation, system specific training.

Conversely, non-linked costs cannot be readily associated to the system. Examples of these costs include items such as family housing, medical services, basic general training (not related to aspecific equipment), headquarters and staff, academies, recruiters, etc.

2.1.2. Direct and indirect costs

A direct cost refers to an activity or a resource that can be easily allocated (without ambiguity and intermediate analysis) to a product

An indirect cost refers to an activity or a resource associated to several products. It must be shared (apportioned) between those products before being attributed to each one.

2.1.3. Variable and fixed costs

Variable costs are those which are affected by, and therefore vary because of, the existence of the system. A variable cost fluctuates proportionally or not (semivariable) with a characteristic of the system (production volume, level of services provided).

Fixed costs do not vary because of the existence of the system. Associated to the organisation rather than the sole system, they are relatively constant within a range of time or volume.

2.2. Cost's categories

Having in mind the above cost types a distinction is made between Life Cycle Cost (LCC), Total Ownership Cost (TCO) and Whole Life cost (WLC).

2.2.1. LCC Life Cycle Cost = Direct costs + Indirect Variable costs

Life Cycle Cost (LCC) consists of all direct costs plus indirect-variable costs associated with the procurement, O&S and disposal of the system. Indirect costs may include linked costs such as additional common support equipment, additional

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

administrative personnel and non-linked costs such as new recruiters to recruit additional personnel.

All indirect costs related to activities or resources that are not affected by the introduction of the system are not part of LCC.

LCC as shown in the chart is typically divided into four phases:

- Research and Development costs start with program initiation at the Conceptual phase through the end of engineering and manufacturing development. R&D includes costs for feasibility studies, modelling, trade off analyses, engineering design, development, fabrication, assembly and test of prototype hardware and software, system test and evaluation, developing support equipment, and documentation

- Production or Procurement includes costs associated with producing or procuring the physical parts of the system, and costs associated with initial logistic support requirements (i.e., support equipment, training, data, initial spares, and facilities)

- Operation and support costs are incurred when systems are deployed and fielded. They include costs of sustaining operation, personnel and maintenance, consumable and repairable parts, and system modification.

- Retirement and Phase-out costs which are associated with deactivating or disposing of a materiel system at the end of its useful life. Disposing of a materiel system can result in additional costs or a salvage value.

