Chapter 11 – CONCLUSIONS

11.1 GENERAL

The results of life cycle costing must, whatever the phase of the programme, contribute to the process by which managers can make the best decisions on options presented to them. These options can include evaluation of future expenditure, comparison between alternative solutions, management of existing budgets, options for procurement and evaluation of cost reduction opportunities. Life cycle costing is also used for affordability assessment and determining the cost drivers associated with the Key Performance Indicators or Key User Requirements.

There are many methods and models available to conduct life cycle cost analysis. It was important to understand the applicability and boundaries of each method and model in order to use them appropriately. The core objective of the SAS-054 Task Group was to understand NATO and PfP nations' methods and models and to promulgate best practice throughout the life cycle.

11.2 REVIEW OF COST FORECASTING METHODS

Most cost estimates require the use of a variety of methods. A different approach may be used for each area of the estimate so that the total system methodology represents a combination of methods. Sometimes a second method may be used to validate the estimate.

When choosing an estimating method, the cost estimator must always remember that cost estimating is a forecast of future costs based on a logical interpretation of available data. Therefore, availability of data will be a major factor in the estimator's choice of estimating methodology.

The best combination of estimating methods is one which makes the best possible use of the most recent and applicable historical data and systems description information and which follows sound logic to extrapolate from historical cost data to estimated costs for future activities.

The report has captured all the key estimating methods and provided examples to demonstrate their applicability. For consistency, both the methods and models have been categorised as Optimisation, Simulation, Estimation and Decision Support.

The findings at Figure 4-4 clearly show that in order to generate a cost estimate all participating nations use many methods across each of the phases considered.

The findings confirm that all nations used a similar process to develop life cycle cost estimates; that the quality of the available data nearly always determines the method to be employed. In addition the type of study (strategic planning, options analysis, simulation and traditional estimating) and the life cycle phase also influence the process and the appropriate estimating method.

11.3 REVIEW OF COST FORECASTING MODELS

All nations use some form of in-house developed model for life cycle cost analysis. The majority also use commercial cost estimating models. A few nations do not use any type of commercial model; instead they rely totally on in-house developed models and/or other types of methods such as expert analysis.

Nearly 40 different models have been identified in the matrices. Almost half of them are commercial models and the remainder have been developed in-house. There are differences between the in-house

models, but one common feature is that many are developed in a spreadsheet environment and are often tailored for each specific programme. The in-house models are generally only used by the nation that has developed the model.

The findings at Figure 5-1 show clearly that models for estimation are the preferred models for life cycle cost analysis throughout the phases. In addition to models for estimation, models for decision support are used in the earliest phases and models for optimisation and simulation later on.

In order to provide verification of the life cycle cost estimate, it is good practice to use more than one model. Where sufficient data is available, the use of models for simulation and/or optimisation to supplement the overall life cycle cost model should be adopted. The use of multiple methods and models should always be evaluated on a cost-benefit basis ensuring that the added value provided from life cycle cost analysis is maintained.

11.4 GUIDELINES FOR THE COLLECTION AND UNDERSTANDING OF COST RELATED DATA FOR NATIONAL AND MULTI-NATIONAL PROGRAMMES

In terms of time, effort, and resources consumed, collection of data is a major part of a life cycle cost study. Life cycle costing is a data driven process, as the amount, quality and other characteristics of the available data often define what methods and models can be applied, what analyses can be performed, and the results that can be achieved.

As a system progresses through the life cycle, the types of data available evolve in a number of ways. As this in turn defines the task of data collection and the life cycle costing process in general, it is important to be conscious of these developments.

First and foremost, the amount of data available increases as the system becomes better defined. Obviously, very little is known about the end system when a project begins and all that exists is an identified capability gap or a general concept, whereas, when a system is in-service, the system and its environment can be documented in almost infinite detail.

Unfortunately, because uncertainty, risks, and opportunities decrease as the life cycle progresses, the need for knowledge is greatest at the earliest stages. This means that more time and resources should be allocated to the data collection effort during the earlier stages of the life cycle in order to develop an acceptable and auditable life cycle cost estimate.

Exchange of data between ERP systems and databases can be a cumbersome and time consuming affair if data formats and data models differ. It is therefore beneficial to have generally accepted and well documented standards. One such is ISO 10303-239 which has been put forward by NATO to be adopted as a STANAG. In the long term, PLCS has the potential to be an important tool to help collect and exchange high quality, well documented data. However, the PLCS is a very large and technically complex mechanism, and implementing PLCS would be a huge undertaking for any organisation. Alternative, ad hoc solutions in the form of agreed upon and documented templates, etc., may be used, but this makes the data harder to use at a later date for other projects or purposes. When possible, officially defined and accepted standards are preferred.

