



INSIDE THIS ISSUE

<i>Chairman's Address</i> 2	<i>SCAF 2017 Calendar of events</i> ... 3	<i>Letter from the Editor</i> 4
<i>Type 31 Considerations – B.Tanner</i> 5	<i>“Great Costing Disasters” - an appreciation of P.G.Pugh</i> 12	<i>Report on the 2017 SCAF Cost Estimating Challenge and Workshop</i> 18
<i>SCAF 2017 Committee Meetings</i> 20	<i>Other Costing Community Related Events</i> 21	<i>SCAF Contacts</i> 22

CHAIRMAN'S ADDRESS



Project X was conceived within the Portfolio Insight Team at the Infrastructure and Projects Authority (IPA) as a vehicle to engage research into

projects and programmes with the 'real-world' issues that are manifest across the Government's Major Project Portfolio (GMPP). It seeks to promote and support research with an ultimate ambition of delivering savings for HM Treasury and enhancing project management capability across government departments.

Project X is the brainchild of Terri Harrington from the IPA and has been developed with support from Academia, Industry, Government and Consultancies. I attended a Project X meeting on the 25 January which was well attended and stressed the need for engagement with industry if the research is going to leave the university and be adopted by projects in industry. Terri kindly gave us a presentation at our Brexit workshop in February. I would encourage members of SCAF to get involved at www.bettergovprojects.com

In February I found myself in Canberra, Australia supporting the Department of Defence. Naturally, it was their summer and it was hot! On the day of my departure the car thermometer read 41°C outside, but it was hotter still in the car where my suitcase and my clothes to travel home in had been baking all day!

While I was there I held a workshop for the ICEAA Canberra chapter in the lecture theatre in Russell (equivalent to MOD Abbey Wood, Bristol) about 25



attendees took the opportunity to exchange thoughts on the maturity of the Canberra cost community while I reflected on UK experience.



The cost engineering tube map which we published in the last SCAF newsletter was published on the LinkedIn social media site. On the last count it had been viewed more than 15,000 times, liked more than 1,200 times, shared more than 200 times and I have received more than 300 comments requesting electronic copies of the poster from around the globe. From the comments I have received it would seem the international cost community needs help to achieve recognition; many people said the poster would help them generate an appreciation of their work and the broad range of knowledge they require to undertake the work proficiently.

Looking to the future, you might be interested that Palisade has an @Risk user conference in London on the 27 April, the ICEAA Canada conference is from the 1 to 2 May in Ottawa and the ICEAA US conference is from the 6 to 9 June in Portland, Oregon.

Closer to home, the SCAF Challenge and Training Workshop with a software theme at the BAWA venue in Bristol was a great success. Well done to all the teams. You gave us something new and contributed to the learning of the less experienced by networking!

Dale Shermon

SCAF Chairman

2017 SCAF Calendar of Events

- 07 Feb 2017** **The Impact of Brexit on the Costing Community, RINA, London**
Since June the financial markets have reacted negatively in the immediate aftermath of the results with investors in worldwide stock markets losing heavily. How do events like this effect your cost forecasts? Are there any new risks or opportunities to consider? This workshop considered what, if anything, is the impact of Brexit on the cost community. **Presentations now available on the SCAF Website Library**
- 04 Apr 2017** **2017 SCAF Challenge & Training Workshop, BAWA, Bristol**
The aim of this workshop was to provide an interactive training session in cost estimating through the presentation of case studies that have been conducted by the younger professional teams from academia, industry and consultants with the added benefit of top-level critique by senior figures in the profession. The programme was instructive, entertaining and suitable for a wide interest audience (estimators as well as managers). **Presentations available soon**
- 13 Jun 2017** **Costing Profession: Recruitment, Retention and Development, Ribby Hall, Preston**
Hear from experts on the benefits in joining the profession and learning the skills necessary for a successful career in cost estimating and forecasting, business analysis and commercial practice. Our speakers will include staff from industry, recruitment agencies and academia. **Papers invited – please contact the Secretary.**
- 06 Jul 2017** **Summer Reception and Awards Banquet, Bailbrook House Hotel, Bath**
This event will provide members and their partners with a chance to meet up with friends and colleagues and gave us the opportunity to recognise and award members for their contributions to the Society over the year.
- 12 Sep 2017** **Annual Conference, The QEII Conference Centre, Westminster, London**
We return a second time to this prestigious venue in London and the theme for this year's conference is "Achieving Value for Money: is partnering the solution". Our speakers will include members of regulatory bodies, industry partners, strategic supportability experts and academia. **Papers invited –please contact the Secretary**
- 14 Nov 2017** **Vendor Day and Service Providers Day, BAWA, Bristol**
An opportunity for costing professionals, business analysts, commercial and project managers to see the latest products and services from vendors and service providers. Exhibition stands will be displayed with a section of the room set-aside for simultaneous small group presentations throughout the day. **Organisations invited – contact Secretary.**



Letter from the Editor

By Arthur Griffiths, SCAF Newsletter Editor

In the last edition of the newsletter I wrote an article entitled “Expectations, Realisation and Divorce: excerpts on the EU” which was based on a SCAF Conference held on the 15th September 1992. In the article I referred to the presentations that were given in 1992 and how there was an emphasis on the optimistic outlook that had been presented. It was never the intent of the 1992 Conference to attempt to forecast too far into the future other than identify some of the risks and uncertainties known at the time. There have been many changes over the years most notably were Social, Political, Industry and Finance.

It was interesting then that the first workshop of 2017 was to discuss the impact of Brexit on the costing community. We all appreciate that there are many things that will be discussed/negotiated before the UK leaves the EU but I felt slightly disappointed that we seemed to have dodged some of the big issues (e.g. Trade Levies, Employment, Escalation, Commodities, etc.) and just skirted around the impact relating to foreign exchange (important as it is). All of these affect pricing and, as such, cost estimates on future projects will inevitably have to be re-baselined and assessed for affordability and value for money. It may not significantly change the way we do business but the challenge must be to ensure that we capture and analyse the uncertainty. When the Euro was first adopted on 1st January 1999 by the 12 member states (Greece adopted it in 2001) and then officially introduced as legal tender on 1st January 2002, commodity and retail prices increased by some 30% for, what seemed to be no reason at all. My thanks to everyone who attended and to the speakers who contributed to a good day – if you missed the event then you can view or download the presentations from the SCAF Website.



Type 31 Frigate Considerations

Brian Tanner



The strategy report “Type 31 Frigate and UK National Shipbuilding Strategy” by Sir John Parker contains a section devoted to the Type 31 Frigate.

Point 16 suggests that the economic life of a frigate should be assessed and the ship should be kept in service for that period or for a lesser period if a sale in support of an export campaign is required.

