



# PARAMETRIC WORLD

Summer 2012 Vol. 31 No. 2

A Periodical of The International Society of Parametric Analysts

## 2012 ISPA/SCEA International Conference

Brussels, Belgium

### KEYNOTE SPEAKERS



**Dominique Arnal**  
Airbus  
*Keynote Speaker*



**Neil Albert**  
MCR  
*Keynote Speaker*



**Paolo Nespoli**  
ESA Astronaut  
*Banquet Speaker*

### SOCIETY HONOREES



**Arlene Minkiewicz**  
receives Freiman  
Award from Jason  
Dechoretz



**Jason Dechoretz**  
receives Service Award

*Photos by Hank Appar*

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# PARAMETRIC WORLD

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## LETTER FROM YOUR EDITOR

### IN THIS ISSUE



In the weeks since the conference, events have gone quickly. Actions that could permit the merger of ISPA and SCEA into a single society are underway. Ballots have been distributed and explanatory

documentation is available. This issue of *Parametric World* features a report from our Chairman explaining where we are in the merger process. The ISPA and SCEA boards have formulated a proposal to be voted on by the members of both societies. If it is approved, the merger will occur.

In this issue we also recapitulate our International Conference just concluded in Brussels. We have tried to capture not only the content of the event, but also its spirit, as typified by the Banquet at the Comedy Museum. We are indebted to Rene Berghuijs for the excellent collection of photos.

On a sad note we note the passing of Mike Masters. We have included a remembrance of Mike drawing on material provided by Carol, Mike's wife.

Finally, let me add my voice to those emphasizing the importance of this merger vote. When we formed ISPA we adopted bylaws that require two-thirds approval for any merger. In the election information package there is an Agreement of Merger and ten Exhibits that provide specifics on the mechanics of the merger.

*Charles Hopkins*

Editor, *Parametric World*  
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## Superieur!

By ANDY PRINCE



**O**utstanding! That is how I would describe this year's international conference in Brussels. Let me begin by thanking all of the hardworking people who made this year's International Conference such a great success. The

conference committee of Jason Dechoretz (Chair), Rene Berghuijs, Natalie Faucher, Sherry Stukes, Roy Smoker, Hank Apgar, Jairus Hihn, and Herve Joumier worked extremely hard to put together an outstanding event. Philip Griffin of RoomTrust did a great job in handling all the complex logistics that go into an event like this. While we may have been down in numbers from our last European Conference, the quality of presentations, speakers, and activities was second to none.

The Annual Conference means elections; this in turn means new board members, officers, etc. However, this year, the only new board member is Hank Apgar, who replaces George Stratton who could not run again due to term limits. George has been a great board member who served as our lead for governance and long range planning. We will miss his wisdom and experience. Fortunately for us he has agreed to continue to serve the society as our lead for governance and long range planning.

Our officers remain the same (Greg Kiviat as Vice-Chair, Bruce Minett as Treasurer, Lisa Yedo as Secretary, Rich Harwin as Executive Manager). Committee assignments include:

- **Membership:** Steve Sterk
- **Professional Development:** Doug Druley
- **Website:** Brian Glauser
- **Parametric World:** Madeline Ellis
- **Governance & Long Range Planning:** George Stratton
- **Elections:** Greg Kiviat
- **History/Legacy:** Hank Apgar

We are now to the point in our merger with SCEA where we are ready for you, the members, to vote.

To keep you better informed we are preparing a set of Frequently Asked Questions (FAQs) to address specific merger topics. These will be posted on the ISPA website soon. If you have a question that you don't see addressed please send it to me, Greg Kiviat, or Jason Dechoretz and we will get you (and the rest of the membership) an answer as soon as possible.

Last but not least, a bit of good news from our lawyer. I am pleased to announce that ISPA has been officially re-chartered in the District of Columbia. When we began the merger process, our lawyer (Craig Max) discovered that our charter had been allowed to lapse many years ago. Obviously, this was disturbing information and the ISPA board immediately authorized Craig to re-establish the ISPA charter. Regaining our charter required working with the DC bureaucracy, filing paperwork, and paying back fees. I am glad we have completed this process, which is an important milestone on the path to a successful merger.

*Andy Prince*

ISPA CHAIRMAN OF THE BOARD

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### Into the Home Stretch

BY ANDY PRINCE, ISPA CHAIR

I am pleased to announce that ISPA and SCEA have agreed unanimously to all the merger details and the Board is ready for you, the ISPA member, to express your wishes through the balloting process.

By the time you get this you will have received the merger package and official ballot (if you have not received your ballot, please contact the Joint Office immediately and they will send it to you). All of the details of the merger have been posted on the ISPA Website. If you do not have a web access, or wish to have your own copy of the merger materials, contact the Joint Office and they will provide them to you either electronically or in hard copy.

I want everyone to make an informed decision so please review this material. We have put together a set of Frequently Asked Questions (FAQs) to try and provide the merger details in 'plain English.' If there is something you do not understand or have questions about that we have not addressed, please contact me or one of the other board members. After you have reviewed the material, please vote (I know I say 'please' a lot. I'm from the South, it's just the way I was raised).