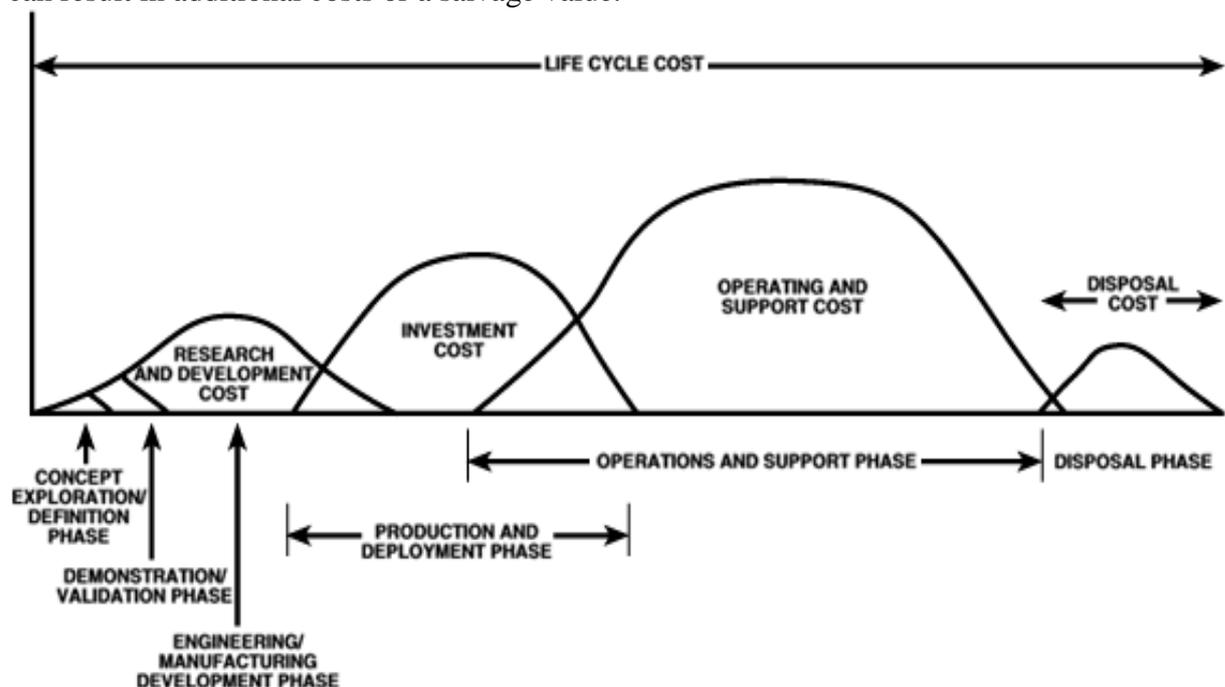


Fig.1 LCC diagram

2.2.2. TOC Total Ownership Cost = LCC + Linked Indirect Fixed costs

Total Ownership Costs (TOC) consists of all elements that are part of LCC plus the indirect, fixed, linked costs.

These latter may include items such as common support equipment, common facilities, personnel required for unit command, administration, supervision, operations planning and control, fuel and munitions handling.

TOC is used for budgeting purposes, determining the use of services between systems, for Optimisation purposes and for financial analysis.

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

2.2.3. WLC Whole Life Cost = TOC + Non linked Indirect Fixed costs

Whole Life Costing (WLC) consists of all elements that are part of TOC plus indirect, fixed, non-linked costs. These latter may include items such as family housing, medical services, ceremonial units, basic training, headquarters and staff, academies, recruiters.

In WLC all costs or expenses that are made by the organisation are attributed to the systems or products they produce.

WLC is used for a strategic view and high level studies.

2.3. Cost Breakdown Structure (CBS)

Apart from general definitions such, LCC is more precisely defined in each project by the list of all the cost elements to be considered in its calculation. This list is usually described by a Cost Breakdown Structure. A CBS may be considered as a tool that enables analysts to define and compute LCC and for decision makers to understand the costs considered and compared in option analysis. An example of CBS for a military generic equipment is presented below.

