PORTFOLIO MANAGEMENT A COSTING METHODOLOGY

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Andy Nicholls PRICE Systems LLC

Who am I? I often ask myself that! Also I'm usually less happy than this picture suggests - it was taken on a good day.

Many of the following slide words speak for themselves – I'm not here to sell a costing tool but cause a consideration about methodology, although I have used a parametric model to create the data for this paper/ presentation. I know slides can be boring so I have a few pictures along the way.

Portfolio Management is a method of managing many different but similar projects as a 'whole'. The words quoted are taken from the United Kingdom Office of Government and Commerce publication "Managing Successful Programmes MSP)". Whilst this particular draft Table did not make it into the final MSP publication the message is still contained in the guidance.

The vogue currently is to speak about "Capability", this may be defined in several ways but in Defence terms it usually means the ability to perform a particular set of actions; all of the necessary equipment and services needed will be included in both planning and implementation of that action. Often such a capability will consist of Air, Land, Maritime and Space based assets each of these will be vital to successful operations. Often the individual projects are grouped for management purposes even though their budgets are owned by different service arms.

My example slide title is a little misleading as what is shown is an attack directed against Land forces rather than a 'defence' or defensive operation. Estimators and those that handle data have a bit of a thing about definitions! However without dwelling on that aspect all force elements must perform and interoperate correctly to deliver a successful mission, this is one definition of capability.

This second illustration is sourced from an unclassified 2007 US DOD presentation to the Software Intensive Systems Acquisition Improvement Group. The picture details most generally expected assets drawn from sub-surface to Space based environments – all are required to deliver a "Defence" Capability.

This is a vision statement – the implied message is that to enhance capability there will be a great deal of improved 'interconnection' required. To this end most major Defence areas have been striving to manage and deliver capability more effectively (all too often a synonym for cheaper!) and to deliver Systems that integrate and co-operate to achieve a performance that enables a particular outcome to be prosecuted successfully. Today it simply is not good enough to try to manage a 'federation of unlinked estimates'.

Why do I highlight this? Well, if what is to be delivered has to integrate and interoperate it makes really good sense to define, procure and manage the same programs/ projects in an integrated way. That way everything stays in step hopefully long enough to deliver the requirement! Currently procurements tend to be by 'projects' and they may be very stove-piped with procurement decisions that match!.

This unclassified slide shows a sub-set of a defence capability using particular assets for a specific role. It depicts the various elements required for the JAS-39 Grippen to deliver a maritime reconnaissance capability. It is focused on a single air sector vehicle type and its necessary ground network requirements.

The defence programs and/or projects may be grouped by major sector – Air, Land, Sea and Joint; whilst this approach gathers together 'like' projects it really does not address the type of 'Capability' groupings I have just referred to - i.e. those assets required to deliver a particular Defence objective. However, for my paper I have used the Sector approach with just two major Sectors modelled – Air and Maritime comprising the top 25 major programs. These programs/ projects are either underway with later phases or new program/ projects yet to start.

What are not included in my analysis are the programs already committed and their sustainment costs to which new phases or new programs must be added. This, whilst acceptable for demonstration purposes would in real life be a failing since the decision makers require at least an outline of 'total defence costs' for the current and future years and this ought to be shown in one place, if only because any adjustments to individual programs may place a burden on other programs awaiting decision.

Data for my parametric modelling and subsequent analysis is taken from a public domain Defence Capability program (DCP) that provides a high level outline of the Defence Program. DCP values presented for budgetary purposes offer a useful range of costs and an indication of where the likely costs may eventually fall within that range. There is no indication of what the confidence levels in those costs happens to be. Where cost is driven by program quantity there is often no indication of total required quantities which could aid realistic estimation. Other public domain sources (Janes, Wikipedia etc) can more often than not give numbers of existing assets and these are a useful guide in the absence of Official data. This is an extracted snapshot from the published figures and by inference the 'Sustainment' and committed projects are the missing part of the picture.

An example of this would be numbers of Service personnel to be outfitted with new night vision equipment under a Land project. A search through public domain sources give broad service personnel and reserves numbers as around 100,000 comprising:

59,023 full-time active-duty personnel,

21,850 active reserves and

22,166 stand by reserves.

Obviously not every one of these personnel will be kitted out. A reasonable assumption might be approximately 10% of full time active duty personnel (6,000) or rounded to say 10,000 units would need to be procured. This assumption places a cost estimator in a better position when it comes to deriving a unit production cost.

