

Chapter 12 – RECOMMENDATIONS

12.1 KEY RECOMMENDATIONS

The following key recommendations are made with regard to the development and improvement in life cycle costing for multi-national programmes.

12.1.1 Life Cycle Costing Methods

1) Life cycle cost estimates should be fully documented (Sub-section 2.3.2)

- A cost analyst should be able to re-create the complete estimate working from the documentation alone.
- All assumptions and data related to the study should be captured in an MDAL or CARD or similar document.
- Assumptions recorded in an assumptions list such as the MDAL or CARD should be questioned by an independent technical team.

2) All life cycle cost estimates should be prepared by suitably experienced personnel (Sub-section 5.2.3.1)

- Decisions such as budget setting and options analysis studies are often conducted when data to support cost forecasting and life cycle costing is very sparse. It is therefore essential that experienced personnel are used to conduct the life cycle cost estimates to support the decision process at these key stages.

3) The life cycle cost analysis should include an affordability analysis (Sub-section 2.9)

- Affordability plays an important part in programme decisions throughout the life cycle. Even before a programme is formally approved for initiation, affordability plays a key role in the identification of capability needs. This aspect is part of the process which balances cost versus performance and in establishing key performance parameters. Although this is not common practice in all nations the assessment of affordability is one that we recommend should be conducted by all nations.

4) Life cycle cost estimates, where possible, should use two independent methods for each cost breakdown structure element (Sub-section 4.4)

- The use of two independent methods to develop the life cycle cost estimates will improve the confidence in the results and help to validate the outputs. It is accepted that this may be tempered by the constraints imposed by a financial threshold (see Sub-section 2.6) or by a simple consideration of what the estimate will be used for (e.g., rough cost for initial views or detailed costs for decision making).

12.1.2 Life Cycle Cost Models

5) All life cycle cost models should be validated (Sub-section 5.5)

- It is essential that all life cycle cost models implemented through spreadsheets or more advanced programming techniques be validated by using recognised testing processes. This will increase confidence that the model is fit for purpose and that the input data and results can be assessed through a clear audit trail and mathematical reasoning of any cost estimating relationships.

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12.1.3 Data for Life Cycle Costing

- 6) **Investments should be made to increase the accuracy, visibility, and availability of cost, programmatic, technical, and performance data within the NATO/PfP cost analysis community (Chapter 6).**
- Data collection forms a large part of the life cycle costing activity and significant effort is expended to gather and analyse the data so that it is suitable for use in life cycle cost analysis studies. Improvements in data exchange standards or even the development of a NATO costing database would:
 - Improve the quality of the life cycle cost estimate;
 - Reduce the effort needed to conduct the life cycle cost estimate; and
 - Reduce the time schedule to conduct the life cycle cost estimate.

12.1.4 Multi-National Programmes

- 7) **For multi-national programmes the participating nations should agree on a common LCC framework (Sub-section 2.10.6)**
- The life cycle cost studies for multi-national programmes follow the same principles as those required by a national study. However, there are some specifics that must be taken into account in terms of organisation, models and the presentation of results. It is essential that all parties in a multi-national programme agree on a common life cycle cost framework. This framework is determined by the costing boundary and the tools that will be employed to populate the framework. A common framework will provide consistency, comprehensiveness, traceability and audit. All are essential to achieve life cycle cost estimates in a timely and responsive manner.

12.1.5 NATO Generic Cost Breakdown Structure

- 8) **Enhancements to the GCBS (generic cost breakdown structure) to improve its use (Chapter 10)**
- It has been found that most nations have not adopted the generic cost breakdown structure reported in RTO-TR-058 as their national life cycle cost breakdown structure. However, the NATO generic cost breakdown structure has been applied on specific multi-national programmes and some areas of enhancement are recommended.

The current structure does not allow the identification of the life cycle cost results over the time phasing for national financial and programme contributions. Therefore, it is recommended to include two dimensions in addition to the Activity, Product and Resource dimensions. These additional dimensions are:

- Time phasing; and
- National contribution.

As the coding of the Generic Cost Breakdown is complex for non-experts, it is recommended to adopt a Generic Hierarchy for the GCBS.

12.1.6 Uncertainty and Risk

- 9) **Risk and uncertainty analysis should be conducted at the same time as the life cycle cost estimate (Sub-section 7.9)**
- Life cycle cost estimates of weapon system acquisition programmes are inherently uncertain and risky. To better support senior leadership, some sense of risk and uncertainty needs to be presented

at the same time as developing the point estimate. This will present the decision maker with a comprehensive true view of the programme's likely eventual outcome.

10) The results of a life cycle cost estimate should be shown as a three point range of estimates (Sub-section 7.9)

- A life cycle cost estimate is not a single number but rather a continuum or distribution of possible values.

12.2 FURTHER RECOMMENDATIONS

In addition to the key recommendations listed above it is further suggested that the other recommendations listed below are considered as each will help in the development and improvement in process and application of life cycle costing.