Your vote will determine the future of the International Cost Estimating & Analysis Association (ICEAA). The ISPA Board unanimously agreed that ICEAA is the best organization to carry forward and advocate for the profession of parametric cost estimating and analysis. By uniting organizationally and with a single purpose, ISPA and SCEA will create a strong association that can better serve the needs of our members around the world. This is a rare opportunity to influence the future. Please take the time to review the merger material, carefully consider your decision, and send in your ballot. The Board encourages you to vote 'Yes' for the merger.

#### Now About that Name...

In the Winter 2012 *Parametric World*, I spent a significant amount of ink talking about our then-proposed new name (the International Association for Cost Analysts). Turns out my comments were premature. While your ISPA Board of Directors accepted the new name, the SCEA Board had concerns, specifically with the lack of any mention of cost estimating. After much discussion between the leaders of our respective societies and within the Integration Committee, we all decided the best way to move the process forward was to select a different name. The name we selected is the International Cost Estimating and Analysis Association (ICEAA).

Getting to a name that both Boards could approve turned out to be a much longer and much more difficult process than any of us could imagine. Names are important, names become our identity. Reaching an agreement on the name required both Boards to focus on what is best for the membership.

ICEAA incorporates and represents the best of both ISPA and SCEA. Per the new constitution, ICEAA will advocate for and represent the interest of cost estimators and analysts who use parametric and other data driven methods. Through this merger, we have a rare opportunity to forge a professional community that can take all the disciplines associated with cost estimating and analysis to the next level through advocacy, professional development, certification, and community engagement. The name may feel a little awkward at first, but I am confident that we will all come to recognize that value behind that name as we move forward together.



## Workshop Program

BY SHERRY STUKES, TECHNICAL WORKSHOP PROGRAM CHAIR

The 2012 Joint Annual Conference and Training Workshop Technical Workshop Program was truly an international event and a phenomenal success! The technical workshop program included 56 outstanding presentations from eight countries including:

- Belgium
- France
- Germany
- The Netherlands
- Switzerland
- United Kingdom
- United States
- South Korea

These presentations were selected from almost 100 abstracts initially submitted for consideration. The selection process was very challenging due to the high quality of the abstracts. The 56 presentations were organized into the following four tracks and were presented over the three-day conference:

- Management and Decision Making
- Models and Methods
- Risk Analysis
- Software and Technology

The remaining abstracts not selected for presentation were placed on a prioritized wait list and were given presentation slots as they became available. Authors on the wait list were able to submit papers and presentations on an e-track that allowed them to be eligible for a Best Paper award while they awaited a presentation slot.



*Philip Griffin at the Comic Museum* (Photo by Hank Apgar)

This workshop program ran smoothly. Every presentation scheduled was presented as shown in the schedule. There were no replaced presentations or empty slots in the program! Copies of the papers, presentations, speaker biographies, and abstracts, were provided to all attendees on a CD.



*Esther Faber (DACE) and Philip Griffin Performing Registration* (Photo by Sherry Stukes)

Many people made this workshop program come together. Of particular note, I would like to recognize and thank the people mentioned in the following paragraphs.

For those of you who attended the conference, you may have seen this "mystery man" working non-stop at the conference. He also worked behind the scenes preparing for the conference. He is Philip Griffin, our conference coordinator, from RoomTrust, an international conference support contractor located in Brussels.

Philip began working with us six months prior to the conference and was responsible for configuring our conference web site including the workshop papers area. Philip assisted us by creating the conference master CD and creating the printed conference proceedings. In addition, Philip managed the registration process for the conference and responded to countless questions and inquiries. The day after our conference ended, Philip headed to Dubai for his next conference assignment.

The Dutch Association of Cost Engineers (DACE) was a significant partner organization for this conference. Julius Freutel, DACE Director, organized an outstanding set of presentations and presenters on a wide range of topics that fit perfectly within the conference tracks. DACE also provided Esther Faber, DACE Secretariat, to assist Philip Griffin with on-site registration.

Finally, I could not have coordinated all of these

*Continued on page 14.*

## Best Paper Awards at 2012 Conference

By SHERRY STUKES, TECHNICAL WORKSHOP PROGRAM CHAIR (PHOTOS BY HANK APGAR)

The highlight of the Technical Workshop Program is the selection of the best paper for each track and best overall conference paper.

All conference workshop papers and presentations were reviewed by a six-member paper awards committee headed by Dr. Jairus Hihn to determine a best paper in each track as well as a best overall conference paper. Each paper was evaluated against four criteria, including:

- Technical content
- Professional application
- Creativity
- Overall quality or style

The paper awards committee reviewers included:

- Jairus Hihn, Chair
- Doug Howarth
- Christian Smart
- Hank Apgar
- Karen Lum
- Sherry Stukes

The committee members were organized into teams of two for each track who evaluated every paper and presentation submitted for their designated tracks before the conference. The members applied a grading scale of 1 - 5 to the weighted criteria categories identified above. After this process was complete and the scores tabulated, the best papers for each track were identified. Then, a team of three members evaluated the track best paper winners to determine a best overall conference paper.