In recent history a similar assessment resulted in the Type 23 frigate, conceived in the early 1980s as a Cold War anti-submarine warfare (ASW) frigate, having a design life of 18 years in comparison with the normal assumption of 25 years. Since the First of Class HMS Norfolk was accepted in November 1989 the end of the Cold War and, more significantly, the 2008 financial crisis has meant that the Type 23 current in service life has almost doubled from the original. But at what expense? At some 24 years of in-service life the later ships are undergoing LIFEX with Sea Ceptor missiles replacing Seawolf together with a ‘Power and MCAS’ replacement to support the combat system upgrades. All this while major structural renovation is necessary, one report including the statement “Structural improvements include replacing the bridge!”.

Experience in the 1980s overseeing the refit of ex Royal Navy ships for a foreign government leads me to the opinion that the maximum ship life for a warship should be no more than 25 years.

An economic life must, for a return on the expenditure, align with the ship’s upkeep cycle and, with a mid-life Upgrade, this life is probably twenty years.

An ‘economic life’ has to include consideration of the cost of a mid-life update. As set out in the article ‘Warship Size and Cost’¹ that means that the ship must not be a minimum practical design. A point reinforced by a statement in the report that the design should ‘ensure the minimisation of through life costs and the ease of physical withdrawal of equipment’

Point 17 suggests that the RN should be willing to support an export drive by releasing a ship for sale before the end of its working life². But at what cost? The Warship 2013 article ‘Rebuilding the Australian Cruiser Squadron 1930 – 1939’ included this statement on the sale of the Leander light cruisers that had been commissioned in 1936:

The Admiralty was prepared to transfer *Apollo* in September 1938 for the price of £1,366,000 and *Amphion* in July 1939 for £1,360,000, these prices being based upon the building cost of the ships with a 12% per annum depreciation on the diminishing value. They also agreed, albeit with an

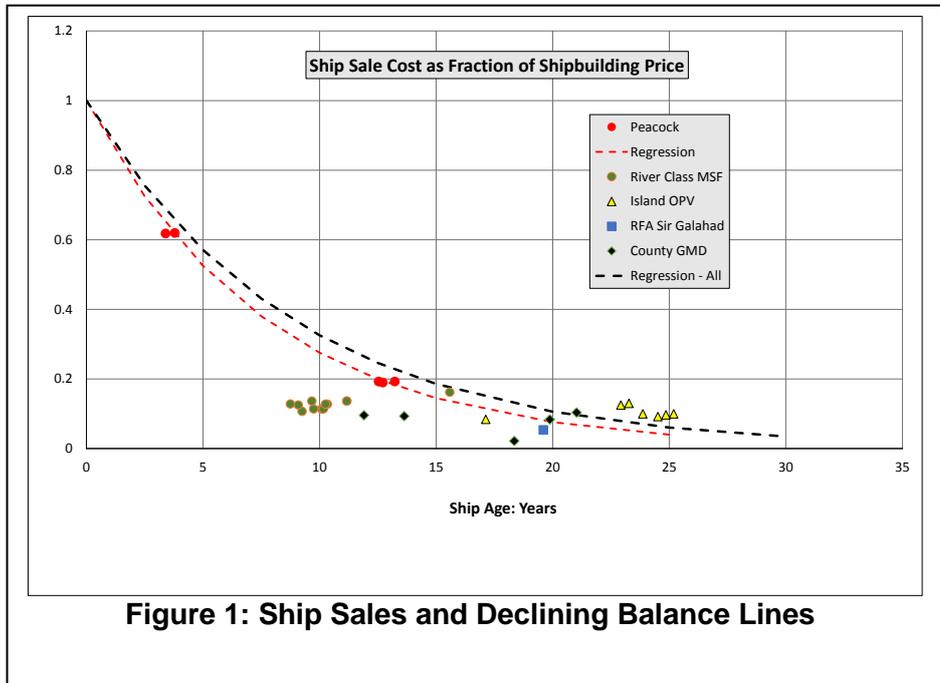
In more recent times the sale of 5 ex-Royal Navy Peacock class patrol ships to the Irish Naval Service (2 off) and the Philippines navy (3 off) displays a similar depreciation rate when based on the original shipbuilding contract price³.

¹ SCAF Summer Newsletter August 2016

² An extreme example being the sale of FNS Normandie to Egypt when the ship was nearing completion by DCNS.

The sale of River class Mine Sweeper Fleet (MSF) ships and Castle class Offshore Patrol Vessels display similar depreciation rates but, probably, influenced by their characteristics and demand for such vessels.

Information on more recent sales of Type 22 and Type 23 frigates cannot be used as batch selling price is all that is published, and the ships are of various ages. The individual prices for County class destroyers are published allowing their inclusion. Figure 1 is the plot of sale ratios.



But the ratios are of the shipbuilding price compared to their sale price. A true representation of the ratio of sale price to unit production price can be made assuming a surface combatant platform to combat system ratio of 60%:40% which would reduce the ratio and make the additional funding for a replacement vessel greater than initially thought.

Point 23 recommends that the Innovation Centre should 'look to critically examine current RN design and production standards and cost them to provide a menu of choice.'

Under NATO Group 6 – Ship Design – there was/is a Specialist Team on Ship Costing that has published two guides: ANEP-41: Ship Costing and ANEP-49 Ways to Reduce Costs of Ships. ANEP-49 scoped many topics, one being Commercial versus Military Standards. I was the UK representative from the late nineties to early noughties and the literature I inherited included the working papers behind ANEP-49. That literature remains in the UK MoD but I retained some summaries, one including Table 1 drawn up from the working papers. The Italian and German experience shows Commercial to Naval standards has a 33% increase in costs while Naval to Commercial has a 25% reduction⁴. But these must be maximum figures.

³ While Hansard 21 Jun 2010 Defence Equipment: Sales records a selling price of £4M for each INS vessel the Dáil Éireann Debate of 1988 on the Defence Estimates records an estimate of *Irish: Punt* Éireannach (IEP) 13.8M, equivalent to £11.81M

⁴ Which is the same figure as 33% is based on commercial cost and 25% is based on naval cost.

One small example of differences is seawater pipework. In commercial vessels it is galvanised steel while naval vessels use non-ferrous pipework. Two incidents come to mind: pipework in Type 22 seawater displacement systems corroded with expensive consequences; a colleague dealing with Castle class OPVs stressed not to use such pipework and valves, expensive and time consuming to maintain. And further back into the second half of the 1970s recollections of a professional institution paper demonstrating that in through life terms non-ferrous pipework must be the preferred option for seawater systems.

Country	Title of Paper	Data Source	Production Cost Saving
Canada	Cost Impact of Commercial/Military Standards	1991 Study into notional military and commercial frigates	35%
Germany	Application of Commercial Standards in Naval Ship Construction	Naval Research Ship Estimate v similar Civilian Research Ship Price	69% (31% reduction)
Italy	Comparison between Commercial and Military Standards in LPD Construction	Experience with San Giorgio LPDs	25%
France	Comparison between Floreal and La Fayette	Study of cost differences in study report	34%

Table 1: Summary of Cost Savings

The papers also included a 1992 French report on a study comparing the Floréal patrol frigate with the La Fayette frigate. Floréal was designed and built to commercial standards by the Chantiers de l'Atlantique shipyard, her armament then being fitted by DCN Lorient; the La Fayette was designed almost entirely to French Naval standards and built by DCN Lorient. Cost differences were attributed to characteristics as set out in Table 2.