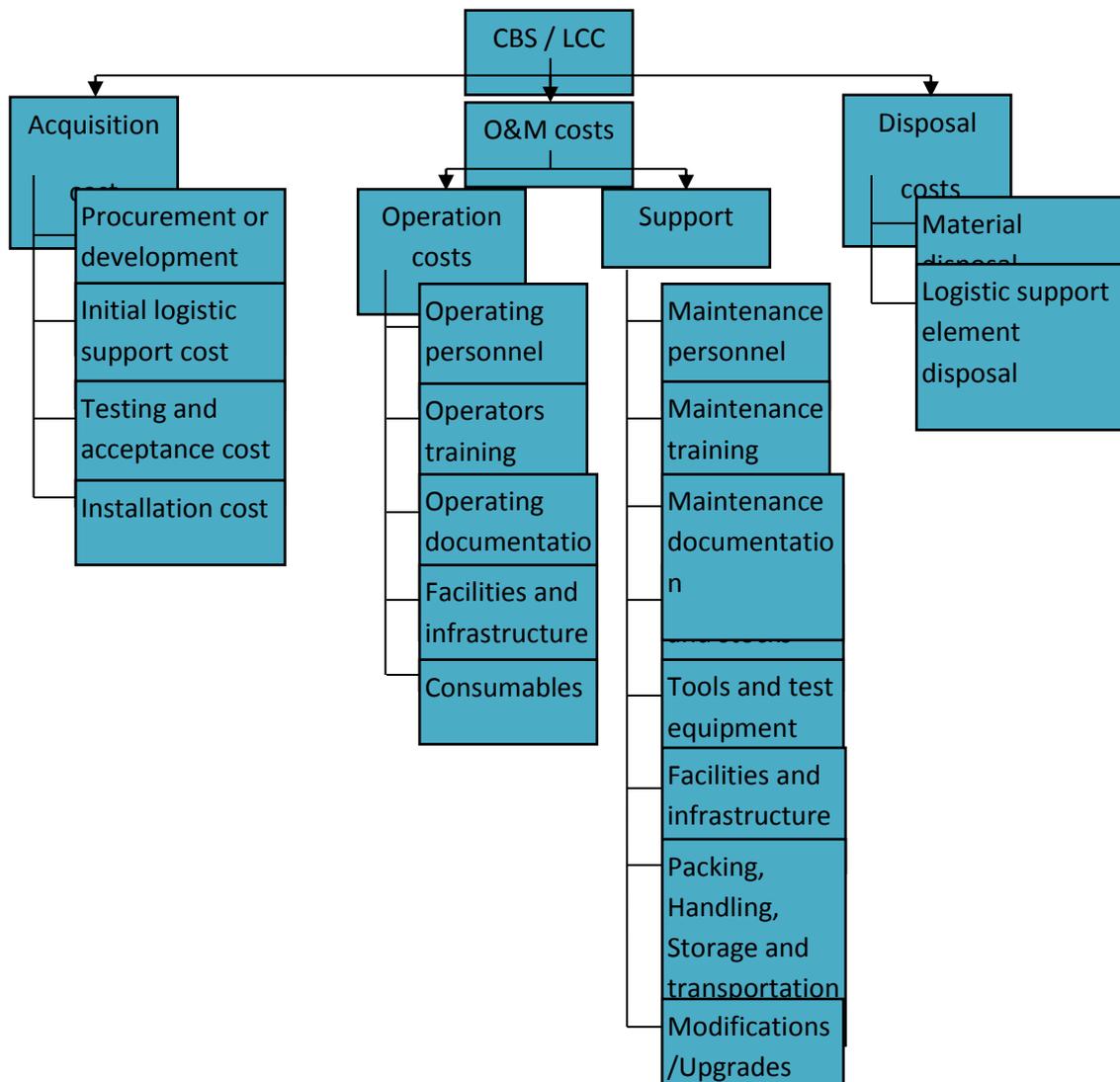


Fig.2 CBS example for military equipment

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

Another important term used, LCC estimate, represents a set of methods for modeling, predicting and analyzing the Life Cycle Cost of a system, at any stage of its life.

3. Military acquisition management and LCC

3.1. General

Life cycle costs should play a stringent role in the management of MOD's acquisition programmes. It offers measurable guidance for the program manager in the analysis and possible tradeoffs between manpower, cost, performance, schedule and logistic support. This means that different elements of an acquisition programme should be translated into a common basis for measurement and evaluation. The most used tool for this is the value in money for programme elements. Describing those in terms of money can simplify management decision and can prove essential for an effective cost control. Nevertheless I consider that this quantification is not a substitute of the decision making process but a simulation of possible cost consequences of acquisition decisions.

Depending on the types of equipment under LCC analyse there are different profiles for costs depicted in time, as shown in the figure below. The competition for recourses among programs/services gives the LCC estimate a decisive role in the decision making process al strategic political-military levels.

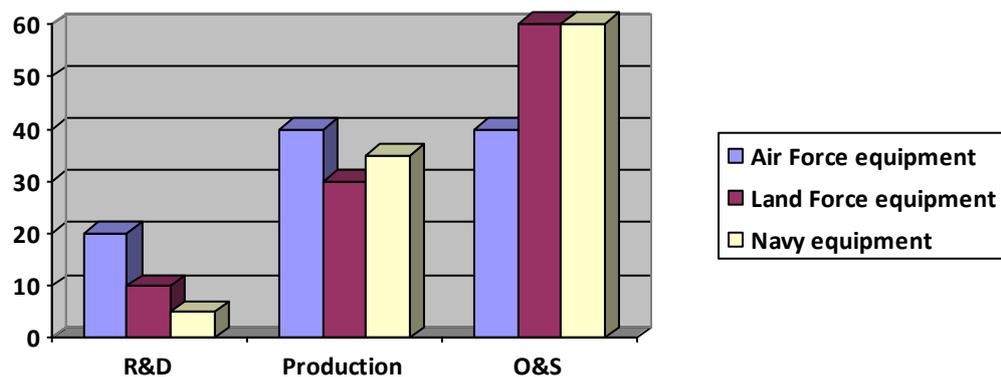


Fig.3 LCC profiles for services equipment [5]

3.2. LCC in ROU MOD acquisition management

In the context of limited resources and budgetary austerity the LCC estimation is one of the tools for reasonable and rational decisions to be taken by decision makers at each decision point inside integrated defence acquisition management system [2].