The 2012 conference winners announced at the awards banquet held at the Comic Museum in Brussels are:

Workshop Track	Paper Title	Author
Best of Conference	Influential Data Points in Regression Analysis	Don MacKenzie
Management and Decision Making	Use of EVM Trends to Find WBS Level 3 Completion Dates	Dr. Roy Smoker
Models and Methods	Influential Data Points in Regression Analysis	Don MacKenzie
Risk Analysis	Joining Effort and Duration in a Probabilistic Method for Predicting Software Cost and Schedule	Mike Ross
Software and Technology	Are Parametric Techniques Relevant for Agile Development?	Arlene Minkiewicz



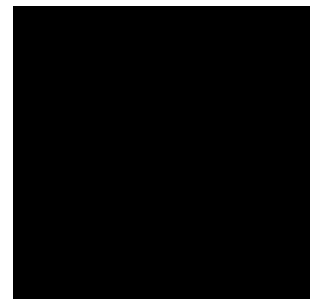
*Don MacKenzie,  
Best Conference  
Paper Winner*



*Roy Smoker, Best Paper,  
Management and  
Decision Making Track*



*Arlene Minkiewicz,  
Best Paper, Software  
and Technology*



*Dr. Jairus Hihn,  
Papers Awards Chair*

**Note:** Mike Ross, Best Paper, Risk Analysis Track, was not able to attend the conference to receive his award.

## ISPA Annual Professional Awards

By JOE HAMAKER, AWARDS CHAIR

As in the past, a highlight of the 2012 Conference in Brussels was the Conference banquet and the presentation of the annual Society Awards. I chaired the Awards Committee this year and while ISPA does not necessarily award all three of our awards each year, this year the Committee selected three strong awardees from those nominated. The ISPA Board of Directors agreed. The awards this year were:



Arlene Minkiewicz

**Arlene Minkiewicz:** The Frank Freiman Award which is ISPA's highest honor to an individual who has made outstanding contributions to the theoretical or applied aspects of parametric modeling or cost estimating, promotion of parametrics, or applications of parametrics

over a significant amount of time. Some of Arlene's accomplishments mentioned in her nominations were research on cost trends; working with industry leaders across the globe; her contributions to moving cost estimating to cloud computing service orientation; her work in Software security and a US Patent for the Parametric Software Forecasting System and Method; and co-authorship of a number of books on topics of interest to parametric cost analysis. Arlene says of her award: *"What a great honor it was to receive the Freiman Award in Brussels! My involvement with ISPA stretches over many years and I have personally witnessed some great leaders in our profession receive this award. I am both proud and humbled to be included in their ranks."*



Peter Frederic

**Peter Frederic:** The Clyde Perry Parametrician of the Year Award is presented to an individual or group who has made outstanding contributions to the profession of parametric cost analysis. Mr. Frederic was nominated for a body of cost analysis work over

the years, some of most recent on NASA's James Webb Space Telescope for which he provided the independent cost estimate; developed a new approach for translating part counts from the Master Equipment List (MEL); and developed technical briefings on complex inputs for cost models. Peter says of the award: *"I am genuinely honored to receive the Parametrician of the Year award. I would like to thank Ron Larson, NASA IPAO management, and Tecolote Research management for giving me the opportunity to work on challenging, high-visibility projects such as the James Webb Space Telescope benchmark cost estimate. Also, I deeply appreciate the support shown by the cost estimating community."*



Jason Dechoretz

**Jason Dechoretz:** The Keith Burbridge Service Award is presented to a Society Member or participating group who has provided substantial volunteer service to ISPA in a manner supporting the principles and goals of the Society. Jason has long been an ISPA Board

Member, Deputy Chair during 2005-2006, and Chair during 2007-2011, during which time he managed the proposed merger with SCEA. Among many other contributions called out in his nominations was his chairing the 2012 International Conference in Brussels.

Please congratulate these three individuals the next time you see them. And as a final note, if the ISPA/SCEA merger goes forward, 2012 will have marked the final time that these awards will be bestowed by the heritage ISPA society. This is another special reason to applaud this year's honorees.



# ISPA/SCEA 2012 International Conference Guest Program

ARTICLE AND PHOTOS BY KURT BRUNNER

Sometimes it's a struggle to initiate a plan, and then at the last moment everything comes together, the pieces all fall into place, and the project goes off without a hitch. Such was the case with the ISPA/SCEA 2012 International Conference in Belgium's Guest Program.

Monday and Wednesday (14 and 16 May), guests were at leisure, and many opted to tour the city of Brussels on foot or atop sightseeing double-decker busses. Cosmopolitan Brussels, where the de facto capitol of the European Union is located (and where the French portion of the country is centered), holds many attractions for the visitor: Shopping; Sensational buildings and monuments; Fountains; Wonderful cuisine; The Grand Palace; Museums; the European Quarter; and The Manneken Pis sculpture that dates to 1619 and his outfits; to name but a few.