	Shock	Signature	Vulnerability	Upkeep	Other	Total
Hull	7.8%	5.1%	9.4%	1.7%	-	24.0%
Hull Installations	4.5%	6.7%	11.1%	1.4%	6.9%	30.6%
Electricity	8.0%	4.2%	22.8%	7.6%	-	42.6%
Propulsion	10.7%	22.8%	9.0%	4.1%	2.9%	49.5%
Total Platform	7.1%	9.1%	11.8%	2.9%	3.1%	34.0%

Table 2: Comparison of French Frigate Costs

Point 19 discusses block build in various shipyards with assembly at a lead yard, quoting the QEC class carriers as an example. German shipyards have greater experience with the K130 corvettes and Type 124 and 125 frigates while in Denmark, the Odense shipyard assembled the Absalon Flexible Support Ships (FSS) (2 off) and Peter Iver Huitfeldt Patrol Frigates.

The Danish experience has been previously quoted in the context of Type 26 and may well be repeated for Type 31 frigates so a precis of public domain information may well be useful:

Programmes.

The Absalon class, originally Flexible Support Ships but now classified as Combat Support Ships (CSS), was ordered on 15th October 2001 from Odense Steel Shipyard. It was not a naval shipbuilder and the strategy was to “build a functional platform that can be transformed into a warship.”

To that end Denmark’s Naval Materiel Command (NMC) retained responsibility for combat system procurement and integration with the completed platform being delivered to NMC for further outfitting with all military specific systems and equipments. The fitting of various combat system elements was done incrementally hence the protracted timescale between delivery and being declared operational as set out in table 3. Some elements were reused STANFLEX weapon modules – medium calibre gun, surface to surface missiles, and anti-air defence missiles.

Name	Production Start	Keel Laid	launched	Delivered	Command-Hoisting (Commissioned)	Technical ready and fully operational
Absalon (L16)	30 Apr 03	28 Nov 03	25 Feb 04	19 Oct 04	10 Jan 05	1 Aug 07
Esbern Snarre (L17)	(30 Apr 03)	24 Mar 04	21 Jun 04	17 Apr 05	17 Jun 05	31 Dec 07

Table 3: Combat Support Ship dates

The effort applied in that period has been summarised as: “Throughout the project period of about three years, more than 60 artisans, engineers, civil and military technicians work full-time on getting the military installation works in place. 200 employees from OPLOG, Workshop Denmark in Korsor and Frederikshavn have at times had the ship as their workplace”. The extent of the work is demonstrated by this extract from a Roxtec sealing modules pamphlet:

“They are then moved to the Korsoer and Frederikshavn Military Naval Bases for retrofit of military systems and equipment. This addition includes the routing of extensive amounts of new electrical cables and piping throughout different zones and hazardous areas onboard.”

The ship was built to DNV classification for naval ships with full NBCD and shock standards applied, the maximum use being made of commercial off-the-shelf equipments, presumably with suitable shock mounting arrangements.

The short time for platform construction suggests a relatively simple ship with, perhaps, not all the features one would expect in a front line warship.

Costs

The contract of 15th October 2001 was a fixed price contract for the detailed design phase with options for the build of two Flexible Support Ships (FSS). In early 2002 the option for two FSS was exercised at a quoted cost of €160M. One other statement gives the cost of each unit as €175M: €80M for the platform; €63M for the combat system and €30 to 35M for the re-used STANFLEX modules. Missing elements appear to be Design/ Development and Initial Support provision.

There is much debate in naval chat rooms about the total cost of the ships, but no further detail on cost.

The Combat Support Ships were followed by three Patrol Frigates which utilised the same hull modified to suit the different roles.

Programmes

The Iver Huitfeldt class of Patrol Frigate (PF) was ordered from Odense Steel Shipyard on 20th December 2006. Dates from the public domain are shown in table 4 while Figure 1 gives an overview of the total programme, again illustrating the significant time interval between delivery of the platform from Odense Steel Shipyard and the frigates being operational

	F361 Iver Huitfeldt	F362 Peter Willemoes	F363 Niels Juel
Ordered	20 Dec. 2006	20 Dec. 2006	20 Dec. 2006
Cut Steel	12 Feb 2008		
Laid Down	2 Jun 2008	12 Mar 2009	22 Dec 2009
Launch	11 Mar 2010	21 Dec 2010	21 Dec 2010
Delivery to DALO	21 Jan 2011	22 Jun 2011	7 Nov 2011
Operational		9 Jan 2014	