- We recommend that each nation sets its own financial threshold value for conducting life cycle cost studies and that this threshold should be determined in terms of total programme cost, political requirements and timeliness (Sub-section 2.6).
- To fully support the tender evaluation process, it is recommended that a life cycle cost questionnaire is issued with the tender documents so that the procurement agency can conduct an independent comparative life cycle cost evaluation on all the tenders. This will improve the understanding of the tender offer and provide a degree of credibility in the predicted life cycle costs results (Sub-section 2.8.3).
- We recommend that when supporting contractor submissions then all cost data and substantiating information is provided in a format that is clear, complete and ready for evaluation (Sub-section 2.8.3).
- There is a clear need for all participating nations in a multi-national acquisition to understand and trust the cost models used. The participating nations will need to agree on a common life cycle costing framework (as detailed in the key recommendations). It is further recommended that clear guidelines are produced with regard to which data to use and how to collect this data (Sub-section 2.10).
- The issue of a reference currency and currency exchange should be resolved prior to commencing any life cycle cost study. It is recommended that advice be sought from the recognised national economic advisor to ensure consistency and correctness in the application of the life cycle cost modelling (Sub-section 2.10.7).
- It is also recommended that each nation within a multi-national programme apply their own cost model and applicable data (CERs, labour rates, etc.) to arrive at its national cost estimate and that this information is used in the collective multi-national life cycle cost framework (Sub-section 2.10.7).
- Prior to the start of production it is recommended that a joint (contractor and government) risk register is developed to support the assessment of the financial risk liability and to assist in the risk management and mitigation activities (Sub-section 3.7.6.1).
- During and Post Manufacture, it is recommended that all actual costs incurred by the contractor are certified. This data can subsequently be used to refine and calibrate future cost forecasting models (Sub-section 3.7.6.3).
- It is recommended that research is conducted continuously to enhance methods and models for life cycle costing (Sub-section 4.4).
- It is recommended that anticipation is made of future data requirements to support life cycle costing and that the data is collected accordingly (Sub-section 6.1). To achieve this, an agreement

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on well-documented templates or standards for the data to be exchanged should be reached between all the stakeholders (Sub-section 6.4).

- In individual nations, the regulations relating to the interpretation and calculation of tax may be different. Should this be a requirement for life cycle costing then it is recommended that advice should be sought with the appropriate national authorities (Sub-section 8.1).
- Larger (more expensive) programmes will usually demand more effort and rigor. It is recommended that sufficient time and effort should be allowed in order to provide a robust cost estimate to meet the programme requirements. However, there should be a balance between estimating effort and the value of the programme (Sub-section 2.6).
- A uniform communications format should be used for presenting the life cycle cost estimates risk analysis. This will aid the decision makers in their evaluation of programmes by presenting the basis of the spread of the costs, the method employed to conduct the simulation and the provision of the underlying assumptions (Sub-section 7.8).

12.3 FOLLOW-ON ACTIVITIES

The following paragraphs outline recommendations for further studies that would benefit the understanding and use of life cycle costing in NATO and multi-national environments.

- The next logical step on completion of SAS-054 would be to demonstrate the proof of concept (methods and models) described in the report by using a practical application of the guideline:
 - A typical example could be an existing NATO programme (but only using data that was available at the time) and/or any other multi-national programme (e.g. AWACS, AGS, JSF, NH-90, FREMM).
- Further research should be conducted in the area of capability portfolio analysis (see Chapter 9). This topic of joint warfare is becoming more important to NATO and, at present, there is insufficient information on how to evaluate the situation where a number of discrete assets share the information/data to provide a total capability solution.
 - An investigation into new methods and databases would support this requirement.
- Research into the life cycle costs of software. This report has not addressed software cost estimating as it was felt that this was a subject in its own right. Many academic studies are being conducted into open system architecture, modular construction and system behaviours that employ software intensive configurations.
 - Much is known about modern techniques in software development but the issue of assessing software quality, reliability and support costs is still vague.
- Life cycle cost estimates are produced for a variety of reasons. It would benefit the NATO community to investigate how the cost estimates are being used in the decision making process.
 - This could avoid the situation where enormous effort may be spent in generating cost estimates when the answer could have been given in a more simplistic and effective manner.
- Estimating accuracy has been an issue for many years. An evaluation could be conducted that studied the delta between the original cost estimates and the actual costs.
 - This would provide a benefit by having a definitive document that could provide a view of estimating accuracy across a number of procurement processes.

- Research should be conducted continuously to enhance methods and models for life cycle costing.
 - Periodically, the US Department of Defense undertake an initiative to review the basis and techniques employed in cost estimating. This is supported by industry, a number of academic groups and learned societies. However, these initiatives purely examine techniques that will be employed within the US. It would be beneficial to conduct a similar continual review across NATO and PfP nations.
- The SAS-054 study gathered information on each nation's approach and use of models to generate life cycle costs. The study did not get a clear comprehension on the range of the functionality that could be provided by some of these models.
 - It would be of benefit to look in more detail on how these life cycle costing models generate cost for Research and Development, Production, Operating and Support.
- The issue of calibration, verification and validation of cost estimating models is of paramount importance. However, little or limited space is given in handbooks on the requirements and methods of validating cost models.
 - A study could be initiated to develop a common methodology for validating cost models, this would help to ensure cost estimating consistency across NATO and PfP nations on each nation's approach and use of models to generate life cycle costs.
- All life cycle cost estimates are only as good as the data that underpins the estimate. Much investment has been made in adopting ERP-systems to support financial and project reporting. The use of these systems in providing good quality data to support life cycle cost estimating is not clearly known.
 - A study should be conducted to evaluate the benefits or otherwise in adopting an ERP-system versus the investment in a bespoke system (e.g. VAMOSOC) to assist the life cycle cost data collection process and improve cost estimating methods and accuracy.

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