On board our minibus as it departed the Sheraton Hotel on Tuesday, 15 May, were our eleven intrepid guests, plus our tour guide, Maryke, and driver, Max. As we reached the outskirts of Brussels the heavens opened up and heavy rain began pelting and pounding the vehicle. Fingers of lightning reached across the sky and thunder boomed. The drone of the thunder was replaced by huge balls of hail hammering the van, while a swirl of white carpeted the road and surrounding fields. After an hour and a half as we just reached Brugge (or, in English, Bruges) the sky



*The intrepid travelers*



*A Street In Bruges*

cleared and blue was peeking through the clouds. The minibus was parked and we crossed over a beautiful river into the medieval city for our tour. All around were fairytale houses, ancient cathedrals, spires, cobblestone lanes, and canals.

Bruges is the capital and largest city of the Provinces of Belgium West Flanders in the Flemish Region of Belgium, located in the northwest part of the country. It is often referred to as 'Venice of the North' and it dates back to the 12th century as a wealthy center of commerce.

We strolled through the streets, entered historical churches, viewed magnificent art, and generally absorbed the alluring atmosphere. A generous lunch (mussels and pommes frites for some) was enjoyed over (for those that wished it) rich dark beer; then our tour resumed. While the sun smiled down from overhead, we were treated to a boat ride that glided along on the canals encircling the fantastic architecture. Afterwards, we were privileged to be enticed into several chocolate (!) manufacturing shops from which we exited carrying copious quantities of the sweet dark black-brown substance. Some of the chocolate even made it back to Brussels! (It is said that 100,000 people inhabit the inner city of Bruges and that there are 300 chocolate shops. That's a pretty good ratio.) Afterwards, we continued to wander the twisting streets, stopping at several souvenir and art stores. We were elated and fascinated. Eventually, and all too soon, we crossed back over the bridge and climbed into the minibus. As the last of the courageous travelers entered, the sky instantly and immediately once again darkened and the rain poured down. We all arrived back in Brussels reenergized (or was it the chocolate?) and thrilled with the adventure we had just experienced. A splendid time was had by all!



(All Photos by Hank Apgar, except as noted)

## Modeling Vision Panel



*'Modeling Vision Panel' Developers — Hans Vonk, Herbert Spix, Dale Shermon, Doug Howarth, Dan Galorath, Tony Demarco*



*Hank Apgar, moderator for 'Modeling Vision Panel'*



*Panelists Herbert Spix, Dale Shermon*



*'Modeling Vision Panel' Users — Arno Rol, Marcel Smit, Michel van Pelt, Don Mackenzie*

## At the Conference & Banquet



*Exhibitors provide hands-on opportunities*



*Natalie Faucher, local Conference Committee member*

## *At the Conference & Banquet*



*Comedy Museum, Sherry Stukes with  
Tin Tin characters, Janssen & Janssen*



*Bianca Castafiore, Tin Tin character,  
at Comedy Museum*



*Conference Planners — Philip Griffin  
and Jason Dechoretz*



*Jason and Yamina Dechoretz*



*Andy Prince, ISPA Chair*



*Awards Chair Joe Hamaker*



*Jacqueline Schlagwein*



## Beyond the Conference

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*The Grand Place at night [Photo by Sherry Stukes]*



*One of many waffle shops in Brussels*



*Attendees relaxing at Belgium's Grand Place*



*One of many cartoon paintings on Belgium buildings*



*Brussels is a town of monuments*

## Beyond the Conference



*Brugge*



*Assorted Mannekin Pis corkscrews for sale*



*Bicycles in Brussels*



*Brussels is a beer town*



*Brussels*





# 2013 ISPA/SCEA JOINT ANNUAL CONFERENCE & TRAINING WORKSHOP



NEW ORLEANS, LA ♦ 18 - 21 JUNE 2013



DON'T MISS OUT ON THIS OPPORTUNITY TO . . .



## LEARN FROM THE BEST

- Gain knowledge you can take back to your employer and customers. Stay up-to-date on best practices and advancements in the field.
- Attend comprehensive training to expand your skill set. 4 Training Tracks will feature over 40 sessions based on the Cost Estimating Body of Knowledge (CEBoK®) and the *Parametric Estimating Handbook (PEH)*.
- Certification Study Sessions will give attendees the chance to work together to prepare for the CCEA® exam, held Saturday, June 22.
- Professional papers, organized into distinctive tracks for all interests, will feature lessons learned from leaders in the field.
- Industry experts will give keynote speeches that will inspire attendees and spark discussion for the rest of the week.



## NETWORK WITH PEERS

- Meet with vendors on our exhibit floor.
- Attend Exhibitor Sessions and learn about software, products, and tools designed to make your job easier.
- Mingle with colleagues and exhibitors at the Tuesday Attendee Reception and other after-hours events.