Table 4: Patrol Frigate Dates

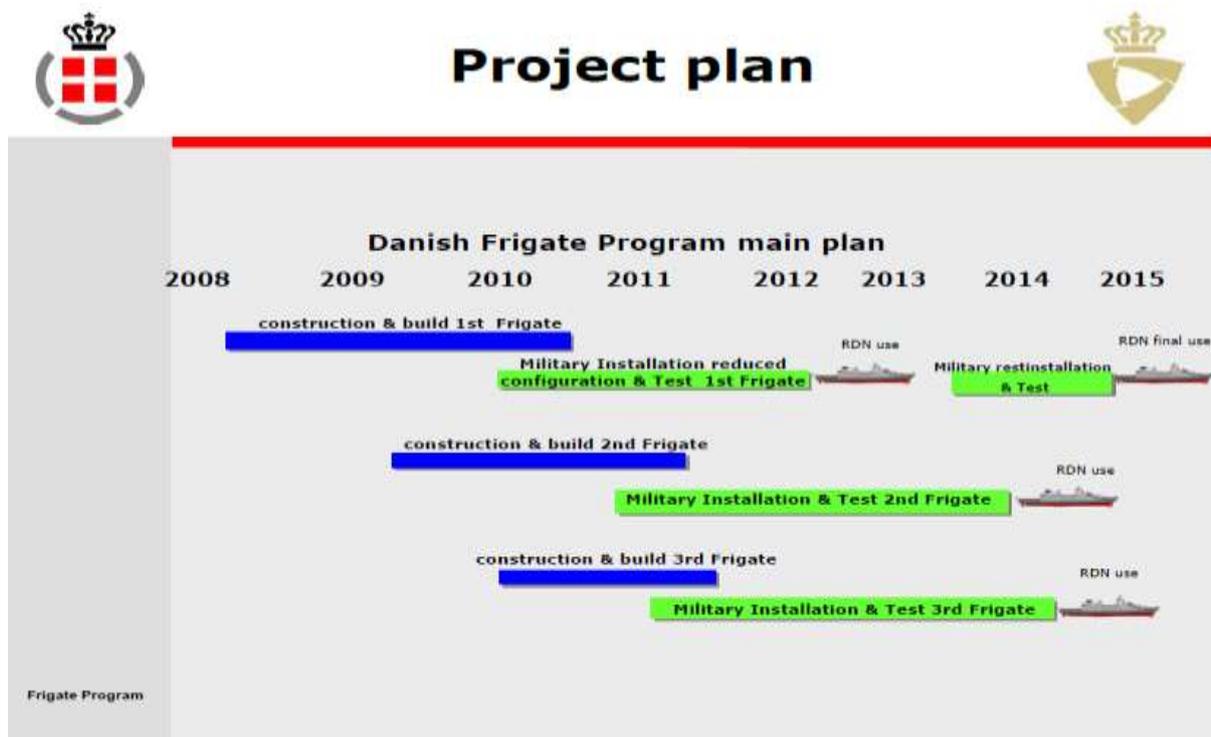


Figure 2: Danish Patrol Frigate Programme

Production began at Baltija Shipyard in Klaipeda, Lithuania, one of the two shipyards in the Baltic states owned by Odense Steel Shipyard Ltd that supplied blocks for Odense Steel Shipyard, the other being Loxsa Shipyard in Estonia.

When finished the blocks were transported by barge to Odense Steel Shipyard for assembly in a building dock and installation of other equipment. In contrast to other Royal Danish Navy new ship buildings over the last decades, including the Combat Support Ships, installation of the military systems was performed by the naval personnel in parallel with the building of the ship.

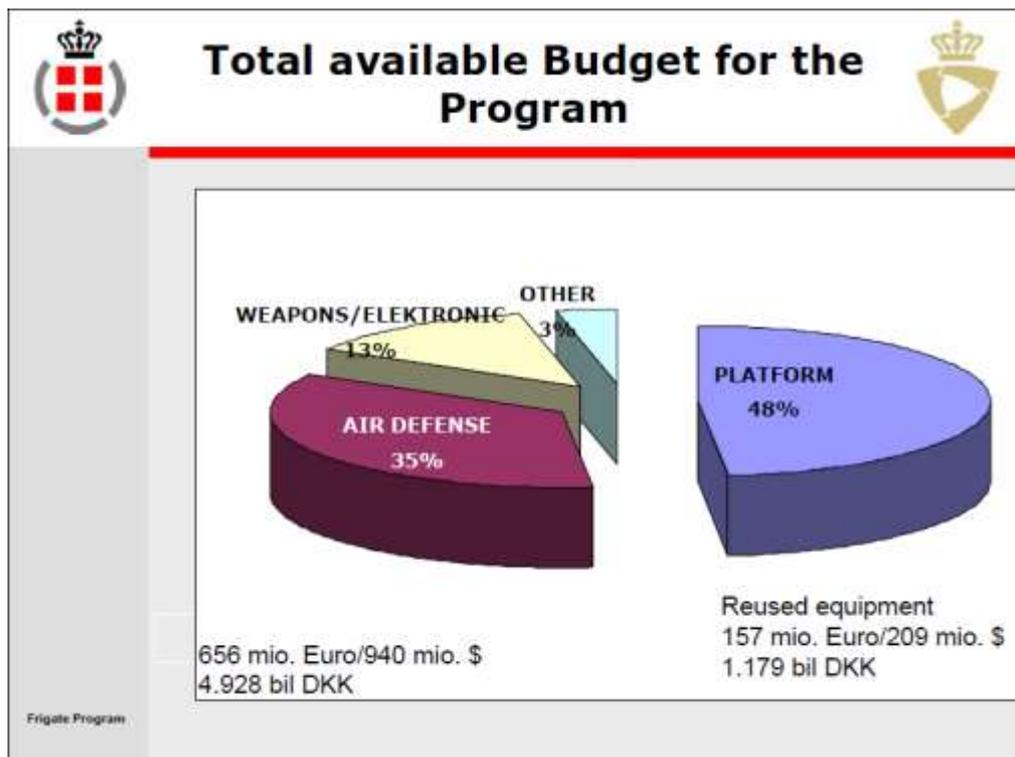


Figure 3: Extract from RDN Presentation

Costs.

Public domain information is sparse. The original budgets are recorded as DKr 435M for initial planning and DKr 4,293B for production, with some cost growth and a total of DKr 4,950B reported at a later date. Figure 3 demonstrates that these figures exclude the re-used STANFLEX containers, the DKr 1,179B being presumed to be the procurement cost if new. The total cost is equivalent to approximately £710M.

The costs for the CSS and PF are significantly less than those reported for other nations' naval shipbuilding. Doubt must exist about the scope of the costs, especially the naval personnel and facilities. But the low cost and short build time with the PFs constructed almost concurrently must indicate examination of which build standards were applied.

Brian Tanner

Independent Cost Consultant



Awareness Development in Cost Engineering

15th to 17th May 2017 - Cost £860

This short course will provide an understanding of the impact of engineering on the cost of a product. On successful completion of this short course you will gain:

- Understanding of cost engineering/estimating concepts
- Understanding of economic manufacture, value for money, and affordable product and service development
- Knowledge of different costing concepts, and how to achieve cost savings
- Ability to model cost estimates for assessing the impact of risk
- Ability to collect, organise and evaluate data for developing cost estimates

For more information please click the link below:

<https://www.cranfield.ac.uk/courses/short/manufacturing/awareness-development-in-cost-engineering>

Cost Engineering in the Oil and Gas Industry- Introduction

15th to 17th May 2017 – Cost £860

Extensive use is made of case studies and ‘hands-on’ use of state-of-the-art industry standard cost-engineering software within the recently opened COST STUDIO®. Delegates will be offered membership to ‘Cost 360’, which provides free on-going post-training support through access to resources within the COST STUDIO®.

On successful completion of this short course you will:

- Understand cost engineering/estimating concepts
- Gain knowledge of data sources and work breakdown structures
- Gain the ability to use software for cost engineering
- Be able to model cost estimates for assessing the impact of risk
- Gain the ability to collect, organise and evaluate data for developing cost estimates
- Be able to organise estimates.



For more information please click the link below:

<https://www.cranfield.ac.uk/courses/short/manufacturing/cost-engineering-in-the-oil-and-gas-industry-introduction>

Great Costing Disasters: Some Lessons from the Past

Philip G Pugh

An appreciation by Arthur Griffiths, Editor, SCAF Newsletter

Philip always called himself just a simple cost analyst but, in reality, he was immense. His books became authoritative reference documents. He could be difficult and challenging but I always found him to be enthusiastic and supporting in my endeavours to learn more about cost forecasting and analysis. He was a prolific speaker and one of the best supporters of our Society. In 1987, Philip was our guest speaker at our summer event and I recently came across a transcript he had used to describe his Great Costing Disasters. What surprised me was that here we are 30 years on and the examples he gave then are still relevant today. I am delighted to reproduce a summary here today and hope you enjoy reading the article. Should you wish to receive a free copy of the transcript then please email me at Editor@scaf.org.uk.