Using Portfolio Management techniques it is necessary to rank or prioritise defence programs to aid their effective management. Programs are Categorised with scores that use six attributes:

Acquisition Cost

Project Management Complexity

Schedule

Technical Difficulty

Operation & Support

Commercial

The 1st & 5th are the outputs from a cost model, the remainder are required inputs.

The DCP contains the traditional view of Programs and Projects across all Sectors. Some of these Programs labelled 'Joint Programs (JP)' form the glue between the major Air/ Land/

Sea assets. The DCP data has 5 categorisation attributes listed for each program. As fortune (or luck) has it, 3 of these have a direct parallel within the cost model and the 4th may be adjusted where there is specific but additional data not contained within the DCP. This eased some of the cost model input requirements.

The DCP top level program data was copied into EXCEL and sorted by Sector and calculated mid-range estimate. This allowed the top 50 programs by value to be identified and also the top Sector programs.

These top 50 programs account for a mid-range estimate of about 90% of all the major programs by value. All data was assumed to be 'prices paid' excluding Tax. Budgetary figures publicly declared are declared as single point plus a range of likely total values. To facilitate comparison between cost model predictions and the budget line, a spread of cost across the program duration using a simple beta type distribution has been derived based on the mid-range budgetary figure and 'year of decision', 'IOC' and a RoM date for completion of acquisition.

Adjusting the cost model workload to cover just two sectors Air/Sea gave 25 programs from the published top 50 at $57Bn mid-range estimate or about 70% of the major programs by value.

I used TruePlanning 2012, which is a parametric cost model and provides a framework into which individual programs and projects may be integrated. The tool provides a variety of outputs based on physical, performance, technology and schedule input data. I am not going to describe the detail of the model used – this is not the place and as I said right at the start this presentation is not about the model it is about the method.

TruePlanning schedule has been calculated using the year of decision as program start date and IOC as first operational date – all other dates are predicted – more on this later.

Here you may recognise the program designations obtained from the DCP, the program data was extracted from the DCP, added to with data taken from public domain sources and engineering judgements to build a predictive model. The costs obtained are 'ball park' and do not reflect any better positioned estimates that are produced or held by the Defence Capability Group – so please do not get hung up on any predicted values you will see on screen. I will explain further as this presentation progresses.

Cost Model predictions are aggregated across all programs and Sectors.

From a financial perspective the example model includes G&A, profit and escalation as base cost predictions are 'as spent'. I have modelled some assumed on-shore developmental activity although certain major items are assumed to be bought in and then modified to meet requirements.

What follows is a series of example graphs of parametric predicted outputs compared to assumed budget profiles – this is not real world and is certainly not 'Official' in the sense the programs have either approved profiling or validated model output numbers. My intention is to show what can be done in a comparatively short time.

Of course the costing tool I used also predicts schedule and using the declared decision dates, IOC and other the Air & Sea Sector predictions may be exported to MS Project for further analysis – this is a simple overall gantt view. This is a very quick way of checking that individual programs/ projects are where they should be on the timeline – mostly a check on start date alignments and IOC dates – often without placing constraints into the cost tool there overall schedule predictions may not align with management expectations!

If just date changes are made the MSP file may be imported back into the cost model and costs then re-calculated to establish changes as a result of schedule alterations.

This slide illustrates the raw cost model total cost output for both predicted costs and mid-range budgetary data for Air and Sea sectors.

The chart shows the point estimate predicted Top 25 Air/ Sea Program non-recurring and recurring costs (developmental and production respectively) predicted for the Air and Sea sector programs as previously described and the associated rough Budget profile. Pink = 'recurring' costs and faded 'Orange' non-recurring costs.

The forward year costs are dominated by 'recurring' costs – this is to be expected as procurement trends tend to be modification of existing off the shelf defence platforms or equipment. In pure cost terms this makes it easy to control 'in year' expenditures by altering project procurement quantities but this may have some drawbacks in capability terms and such short term changes may cause movement in unit prices due to contractual issues.

Generally I conclude that both profiles are similar and that there is more 'over-run' than under run in the budget when we consider the point estimate predictions. Also the predictions indicate that significant costs are incurred against a longer schedule than the public domain figures might suggest.

The production cost spike around 2024 – 2027 is caused mainly by later Air program phase and a maritime program.

The public data lacks sound profile information, does not contain the "legacy" or Approved Major Capital Investment Project costs and this prevents a more full analysis of forward profiles. This Graph depicts my version of the public budgetary figures spread over DCP dates using the declared cost ranges. In gross terms this carries a very similar profile to that obtained from the predictive model with one exception – the later years spike is not as marked as the from the model.

There are three lines on this graph – each is created from the available data, budget range High is shown in 'Red', Low is shown in 'Blue' and mid-range in 'Green'.