## MEET US IN NOLA!

- The Conference hotel will be the Sheraton New Orleans, with a discounted room rate of \$182.
- Come to learn, stay for the world-class nightlife, history, arts, and culture that await you just steps from the hotel door.



## STAY TUNED!

- The Call for Papers will be sent out in August 2012
- Registration will open in January 2013
- Visit [www.sceaonline.org](http://www.sceaonline.org) or [www.ispa-cost.org](http://www.ispa-cost.org) for more details

### Election Results

BY BRIAN GLAUSER, ELECTIONS CHAIR

**T**his year we had eleven very qualified and capable candidates vying for five BoD positions up for election. The election for the 2012 International Board of Directors was concluded at the Conference in Brussels in May. This election had participation from nearly half the membership. Many thanks to Lisa Yedo, Roy Smoker and Harold van Heeringen who served on the elections committee at the conference to facilitate the ballot verification and counting process.

The outcome of the election was announced at the conference banquet on 16 May 2012. As you can imagine, with 11 very qualified candidates, the results were close. Elected to the Board was Hank Apgar, and re-elected were Andy Prince, Greg Kiviat, Kurt Brunner, and Madeline Ellis. They join the existing Board members: Lisa Yedo, Bruce Minett, Herve Joumier, Rich Harwin, Steve Sterk and Brian Glauser.

At the first Board meeting of the newly elected Board, which was conducted on May 17th, per the bylaws of the Society, an election of officers was conducted by the Board. The results of those elections are: Chairman, Andy Prince; Deputy Chair, Greg Kiviat; and Secretary, Lisa Yedo.

We want to thank all of the candidates for their willingness to volunteer to serve the Society in this capacity. We congratulate the winners on their election and look forward to the service they will provide as we work through a transition period to the new Association. We especially want to thank the organizations that employ our Board members for their commitment and generosity to make it possible for the members to travel and invest their time for the benefit of our Society. Lastly, we are grateful for all of our membership for participating in the election process and making it a success.



Hank Apgar



Andy Prince



Kurt Brunner



Madeline Ellis



Greg Kiviat

*Continued from page 5.*

enthusiastic group of nine track chairs. At the conference, the track chairs introduced the speakers, ensured that the tracks ran smoothly on schedule, and managed the audience questions. By having multiple track chairs for each track, the track chairs were able to make their presentations and attend sessions from other tracks.

The track chairs include:

<b>Management and Decision Making</b>	Ed Dean, Robert Bitten, George Teologlou
<b>Models and Methods</b>	Herbert Spix, Hank Apgar
<b>Risk Analysis</b>	Greg Kiviat, Don MacKenzie
<b>Software and Technology</b>	Arlene Minkiewicz, Harold van Heeringen

This workshop program was one of the best we've held! The cultural diversity of the delegates and exchange of ideas in the workshop sessions made it a memorable event.



Julius Freutel,  
DACE Director  
at the DACE Booth  
(Photo by Sherry Stukes)

## ISPA Southern California Chapter News

BY KURT BRUNNER, PRESIDENT; QUENTIN REDMAN, VICE-PRESIDENT; SHERRY STUKES, SECRETARY/TREASURER

Our Spring Joint ISPA/SCEA Workshop was hosted by Raytheon Space and Airborne Systems (SAS) on 21 March 2012 in El Segundo CA. The speakers and topics at this workshop included:

**Joel Moorvitch, Raytheon SAS**, 'Welcome to Raytheon SAS' (SAS Life Cycle Sustainment Engineering and Assessment Department Manager)

**Mike Ross, Tecolote Research, Inc.**, 'An Improved Method for Predicting Software Code Growth' (*2011 Conference Risk Track Best Paper*)

**Jeff Platten (retired Northrop Grumman)**, 'A Parameter-Driven World'

**Danny Wong, Raytheon SAS**, 'Choosing the Right PET (Production Estimating Tool)'

**Mike Butterworth, TASC** 'Earned Value Management (EVM) Trend Tool' (*Training Topic*)

**Pierre Foussier, 3F (Paris, France)**, 'Introduction to the Non-Parametric Approach'

**Mike Thompson, MCR Federal**, 'From Berry to Bottle, How Much Should That Wine Cost?'

Each of the speakers at our Spring Workshop received a beautiful ISPA Coffee Container!

If you would like a copy of these or previous workshop briefings please go to the ISPA web site located at: [www.ispa-cost.org](http://www.ispa-cost.org) under the Southern California Chapter Past Presentations. All available presentations are loaded on the web site immediately following the meeting. If you have any questions about the presentations please feel free to contact the workshop program coordinator, **Henry Apgar**, at [hapgar@mcric.com](mailto:hapgar@mcric.com).

Our Fall Joint ISPA/SCEA workshop planning is well underway. It will be hosted by SAIC in El Segundo, California and is to be held on 12 September 2012. There will be 'Best Paper' winners presenting their briefings from the Joint 2012 Conferences held in Brussels and Orlando, a training subject, and our ISPA Chairman, Andy Prince will discuss his 'Human Spaceflight Value Study'. An Executive Speaker from SAIC will also address the group.