Mr Chairman, ladies and gentlemen; it is a considerable honour to address you at this special event and I thank you for that. My primary aim is to entertain; but, maybe, I can instruct a little also. Times have changed but the basic problems have not. The best way of demonstrating that is to launch into my first example.

HMS Sovereign of the Seas

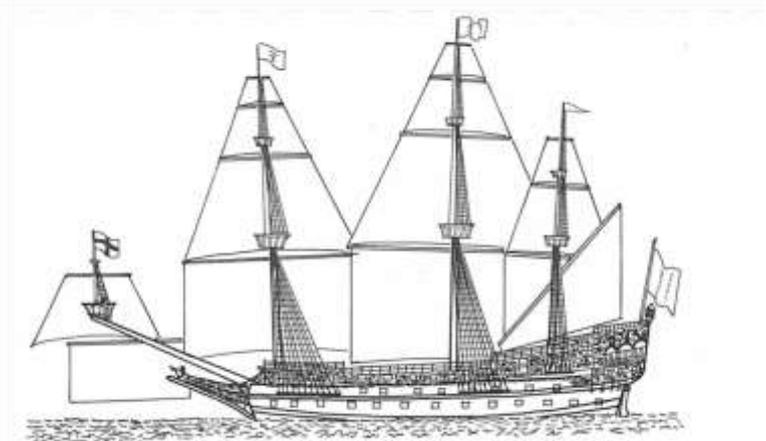
By 1635, King Charles I had a severe budgetary problem. He was avoiding the difficulties of argumentative parliaments by not having any (but these were the only legitimate method for general taxation" so Charles I was forced to "live on his own" that is to fund the whole machinery of government from his personal income.

Aside from his estates, his source of personal income included "ship money". This was a levy on the "sea shires". It was meant to defray the expenses of the warships of the Royal Navy – which were then the property of the King.

Piracy was rife in the English Channel while pirates from the Barbary Coast repeatedly attacked fishing fleets and coastal towns. They were the international terrorists of their day and they ranged far and wide. For example, in 1627 Barbary pirates attacked an island off Iceland and carried away all its inhabitants into slavery within the Islamic states North Africa. Something had to be done. The obvious remedy was to build more warships. Each would have to be bigger than the pirate vessels-who were no mean opponents. But how much superiority would be enough? Here the siren song of showy prestige seems to have been heard. Whereas the need was for frigates in considerable numbers, when the decision was made in 1634 it came down in favour of spending the bulk of the budget on a single warship – the largest the world had ever seen.

The going rate for a 40-gun Frigate was then about £6,000. The new warship was 102-guns and by simple proportion would be £15,000. In practice things turned out differently.

Not only did the construction costs increase but the King decided to "gold-plate" the vessel – literally as well as figuratively. Her elaborately carved and gilded work cost more than many a complete frigate.



Sovereign of the Seas : 1637 AD

Length (keel) 127 ft,
Beam 48 ft,
Draught 23ft. 6 in.
1605 tons

The grand total came to £65,586 16s 9½ d. The halfpenny at the end typifies the vital distinction between precise book-keeping on the one hand and prudent financial management on the other. There were far ranging consequences of this prestige project which exceeded its original estimate by 379%.

I think that we should all feel profoundly grateful that there are rarely so drastic consequences of accepting optimistic cost estimates and tolerating gold-plating. As to the ship itself its role was undistinguished. It was immensely powerful but it was alone. Even the largest ship could not be in two places at once and so could contribute little to the suppression of numerous small pirate vessels. Nor did it help that so much money had been spent on construction and fitting of one warship. Soon, there was nothing left for running costs of the Royal Navy.

HMS Warspite

My next example was not really disastrous in terms of cost over-run but it could easily have been and it so well characterises a common problem that it justifies inclusion.

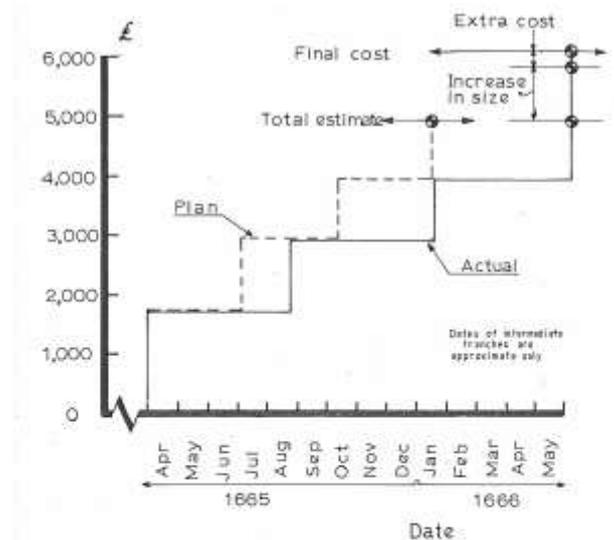
At the end of 1664, the Royal Dockyards were overloaded with work. As a result, a contract was placed on 1st April 1665 with Henry Johnson and Francis Barham for the construction of the hull of a 60-gun ship-of-the-line at their yard on the Thames. The ship was to be about 700 tons burden and constructional features were set out in detail in the contract which ran to some 3,500 words with a precision of wording and absence of repetition that might well serve as a model for its modern equivalents.

The cost was agreed at £7 per ton and its payment linked to progress milestones. In modern parlance, these prices were firm and fixed. The Navy Board might justifiably feel that they had sewn this job up nice and tight. However, this was the 17th century and methods of shipwrigthry did not permit a very precise prediction of a vessel's tonnage. One started by laying down what should have been about the right length of keel and worked on from that. Only when you finished did you know exactly how big the ship was.

Then a familiar problem intervened. The OR branch re-evaluated the threat and changed their requirements. King Charles II asked for an increase in beam (effectively cancelling that clause in the contract). The contractor is not concerned as he will be paid £7 per ton whatever the size.

In attempting to reduce the costs the Navy Board dispatched Commissioners to conduct a technical and cost audit. Their report disallowed some items but conceded to others and agreed that as to the size of the ship, there was nothing they could do. The £7 per ton was sacrosanct.

It was latter noted that, in truth, the Navy Board got off lightly but minuted in 1690 that "merchants never want acts and pretensions to heighten their prices" and went on to warn against the unwisdom of giving them a chance by any deviation from the usual contracting procedures.



HMS 'Warspite': Expenditure profile

London & Birmingham Railway

I turn now to a much later time and a very different type of project. The London and Birmingham railway was one of the earliest trunk railways in the world. It was the first to compete directly with successful and established modes of transport for large volumes of traffic.