The TruePlanning top down cost model outputs a cost distribution that contains uncertainty – based on model user inputs. Shown in the chart are the 10%, 50% and 90% confidence outputs. Although any confidence value between 5% and 95% may be selected at 5% intervals.

In my example model, the early and later years show convergence because of scale compression and data quality. This chart uses the declared budgetary range figures shown in 'Green (Mid-range) and Red (budget High range)' compared to the TruePlanning cost model predicted uncertainty cost distribution output at the 50th (50%) percentile.

Quite clearly there are marked differences between published High & Mid Band and cost model predicted annual values – as a demonstrator this is acceptable but if it were 'for real' then cost assurance processes would ensure that any differences in data and assumptions were removed or agreed before such a comparison could be discussed constructively.

Déjà vu! Remember this earlier slide?

The spike around 2024 – 2027 is caused by a modelled Air program later phase. Public domain data indicates a particular quantity of new aircraft – the model input data therefore has two delivery runs with a small gap, this gives rise to the later year spike in production costs 2024 – 2027.

Note the under run in budget to prediction in 2015 – 2021 where some opportunity may exist to defer programs 2012-2015 or increase spend post 2015-2021.

I will examine a simple method of adjusting cost model profiles to budget next.

Assuming that the Air program later Phase is still required then consideration may be given to both the rate and in year quantity deliveries that could be practically achieved without impacting significantly the unit prices paid.

By moving production quantities into the earlier years of the program and reducing the later year profile (still consistent with introduction of the later 4th squadron capability) – a re-run of the overall cost model now clearly shows a better point estimate match with planned budget.

This is not perfect but it is better for budgeteers however, it does single out one program from others for preferential treatment so such an approach will never satisfy all concerned and may have consequential impacts on other related projects (perhaps associated Weapons projects).

Note that further cost model adjustment for the other major contributor in this timeframe – the maritime program for example - would reduce still further the over-run in years 2022 – 2027 but due to the nature of this particular program the later years budgets would then require consideration if anticipated new submarine deliveries were to be matched against likely expenditures.

However from a Portfolio Management perspective the simple adjustment to production deliveries is only one small part of the process since adjustments must also be made to:

- linked programs,
- other cost streams such as recruitment of Service crews /
- crew training delivery to ensure operational availability and
- setting up of support capabilities

This is far from the simple adjustment that my example portrays. With a properly linked and integrated cost model the changes are fairly swift and impacts can quickly be noted for informed discussions. Note that whatever the method selected the original cost model **must be re-run** to determine changes to cost predictions after any adjustment of assumptions or program data that feature as model inputs – it is not good enough to simply adjust or pro rata cost model outputs which mostly what happens today.

A review of lower level detail in the adjusted cost model reveals that two Air and a maritime program are key drivers beyond 2017.

There are many ways to show the Capability Groups – in this stacked method the comparative value and phasing may be clearly seen. In an ideal world all linked/ co-operative programs would carry a similar colour coding to ensure that if a major program within the Group is moved then the need to adjust the others is obvious.

From a financial perspective the example cost model includes G&A, profit and escalation to obtain cost predictions ‘as spent’. GST is excluded. I have included on shore developmental activity although some major items are assumed to be bought in and then modified to meet requirements.

What follows is a series of example graphs of predicted outputs compared to assumed budget profiles

This cubic representation shows how an integrated approach may be used from the most senior decision maker down to the analysts and estimators who create individual models. Each level has its own input data and reporting requirements from detail widget to whole portfolios. The key points to note are that a ‘Cost Management Team’ is responsible for the management and updating of data, calculation engines and requirements.

Summarising – I do not know how long it took the public program figures to be created but for the Air & Sea Sectors my Rough Order of Magnitude top down model took less than 8 days and most of those were spent searching for information that was not within the public domain. I suspect that the real estimates took many person months to achieve and this effort would have been spread across resources in several specialist areas.

The model itself is iterative and would in real life be subject to frequent updates as changes to requirements occur, tenders are reviewed and contracts placed – this iteration is crucial to any cost management process. Comparison information obtained from contract data to original estimates is of great value in reviewing and updating the 'future' elements of a Defence Portfolio and also the inclusion of data for existing/ legacy programs would enable comparisons against overall Departmental budgets and cost profiles.

Although not within my paper a method exists to combine the uncertainty based cost model outputs with program risk from risk registers.

An organisation that maintains a 'federation of estimates' rather than maintaining an integrated suite automatically places itself at a disadvantage in terms of efficiency and agility.

The use of an integrated model supports the Portfolio approach.

Acknowledgement and thanks to NASA for the closing slide photo.