The agenda will be e-mailed to ISPA and SCEA members and previous workshop attendees in July, and it will contain a location map and driving instructions. The agenda will also be posted on the ISPA web site ([www.ispa-cost.org](http://www.ispa-cost.org)). You may contact the SAIC registration point of contact, Ms. Angela Barba at: [barbaa@saic.com](mailto:barbaa@saic.com), [ANGELA.BARBA@saic.com](mailto:ANGELA.BARBA@saic.com), or **(310) 524-3164** to



Workshop Attendees — 21 March 2012 — Raytheon SAS, El Segundo



register. As always, our workshops are free.

At the conclusion of the workshop, as an incentive to stay until the last presentation is complete, a membership drawing will be held. Our ISPA Membership Chair, **Steve Sterk**, will be on hand with a selection of great gifts for the drawing 'winner must be present'. If you have questions about your membership status or would like information about membership in general, contact Steve Sterk at [steve.a.sterk@nasa.gov](mailto:steve.a.sterk@nasa.gov) or **(661) 276-2377**. A SCEA membership drawing will also be held.

Please consider hosting a workshop or presenting at a workshop! It will be a rewarding experience. If you are interested in hosting a workshop, please contact any of the board members listed below. Also, if you are interested in making a presentation at a workshop, please contact our Program Coordinator, **Henry Apgar**, at [hapgar@mcri.com](mailto:hapgar@mcri.com).

We look forward to seeing you at the next workshop!

*Kurt Brunner*



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## IN REMEMBRANCE: MICHAEL MASTERS



**W**e remember Mike as a stalwart of ISPA. He was a major player in the affairs of our society. Mike served on the international board of ISPA, and twice served as President of the Southern California chapter.

Mike was born in Newark, New Jersey in April of 1940 but, like many of us, ended up in Southern California. He attended Glendale Community College and Long Beach State University. He received a degree in Industrial Arts.

During college Mike worked part time for General Dynamics in Pomona. He worked at North American Aviation through the late 1960's. In 1969 he changed to Mc Donnell Douglas (and its successor company) where he spent the rest of his career. He retired from what had by then become the Boeing Company, in 2002.

In 1967 while working at North American he got married, which is fortunate for us because we are indebted to Carol Masters for some memories:

*"I did find Mike's certificate of membership to ISPA. He joined May 5, 1981. The certificate is signed by Henry Apgar. The first conference he went to was in San Diego. I know Mike was already on the board in 1987 because that is when he broke his back in St. Louis. I remember taking him to a board meeting at Peter Korda's place in his wheel chair. I know he was chairing the first attempt at a manual for cost estimating. Mike retired from Boeing in 2002. I think his first and last conferences were in San Diego."*



## Photo Montage from Rene Berghuijs: The Banquet



*Award ceremony with opera singer*



*Brian Glauser with Janssen & Janssen*



*Rene with Janssen & Janssen*



*Rene with opera singer*



*Paolo Nespoli with Janssen & Janssen*



*Jacek Pachoki with Paolo Nespoli*

## Arthur Griffiths: Announcement from the UK



[www.scaf.org.uk](http://www.scaf.org.uk)

# SCAF Annual Conference “Forecasting for Success”

Tuesday 18<sup>th</sup> September 2012  
The BAWA Centre, Filton, Bristol

In May 2012, the NAO published its report on “Assurance for Major Projects” and stated that central government’s major projects are frequently large scale, innovative, reliant on complex relationships between diverse stakeholders, and high risk. They include the introduction of large IT systems, the construction of defence equipment such as ships and helicopters, and the implementation of major changes to how services are delivered by government. They must be well planned and executed in order to be delivered on time and on budget. Government must find ways to avoid repeating the poor performance which has led to previous high profile project failures. Alongside measures to increase the project management skills of its staff, an effective system that gives assurance over project progress is critical for ensuring successful outcomes.

In government projects stakeholders can be the project’s senior responsible owner, the department’s Accounting Officer, or HM Treasury as the provider of the project funding. Assurance opinion is accompanied by recommendations which, if implemented, can help reduce project failure, promote successful conditions and increase the chance of delivering the required outcome cost-effectively. What is key is the department’s ability to forecast for success.

Our conference speakers have a wealth of experience with the implications and challenges facing major projects and will provide a knowledgeable body of experience and learning experience to the attendees.