The stakes were considerable. In this age of motorway and juggernaut lorry it is easy to forget just how much traffic moved about Britain even before the railway. Between London and Birmingham large fleets of narrow boats moved heavy cargoes along the Grand Junction Canal, 26 fly-boats carrying perishable goods passed through in each direction every day while 16 stage-coaches each way daily added to the waggons on Watling Street. Much greater still was the traffic on shorter journeys including more than 1,100 head of cattle driven daily on the hoof to London. Add to this established traffic the multiplication of passengers to be expected from a 3-fold or 5-fold increase in speed and glittering prospects unfolded for profit.

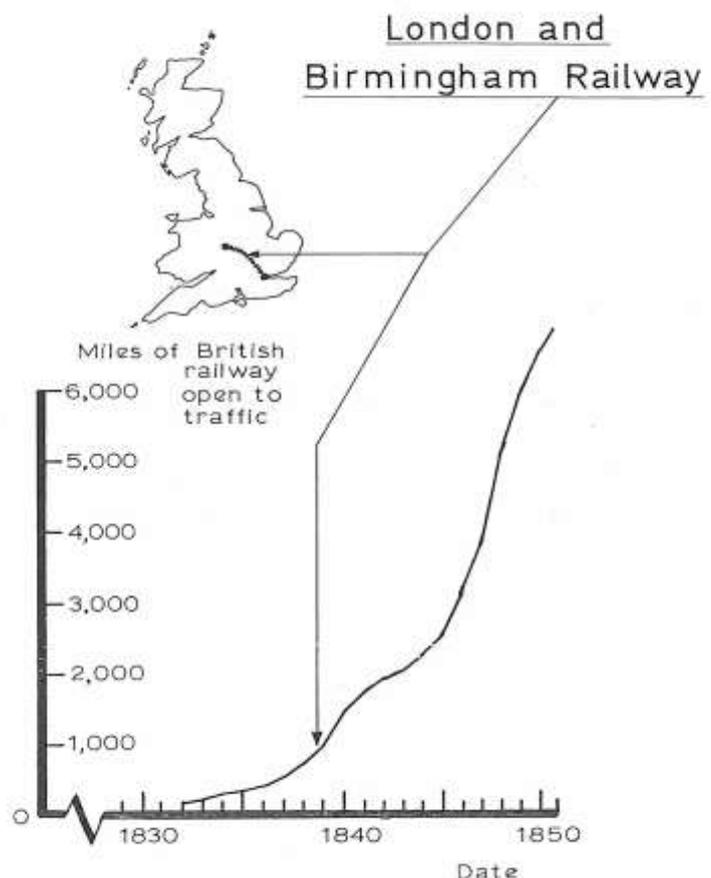
Naturally, these established transport interests opposed the proposal for a railway. They rallied to their side landowning MPs who feared the effects of cheap travel upon the semi-feudal sway which exercised over their estates whose workers had no easy access to alternative employment in the towns.

The requisite Bill passed the House of Commons on 1st June 1832; but was thrown out by the Lords on 8th July. Railway's projectors succeeded at their second attempt and the Bill then passed into law.

They ascribed their success to "timely explanations and judicious management"; but those seem to have consisted of offering blank cheques to the affected landowners. By the time a total of £750,000 had been paid for land with a market value of £250,000 – money proved to be an effective salve for previous concern that money would "destroy the noblesee".

On 20th September 1833 the directors of the London and Birmingham Railway confirmed the appointment of their adviser Robert Stephenson to be the railway's engineer. He estimated the cost of constructing the railway as £2,400,456. This worked out at £21,736 per mile which compared reasonably with the £18,846 per mile actual cost of the only precedent – the Grand Junction Railway for which the civil engineering works were much lighter.

The undertaking was enormous. Work went on concurrently throughout the 110 mile length of the line with a labour force which rose to 20,000 men and never fell back to less than 12,000 until the railway was complete. Herein lay the problem. There was no contractor capable of taking on a job of this size or even a substantial part of it. Instead, the work had to be split into numerous small contracts. The line was divided into sections averaging 6 miles in length for each of which separate contracts were placed.



In addition, major civil engineering works (viaducts, tunnels, etc.) were each the subject of further, quite separate contracts making 29 contractors in all. Even so, the resources required were beyond the means of most contractors. In turn, they had to further divide their sections between numerous sub-contractors and, so, they were forced to undertake administrative, contracts negotiation and supervisory tasks that were quite novel to them.

To manage this spider's-web of contracts, sub-contracts and, even, sub-sub-contracts Stephenson had a staff of only four Assistant Engineers each with three Sub-Assistants plus around 10 draughtsmen installed in the withdrawing room of the Eyre Arms Hotel at Swiss Cottage. The explosive growth of railway building had far outstripped the supply of trained engineering talent. These 26 men were all the headquarters staff to be had.

It is small wonder that very soon after work began in November 1833 the whole enterprise dissolved into a continuous nightmare of crisis management. Moreover, it got worse as time went on. Sub-contractors failed and dragged down contractors into financial trouble until more and more of the work had to be taken under the direct control of the railway company – to be directed by Stephenson and his tiny staff on top of all their other duties.

By the time of its opening on 17th September 1838, the total cost had risen to £5,500,000 or £50,000 per mile i.e. a 130% cost over-run.

Yet this story has a happy ending. Despite the cost over-runs the railway was a financial success and the reason that the project recovered from so bad a start deserve consideration.

What saved it was the speed of its completion. No part of the project was individually of excessive technical risk. Problems arose in plenty but none lacked an immediate design solution. So there was always progress – more hard won than expected – but always sufficient to maintain the confidence of investors in eventual success. And, vast though the overspend grew to be there was no time for interest on borrowings to accumulate into a crippling debt mountain. Thereafter, deficits were washed away by a flood of traffic revenue which justified even the most sanguine of the promoters.

One must also observe that the speed of completion owed much to the demonic energy of Robert Stephenson and his staff. Stephenson himself walked the entire 110 mile length 15 times over – quite apart from his almost incessant journeys on horseback or by coach. As for the drawing office, how they worked! Over one 18 month period they produced 30 drawings every week – an average of two man-days per drawing including its two hand-drawn copies and all the schedules and calculations that went with them. Something to think about in our age of vaunted computer-aided design perhaps? Certainly, a testimony to the importance of having the right people in the right place at the right time.

Philip's transcript included further examples on the SS Great Eastern and USS Alaska programmes that identify other reasoning and causes of costing disasters. Each are summarised below:

SS Great Eastern

Of all the examples I am describing, the tale of Brunel's great ship has the most urgent message for our times. It is often admired before sadly concluding that it was "too far ahead of its time". Such a non-explanation serves only to obscure the truth that this project was doomed from the moment of its conception. It was born from the malformed progeny of over-simplified theory out of disdain for practicalities and absence of commercial realism. It was sustained beyond its natural term by an obsession with technological challenge until, like Frankenstein's monster, it became the ruin of its projectors and the death of its engineer.