These leads to the second question that I proposed for this graduating paper: **How we build and use the cost estimates?**

The process for estimating costs for major military acquisition programs in the Romania MOD is relatively recently established.

Three systems interact and interface with one another in order that military acquisition process to be efficient and effective:

- The Planning, Programming, Budgeting and Evaluation System (PPBS)
- The Mission Requirements System (MRS)
- The Defence Acquisition Management System (DAMS)

Consequently, the Romania's integrated defence acquisition management system is driven by three decision authorities (boards).

MRS is led by the Mission Requirements Board (MRB) that validates and approves *The Mission Requirement Document* and *Operational Requirement Document* issued by

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

the armed forces services. MRS is based on a continuing assessment process of the current force structure capabilities to meet the projected threats.

PPBES is led by the Defence Planning Board (DPB) and has the following missions:

- financial support for the programs;
- establish (with other systems) the priorities for resource allocation, in accordance with the state budget law

DAMS it is led by the Defence Acquisition Board (DAB), and has the following responsibilities: project management, acquisition program management, contract management, T&E management, quality management.

A milestone decision process is used by the MOD to manage the acquisition of major military systems. In large terms, the process presumes that a well managed acquisition program proceeds through several distinct phases. The point of transition between phases is a decision point. The overarching question at each milestone is whether the system is ready in all respects to go on to the next phase. The authority to make that decision for a major weapon system acquisition belong to DAB.

So acquisitions programmes are grouped into Acquisition Categories (ACATs) based on their size and complexity and are structured into phases separated by major milestone decision points, namely:

- Preliminary phase: identifying mission requirements related to capability gaps;
- Phase 0: Concept study and selection;
- Phase 1: Programme definition;
- Phase 2: Technology development (only for acquisition programmes that require R&D);
- Phase 3: Production and delivery to end user;
- Phase 4: Operation & Support (including disposal)

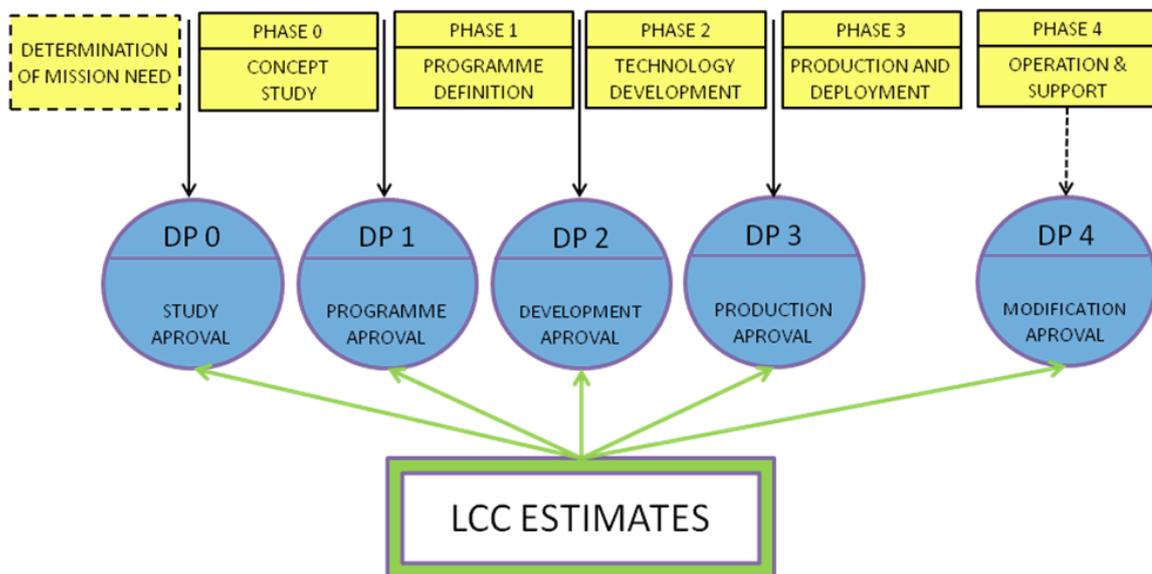


Fig.4 military acquisition process

Decision point authorization covers a substantial list of topics such as: the technical characteristics, test and evaluation plans, the delivery plan and of particular interest cost and budget.