- 
- 09.00 Registration and Coffee**
  - 09.45 Welcome and Opening Remarks - Arthur Griffiths, *Chairman, SCAF***
  - 10.00 Dr Tim Sheldon – *Head of Cost Assurance & Analysis Service, Defence Equipment & Support, Ministry of Defence***
  - 10.40 Dr Stuart Wicks – *Head of Business Analysis, Rolls-Royce Submarines***
  - 11.20 Dr Andrew Tyler – *Chief Executive Officer, Marine Current Turbines Ltd and former Chief Operating Officer, Defence Equipment & Support***
  - 12.00 Society Business and General Meeting, Arthur Griffiths, *Chairman, SCAF***
  - 12.30 Buffet Lunch**
  - 13.40 Hans Pung - *Vice President, RAND Europe***
  - 14.20 Mick Porter – *Director - Estimating Capability and Independent Evaluation, BAE Systems***
  - 15.00 Tea**
  - 15.20 Phil Wardle – *Former Engineering Manager, BAE Systems and Visiting Lecturer Cranfield University***

# Membership Report

By STEVE STERK, CPP

I have received a lot of inquiries about the upcoming merger with ISPA and SCEA. ISPA will merge into SCEA to create a new organization named the International Cost Estimating and Analysis Association (ICEAA). I assure you that your membership records will automatically be transferred over to the new society. But before that happens, I encourage you all to VOTE. The ballots have been mailed out to you. In this package, Exhibit G of the Agreement of Merger spells out the dues policy for the new organization.

**New Member Drive.** I am excited that the Board of Directors voted to initiate a new Membership Drive. This drive is specially targeted for NEW Members. The new member price is \$35.00 for the first year. Qualification for this very ridiculously low price is that you must never have been a member of ISPA.



**Douglas A. Comstock**

At this time I also like to welcome Mr. Douglas A. Comstock as the most recent new member. Doug is the new Director at NASA Headquarters Cost Analysis Division. Doug was the recent Director of the Innovative Partnerships Program. We look forward to hearing from Doug at the NASA Cost Symposium scheduled August 20 – 23, 2012 at APL.

For new ISPA memberships please get hold of Erica Wilkening at the Joint Business Office (703) 938-5090, [erica@sceaonline.org](mailto:erica@sceaonline.org) or send an email to [steve.a.sterk@nasa.gov](mailto:steve.a.sterk@nasa.gov). We can normally turn around your request within 24 hours. Members who would like to renew can now pay on-line through our secured web site. [www.ispa-cost.org](http://www.ispa-cost.org)

See you in Los Angeles at the Joint ISPA/SCEA Workshop, Wednesday, September 12th, 2012.



**Steve Sterk (CPP)**

*ISPA Membership Chair*  
[steve.a.sterk@nasa.gov](mailto:steve.a.sterk@nasa.gov)  
(661) 276-2377

## New Members

Here is a list of people who recently joined ISPA. Please welcome the following to our professional society:

### Doug Comstock

*NASA HQ, Cost Analysis Division*

### Mark Gilmour

*QinetiQ*

### James Lancaster

*Defense Contract Management Agency*

### Jack Self

*Labrie EnvironmentalGroup*

### Michael Small

*Northrop Grumman*

### Alan Di Giovanni

*UK MoD Cost Assurance & Analysis Svc.*

### Andrew Eyers

*UK MoD Cost Assurance & Analysis Svc.*

### Angus Gordon

*UK MoD Cost Assurance & Analysis Svc.*

### Yasser Jeeworth

*UK MoD Cost Assurance & Analysis Svc.*

### Mark Johnson

*UK MoD Cost Assurance & Analysis Svc.*

### Matthew Leigh

*UK MoD Cost Assurance & Analysis Svc.*

### George Stirling

*UK MoD Cost Assurance & Analysis Svc.*

### Kelly Turner

*UK MoD Cost Assurance & Analysis Svc.*

### Kevin Wade

*UK MoD Cost Assurance & Analysis Svc.*

### Stephen Whitehead

*UK MoD Cost Assurance & Analysis Svc.*



## Certified Parametric Practitioner Activities

BY ROY SMOKER, CHAIR, CERTIFIED PARAMETRIC PRACTITIONER PROGRAM

**T**he ISPA/SCEA Joint Conference in Brussels was a resounding success. All of the instructors were present for the training program. They made superior presentations to the conference attendees.

The following instructors made the respective presentations in the Parametrics Training track: *Dale Shermom of QinetiQ, UK* gave the Parametric Analysis Overview; *Rene Berghuijs of NATO, Belgium* presented the Cost Estimating Relationships training; *Hank Apgar of MCRI, LLC* taught the Company-Developed Complex Models; *Greg Kiviat of Sikorsky, US* presented the Complex Hardware Models training; *Sherry Stukes of the NASA JPL, US* covered the Complex Software Models; *Andy Nicholls of Price Systems, UK* taught the session on Government Compliance; *Paul Duvall of Atkins Ltd., UK* presented Other Uses of Parametrics; and *Fabian Eilingsfeld of Price Systems, Germany*, presented International Use of Parametrics.