It is recommended to have previously agreed upon and well documented templates or standards for data to be provided by contractors and suppliers. Furthermore, particular care must be taken to secure that the data received from contractors, or other sources with a vested interest in a programme, are accurate and unbiased. The UK MDAL (Master Data and Assumptions List) is one well documented mechanism for

ensuring that all stakeholders buy into a common and clearly stated understanding of the project and the system of interest. A similar function is fulfilled for major acquisitions of the US DoD by the CARD (Cost Analysis Requirements Description). Furthermore, the US DoD has developed the CCDR (Contractor Cost Data Reporting) and SRDR (Software Resources Data Report) systems for accumulating actual contractor costs necessary to analyse costs efficiently and effectively. While data collection through formal reports such as CCDRs and SRDRs is extremely important and beneficial, there is still no substitute for taking the time to understand and verify the accuracy of historical information, and the programmatic context in which it was obtained.

11.5 TREATMENT OF UNCERTAINTY AND RISK

History has shown that cost estimates tend to be low – only about 10% of all programmes come in under or on budget. Because of this, cost estimates need to be adjusted for risk. Mistakes happen during estimation, schedules slip, technical difficulties arise, assumptions prove false, missions change, or the proposed hardware or software solution turns out not to meet the needs of the joint war-fighter. Because of all of these factors, risk needs to be included so that the analyst truly conveys to decision makers the uncertain nature of the estimate.

There are a wide variety of methods and models available for conducting risk and uncertainty analysis of life cycle cost estimates of weapons systems. These include sensitivity analysis, risk registers from the U.K., and detailed Monte Carlo simulation. Each, if used properly, can yield scientifically sound results. However, based on our collective experience in cost estimating within the government and in the private sector, it's fair to say that the sophistication and underlying theory of many popular models often far exceeds the quality of the basic data inputs. There is simply no substitute for taking the time and effort to understand the technical risks and challenges in developing and producing sophisticated defence systems.

The most important part of the process of estimating risk and uncertainty, and probably the most difficult, is data collection and analysis. All the variables in the cost estimating model potentially affected by risk and uncertainty first need to be identified. These variables often include simple ratios and factors as well as more sophisticated cost estimating relationships (CERs) based on regression analysis. For Monte Carlo simulation, probability distributions need to be estimated or selected for each variable.

In terms of presenting results to senior decision makers, we highly recommend the use of a standard format which includes use of a three-point scale to convey the idea that a cost estimate is not a single number but rather a continuum or distribution of values. Assumptions or scenarios associated with low, baseline, and high estimates should be stated to enable decision makers to see clearly the cost implications of events that can influence the outcome of an acquisition programme.

11.6 GUIDELINE FOR MULTI-NATIONAL PROGRAMMES

The life cycle cost studies for multi-national programmes follow the same principles as defined for national programmes. Nevertheless, there are some specifics that should be taken into account in terms of organisation, types of life cycle cost studies, cost models and presentation of results.

In terms of organisation, life cycle cost studies should be co-ordinated centrally by the pilot nation or the IPO or the NATO agency following the multi-national structure adopted. One or more participant(s) could perform a peer review including a verification and validation of the life cycle cost studies performed above.

The type of life cycle cost studies could be focused on the assessment of different alternatives related to commonality part. For this purpose, a specific process is necessary to identify the areas in which

alternatives could be defined and assessed. Figure 2-16 shows a process for the selection of the areas and the definition of the related scenario.

The basic principle for these studies is that they should be based on an agreed common life cycle cost framework. This implies the selection of a common model(s), the building of a common cost breakdown structure, the aggregation of the different outputs from the models, the definition of harmonised assumptions (in particular for deployment(s)) and a common process for data collection.

The life cycle cost results should be presented in one currency. The choice of the currency should be made before the launch of the life cycle cost studies and the evolution of the exchange rates taken into account in the model.

11.7 AWARENESS OF NEW DEVELOPMENTS IN METHODS AND MODELS

This study identified that the topic of joint war-fighting is becoming more important to NATO and this will influence the life cycle costing requirements. 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. The costing of the assets themselves is straightforward, but when combined the interpretation on apportionment where multi-mission systems feed into several capabilities is not clear.

Viewing capabilities across the entire portfolio of assets enables decision makers to make better informed choices about how to reallocate resources with the ultimate goal of delivering needed capabilities to the joint force more rapidly and efficiently. Capability portfolios are intended to serve as a basis for strategic level trades by senior decision makers and it is essential the life cycle costing plays a major role in supporting this new development.

For the NATO and PfP cost community, this will cause a shift in emphasis from the analysis of individual programmes at key gates or milestones to the analysis of entire portfolios of assets. This will require further investigation and examination to assess the impact.

11.8 REVIEW AND POSSIBLE ENHANCEMENT OF NATO GENERIC COST BREAKDOWN STRUCTURE

The SAS-028 Task Group related to cost structures and life cycle costs for military systems developed a NATO generic cost breakdown structure and associated definitions that can be used by any military programme to construct its own cost breakdown structure. The outputs of this Task Group have been applied on specific programmes and some areas of enhancement have been suggested.