The first phase in the acquisition process in which cost estimates are used is the concept study. Under DMAS responsibility, the concept study identifies and compares different alternatives for implementing the mission requirements. It is the moment when

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

the first LCC estimate is used among other criteria in the DP1 to initiate or not an acquisition programme. Also, based on the LCC estimate the programme fits in one of the ACATs and therefore follows the specific path related to decision authorities. DP1 also determines if R&D is necessary or existing equipment will be purchased.

During the Phase 1 and Phase 2 the LCC estimates are updated and used as decision criteria for PD2 and PD3 to validate the decision to continue with the production phase.

If modifications are established as necessary during the production phase the associated costs are also evaluated before beginning the operation and support phase.

Throughout the acquisition programme phases, starting with DPO, the DAB nominates the Product Supervision Team, Product Team and Programme Team with responsibilities in identifying and assessing resources, directing, controlling and reporting the status of the acquisition programme. Actually according to MOD regulations [2] a Cost Assessment Programme Team (CAPT) under the programme manager coordination must be established. It should be a multidisciplinary team whose members have functional skills in financial management, engineering, acquisition and logistics, forecast and mathematics. The team should also include participants or reviewers from the operational and maintenance units. Team members might also be drawn from other organizations. In the best case, the CAPT is collected of personnel who have familiarity in estimating all cost basics of the program.

So the LCC estimate for each of the acquisition phases is used by DAB in the Decision Points to evaluate if the programme is inside the timeline and available funds. Another important element in the LCC estimate is the costs associated with risk and uncertainties along the acquisition phases. Updated LCC estimates help give programme teams control over the project's when new requirements arise under fixed budget conditions. This is especially important early in a project, when less is known about requirements and the opportunity for change and cost increase is greater. As more information is gained, programs can retire some risk and reduce the potential for unexpected cost and schedule growth, as depicted in the figure below [5].

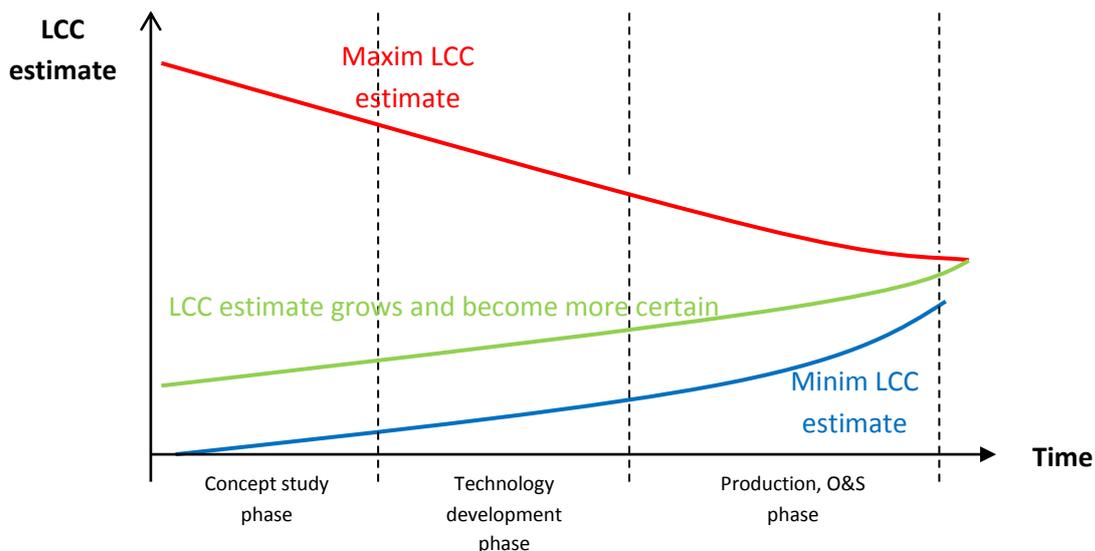


Fig.5 Evolution of LCC estimate

The LCC estimate process is a very complex that requires specific knowledge and experience. According to *Cost Estimating and Assessment Guide – Best Practices for*

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

Developing and Managing Capital Program Costs, United States Government Accountability Office, martie2009 there are 12 steps in the LCC estimation process:

- Define estimate's purpose
- Develop estimating plan
- Define program characteristics
- Determine estimating structure
- Identify ground rules and assumptions
- Obtain data
- Develop point estimate and compare it to an independent cost estimate
- Conduct sensitivity analysis
- Conduct risk and uncertainty analysis
- Document the estimate
- Present estimate to management for approval
- Update the estimate to reflect actual costs and changes

How well are we doing? (Efficiency considerations)

Although these processes have been determined inside Romania MoD [1] the application of LCC estimates is at its dawn and is extremely challenging. There are several reasons for that.