Indifferent to detail, Brunel seized upon the idea that, everything else being equal, he could scale everything up (size, fuel consumption, carrying capacity, bunkering, steam, etc.) in size. This analysis had already underpinned the scaling up from his successful "Great Western" to his technically brilliant and commercially disastrous "Great Britain".

Why was the project not quietly dropped once these fatal flaws had been identified? The main reason was the too much had already been spent. Large funds had already been raised and the project launched with much publicity.

Brunel originally estimated the cost as £500,000 and in 1854 work started on behalf of the Eastern Steam Navigation Company. Various problems ensued with construction and design causing large cost growth in the project. The extent of the cost growth destroyed the Eastern Navigation Company who then sold the hull for the knock-down price of £165,000 and wound itself up on 17th December 1858.

The “Great Ship Company” took over, completed the build and set out on trials on 9th September 1859. On her third voyage, a storm stripped off her paddle wheels and the following summer she grounded at the entrance to Long Island Sound. More money for repairs was required and two later accidents occurred. That finished the company and, after one more voyage to New York the ship was sold for a mere £25,000.

As a postscript to this sorry tale, it is worth remarking that had Brunel simply scaled up the actual cost of “Great Britain” in proportion to gross tonnage his estimate would he been less than 1% too high. Alternatively, he might have held to his original estimate for the “Great Eastern” and then added to that the same (percentage) contingency as was needed to reconcile out-turn and estimate for the “Great Britain”. That way he would have been only 4% low. There can be few better examples both of the predictive power of simple ‘top-down’ cost-estimating.

USS Alaska

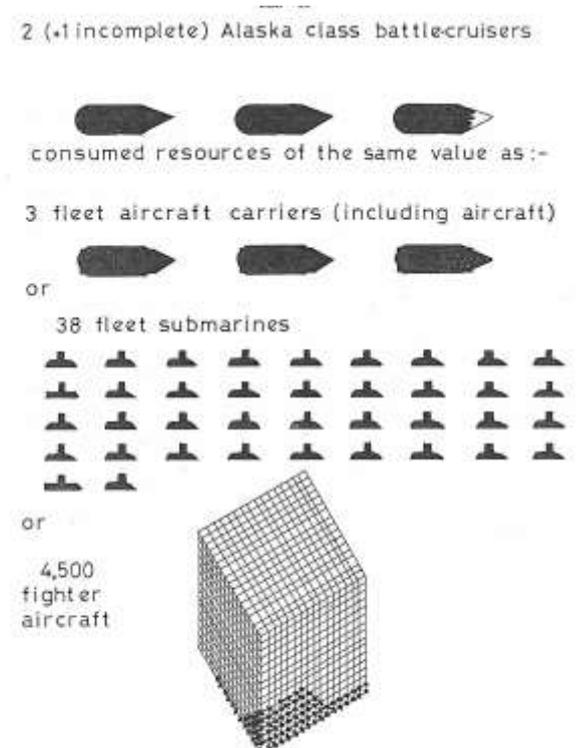
My final example also concerns a large ship. In this instance, it is a 20th Century ship but, again, illustrates how vast projects can be begun upon slender uncritically-considered evidence of need, and, how, once begun they acquire life and momentum of their own.

Between the two world wars, competition in naval armaments was restrained by a series of treaties. The last of these was concluded at the second London conference of 1935-36. That limited the guns of new battleships to a maximum calibre of 14 inches. However, in an atmosphere of growing international tension, Japan refused to ratify this treaty. This triggered Japanese, USA and UK programmes of battleship construction.

As United States Navy planners expanded their pre-war construction programmes, their minds began to be haunted by a dreadful thought. This spectre grew, feeding upon the fears that it inspired, until it became to seem terribly real. Eventually, and with President Roosevelt’s encouragement, the keel was laid for the first of six “Alaska” Class battlecruisers on 17th December 1941.

Scarcely had work started when the actions of the war with Japan began to shed doubt on the reality of the supposed threat. By June 1943 it was evident that the threat was purely chimerical. Three “Alaska” ships were cancelled before being laid down and only two (Alaska and Guam) were completed. They served during 1945 as escorts to USN fast-carrier task forces and were in reserve from 1947 onwards until they were scrapped in 1960 and 1961.

Including the one partly completed ship, about \$210m were expended to meet a non-existent threat conjured up from no evidence by collective fright. These funds would have built and equipped: **3** x Essex Class fleet aircraft carriers (to form another of the task groups ranging in triumph across the Pacific) or, **38** x Fleet submarines to choke off Japanese



supply lines or, 4,500 x fighter aircraft.

So if someone insists on the very highest of high technology because “The threat is sure to have it” then it is time to recall the “Alaska” story and to demand hard evidence. After all there can be few ways of damaging a nation’s defence more than by diverting scarce resources to match a non-existent (or exaggerated) threat.

Lessons Learned

What lessons can we derive from these examples drawn from the past 350 years? Do we simply shake our heads over the follies of our forefathers and continue secure in the comforts of our computerised information systems with consultants ever anxious to lend their aid?

I think not. There is a feature common to all the examples and quite independent of age or context from which they came. It is that the seeds of disaster were sown long before work ever began. The fault lays not in the execution – to which our modern aid apply. Rather, they were doomed in their very conception – where we are no better aided than our predecessors. Modern techniques do but make explicit and quantify such factors as we have identified to them. Against overlooking some basic misapprehension we are armed only with such native intelligence, objectivity and healthy scepticism as we can muster for ourselves.

It appears to me that we are prone to emphasise skill, energy and determination in the execution of a project and to neglect the need for caution and probing criticism of both means and ends before ever starting.

We do not have to be right on all points all the time. As shown in the account of the London Birmingham Railway, one major weakness need not be fatal if the rest of the project is sound. Nevertheless, this task of probing and testing before work starts may well be the most essential and yet most difficult role of all – especially in this era when belief in the power of technology is an article of faith and rational doubt is so readily dismissed as luddite.

Therefore I commend the examples from the past. If it is urged that “the specification is not ambitious enough” then remember “Sovereign of the Seas” and the fate of her sponsor. “Warspite” reminds us that specification changes are invariably expensive no matter how high the authority for them. When urging of some alleged imperative need becomes very generalised and yet strident, the memory of “USS Alaska” may give pause.

Finally, “Great Eastern” has many lessons. Perhaps the most pertinent may be that the greater the assurance with which someone handles high technology the less likely they are to recognise when it’s limits have been over-stepped.

I am sure that there are many of our readers who, like me, could name several of our current/planned projects where scrutiny and options have been overruled by political and vanity observation and pressure.

Arthur Griffiths

SCAF Newsletter Editor

*Based on a presentation transcript by Philip G Pugh

Report on SCAF Workshop

Theme: SCAF 2017 Cost Estimating Challenge & Training Workshop

April 2016

The BAWA Centre, Bristol

Once again we were delighted to receive several nominations from organisations wishing to participate at this year's event. The aim of this workshop was to provide an interactive training session in cost estimating through the presentation of case studies that had been conducted by young professional teams from academia, industry and consultants with the added benefit of top-level critique by senior figures in the profession. This year we had seven teams participating.