The main reason in my opinion is the limited information provided by the producer in its response to the Request for Information initiated by the Armaments Department during the concept study phase. Even though there are explicit requirements include in the RFI the cost elements and the CBS are not detailed.

Another fact that aggravates the LCC estimate is the lack of cost data bases from previously acquisition programmes. Since the LCC process it is just starting to be implemented in Romania MOD the historical data that are usually used in the initial phases of estimates are not available or extremely limited.

Finally, the O&S costs for the equipment in the inventory are not yet structured and recorded in a manner that could help for modelling a generic O&S cost and consequently to be used for new acquisition programmes.

4. Conclusion

Considering the regional military context and the limiter economical strength, spending the public money efficiently within the MoD, it makes the difference related to capability between performance and survival.

Without a concentrated effort in analysing the real requirements and the economical implications in fulfilling those requirements on one hand and carefully planning the financial recourses available on the other hand, we will continue to plan for the acquisition of capabilities that we might not afford.

Consequently, after many years of under finance that prejudiced the force planning on short, medium and long term, it is absolutely mandatory to clearly estimate the cost of each desired capability in order to better decide what is affordable.

All military capabilities are built mainly on two fundamental pillars: personnel and equipment. The money needed to build those capabilities is always less than necessary. LCC estimation is a comprehensive tool to be used by Romania's defence acquisition management integrated system decision makers in order to better plan the recourses for developing military capabilities.

The purchase of major systems requires long term cost commitments by the acquiring organizations, thus the resource allocation decisions must be based on life-cycle oriented analyses rather than of the costs associated with initial acquisition costs.

THE IMPORTANCE OF THE LIFE CYCLE COST IN THE MILITARY ACQUISITIONS

The Romania's defence acquisition process and cost estimation process which help decision makers allocate valuable resources to a program or among programs have natural uncertainties about future program outcomes. Hereafter, the cost uncertainty analyses about the expected program costs, helps the programme managers reveal the costs risks linked with the program, develop realistic program cost estimates, and take appropriate measures, thus the program will continue without significant breaks resulting from the lack of funds.

Is There a Light at the end of the Tunnel?

First, there is no need to reinvent the wheel in this field of activity. An inside research on other military organization or even civilian companies can be used as a method to ease and shorten the path to a practical and workable LCC process.

Second, the LCC importance should be "marketed" inside Romania MOD structures and more important thought in specialized courses. To improve the number of training opportunities and the quality of training available for human resources in the costing community would really boost-up the LCC proces.

Third, the application of LCC may be extended beyond the acquisition of major military equipment. For example, O&S costs for the equipment in the inventory could be structured and recorded in a manner that would help modelling generic O&S cost to be used for new acquisition programmes. Also the logistic support services purchased by the services could implement the LCC methods and analysis.

References:

- [1] *Manualul pentru estimarea costurilor echipamentelor pe durata ciclului de viata*, Ministerul Apararii Nationale, 2014, 145.
- [2] *Instructiunea privind managementul achizițiilor pentru aparare*, Ministerul Apararii Nationale, 2001, 65
- [3] RTO Technical Report TR-058 SAS-028, *Cost structure and Life cycle costs for military systems*, NATO TRO, 2003, 1004.
- [4] Yoner, Numan, *Major Weapon Systems Acquisition and Life Cycle Cost estimation: a case study*, NAVAL POSTGRADUATE SCHOOL Monterey, California, 2001, 137.
- [5] United States Government Accountability Office, *Cost Estimating and Assesment Guide – Best Practices for Developing and Managing Capital Program Costs*, 2009, 440.
- [6] David Petrucci, *Improved Affordability in DoD Acquisitions through Strategic Management of Systemic Cost Risk*, Massachusetts Institute of Technology, 2014, 103.