Background to the Challenge

All new upmarket luxury cars, regardless of the brand, have technical features to attract their potential customers. Such

technical features (remote temperature control, automatic route memory etc.) are unique for one brand and not available on others. A company specialising in software development is planning to develop a third-party application that will interface with the main technical features (potentially the top five), enabling them to be easily accessed/controlled using a single device. The app will need to work on all major brands of automotive platform. The autonomous driving market will be a key focus for this company in next five to ten years; provision should be made in the development phase to enable the company to tap into this market.

The Challenge (Problem)

The challenge was to gather cost and size data, and then generate the cost for development of a third-party application to be used on OS, Android and Windows platforms for major automotive platforms in UK.

The Solution

Each team was expected to present its solution including;

- The sources of data,
- approaches to data gathering,
- identify any ground rules or assumptions made,
- normalisation techniques,
- analysis of the size and capability of the Apps,
- consider the cost drivers for an automobile App,
- establish if a cost estimating relationship can be determined for automobile Apps.

The objective was not so much to prepare accurate and realistic estimates, but to describe the approach to this task and how the task had been conducted. The teams may use and display public domain models or even invent some models for the purpose of the exercise. There was no pass or fail and certainly no "right answer."

It is SCAF's objective to keep the estimating spirit alive and to present a good cross-section demonstration of how world-class estimators approach the issue of analysing data and producing risk adjusted analysis.

Each team were allocated a 25 minute presentation time (including brief clarifications questions). A response from the review panel and a plenary discussion followed after the afternoon break.

It was good to see similar but different approaches to the problem and this, in itself, was educational for all the 60+ attendees. For the Society it showed that the workshop had fully achieved its aims and objectives by providing a training session in cost estimating conducted by graduate professional estimating teams and retained the enthusiasm with a programme that was instructive, entertaining and enjoyed by all including the experienced costing practitioners, finance managers and project staff in addition to all the presenters. Our thanks to all the teams and their organisations for their support to this excellent lessons learned workshop.

Our participating teams were:



Team Atkins: *William Badham, Husman Mahmood, Lee Shinkin*

Team Babcock: *Adam Read, Jack Revers Harris, Ashely Haycock*

Team BAES: *Emma Lister, Conor Wilkin, David Pearson, Phil Yates*

Team CAAS: *Mathew Bosworth, Timothy Hodgkinson, Haroon Majid, Mathinyan Nithiyanthan, Moundir Selougha, Carl Zalek*

Team Cranfield: *Duarte Rodrigues* **Team FFI:** *Brage Lien, Brynjar Arnfinnsson, Emil Graarud*

Team Thales: *Adrian Wedesch, Joseph Mosley, Amy Clark, Laura Brooker*



And a big thank you to our expert panel from L to R

Alan R Jones, Owner, Estimata Ltd

Arthur Griffiths, SCAF Newsletter Editor

Steve Webb, Owner, SW (Software) Estimation Ltd

The comments and reviews say it all – Make sure you attend in 2018

SCAF Management Committee Meetings 2017

Date	Venue	Focus
10 Jan 2017	QinetiQ, Bristol	Finalise SCAF 2017 Challenge
07 Mar 2017	QinetiQ, Bristol	Discuss Awards Dinner Nominations and annual SCAF Budget
16 May 2017	ATKINS, Aldershot	Annual Conference, final details for Awards Dinner, Committee nominations, subscription budget
11 Jul 2017	QinetiQ, Bristol	Final details Annual Conference & AGM information
03 Oct 2017	ATKINS, Aldershot	2018 Annual Programme and November workshop
07 Nov 2017	QinetiQ, Bristol	Ideas for SCAF Challenge and February workshop
05 Dec 2017	ATKINS, Aldershot	Finalise 2018 events programme and interim 2019 programme

The committee would welcome any suggestions on particular topics that can be developed for debating at future workshops or for round table/panel discussion. We would also welcome any comments on changes or otherwise you might like to see to the workshop structure and content.

Please forward your comments to editor@scaf.org.uk where they can be put on the agenda for committee discussion and action.

Please also remember that the committee works for the members and will do their utmost to address any issues raised to the benefit of the Society.

SCAF Corporate Membership

Are you a company that sends 5 or more staff to any of our workshops? There are discounts available for block bookings with further flexibility offered for Corporate Membership. Further details can be obtained from the SCAF Secretary, Neil Morrill email: ndmorrill@dstl.gov.uk or call 01980 955548

Other Related Events

SCAF is not responsible for the content of any external websites published in this Newsletter

27th Apr 2017	APM Project Management Conference, Barbican Centre, London: please see www.apm.org.uk for further details.
27th Apr 2017	PALISADE Risk Conference, Thistle Holborn, London: please see www.palisade.com for further details.
1-2nd May 2017	3 rd Annual ICEAA Canada Conference, The Westin, Ottawa, Ontario Canada: please see www.iceaa.ca for further details.
4th May 2017	ACostE North East Region Breakfast Seminar – “An insight into supply chain opportunities” – The Heart, Redcar, North Yorkshire: please see www.acoste.org.uk for further details.
18th May 2017	ACostE South West Region Seminar – “Why invest in data collection, collation & management” – Aztec West, Bristol: please see www.acoste.org.uk for further details.
6-9th Jun 2017	ICEAA 2017 Professional Development & Training Workshop, Portland Marriott, Downtown Waterfront, Portland, Oregon, USA: please see www.iceaaonline.com for further details.
18-21st Jul 2017	34 th International Symposium on Military Operational Research, Royal Holloway, University of London, Egham, Surrey: please see www.ismor.com for further details.
20th Nov 2017	APM Project Management Awards, Old Billingsgate, London: please see www.apm.org.uk for further details.

Networking for the Cost Forecasting and Analysis Community



Society for Cost Analysis and Forecasting

www.scaf.org.uk


**Bridging relationships in
cost estimating**

For over 20 years the Society has sought to illuminate key issues in the analysis and forecasting of project costs—and to promote best practice within the cost forecasting community.

The Society provides a single point of contact for advice to those wishing to address key issues in the analysis and forecasting of costs and timescales of complex programmes.

Workshops and seminars are held at regular intervals throughout the year. A newsletter is published electronically 4 times a year.

Collaborative links with other societies has always been maintained and a library of relevant papers are available. A single annual payment at the Annual Conference entitles members to attend all the years' programme of SCAF events at no further cost. The Summer Reception is also provided free to SCAF members and their guests.

SCAF is committed to providing Continuing Professional Development (CPD) through the provision of its skills workshops and its support to Professional Development courses.

The Society is self-funded and a Not-for-Profit organisation that continues to provide its members with exceptional value for money.

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