The following topics and associated instructors made the presentations for the Fundamentals track. Cost Estimating Basics was presented by *Stuart Wicks of Rolls-*

*Royce, UK*; the Cost Estimating Techniques topic was given by *Ton Dekkers of Galorath from the Netherlands*; Data Collection & Normalization was presented by *Dan Galorath of Galorath Inc, US*; the Data Analysis topic was covered by *Kurt Brunner of Tecolote, US*; the Learning Curve Analysis topic was presented by *Natalie Faucher, of MCR LLC, NATO office in Brussels*; the topic of Linear Regression was covered by *Herve Joumier from the European Space Agency*; the Risk Analysis Basic Part I was presented by *Eric Drucker of BAH, US*; the Risk Analysis topic Part II was also given by *Eric Drucker of BAH, US*; the topic of Probability & Statistics Basic was taught by *Peter Braxton of Technomics, US*.

Congratulations go out to all of these instructors for presenting outstanding training material to the conference attendees. For those who are counting, there were eight trainers from the European community and eight trainers from the United States. Only one student took the Certified Parametric Practitioner exam; congratulations go to *Mr. Mark Gilmore of QinetiQ, UK* who passed the CPP exam.

## Secretary's Report

BY LISA YEDO, ISPA SECRETARY

**T**he ISPA Board of Directors met in May in beautiful Brussels, Belgium. The conference was held May 14th – 17th and drew approximately 100 delegates from around the world. Among the topics of discussion were the 2012 Board elections and the upcoming conference in 2013 in New Orleans.

The Board elections were unique this time due to the upcoming merger with SCEA. The elected Board will be for an interim term. There were five open seats on the Board, with four eligible incumbents: Andy Prince, Greg Kiviat, Kurt Brunner, and Madeline Ellis. One Board member, George Stratton, termed out drawing many expressions of thanks for his service and dedication. There were eleven candidates in all, including the incumbents. The elections resulted in all incumbents being reelected and the fifth seat being filled by Hank Apgar. The resulting Board assignments are as follows:

- **Andy Prince** — Board Chair
- **Greg Kiviat** — Deputy Chair

- **Bruce Minett** — Treasurer
- **Lisa Yedo** — Secretary
- **Rich Harwin** — Executive Manager
- **Kurt Brunner** — Southern California Chair
- **Madeline Ellis** — Parametric World Chair
- **Steve Sterk** — Membership Chair
- **Brian Glauser** — Deputy Membership Chair
- **Herve Joumier** — Board
- **Hank Apgar** — History/Legacy

Thanks to all the Board members for their service to the society!

The 2013 conference was also a topic of discussion. It was announced that the conference will be held in New Orleans. This has proven to be a great location for past conferences with so much to see and do for delegates and their guests, as it offers world-famous music, food, and culture. The conference committee is working hard and more details will be released as they finalize their plans.



## The ISPA Banner

BY HANK APGAR, ISPA HISTORIAN



*The ISPA Banner was inaugurated in 1982 at Virginia Beach Cavalier.*

I am not Francis Scott Key, but I do get excited about the appearance of our American Flag flying over significant sites, such as American embassies abroad and at 4th of July parades. I feel that way about our ISPA Flag, too.

I suppose it is not really a flag in the nationalistic or patriotic sense but it does symbolize our professional heritage and it has 'flown' for 30 years (as a battle flag) over all domestic and international conferences.

It first 'flew' thirty years ago, in 1982, over the conference center main entrance at the Virginia Beach Cavalier Hotel. The occasion was our fourth conference. The flag still frames our group photo at the quarterly Southern California workshops. And it flew (not really 'flew' as we were not allowed to hang it in the Brussels Sheraton) at our 2012 conference in Belgium. Several of us have shared the courier responsibility of carrying the flag (some call it a banner) to and from our conferences and workshops around the world.

In fact, we nearly lost the flag in May in Brussels. The exhibitor tear-down proved somewhat hectic at the conclusion of our conference and the flag was being used as a table cover for ISPA and other professional groups who wanted to display their own publications and future conference announcements. And so, I 'forgot' to retrieve it in my haste to get on the bus to the Comedy Museum for our annual awards banquet. When I returned to the hotel that evening, the conference center was closed and I had to wait until morning to summon help.

Eager to retrieve our flag, I visited the conference center before breakfast and encountered a swarm of workers transforming the facility for another group. The flag was gone! I checked with the hotel staff they referred me to 'hotel lost and found' but no luck. I even displayed an illustration of our flag in my conference presentation, 'The Evolution of Parametrics in Parallel with the Maturing of ISPA.'

By this time, the conference center had been transformed into another meeting site whose conference members had their own 'flags' in prominent display. Frustrated by my inadequate diligence the previous evening and the thought of having to explain to the ISPA Board of Directors later that day, that, after all these years, I had lost our flag. I proceeded to harass the work staff again. But, this effort was encumbered by their inability to understand my English — most spoke only French or Flemish.

I focused on the one word that is language-common: 'tapestry.' I described my lost 'tapestry' and I drew out the shape of ISPA with my finger on my other palm. I even showed them the photo from my paper. And then, one of the waiters seemed to understand; he literally ran back to the kitchen and retrieved a soggy 'tapestry' from the garbage bin just before the garbage scheduled pickup time. With a little bit of cleaning, the ISPA flag will fly again.

***Then conquer we must, when our cause it is just, And this be our motto, 'In God is our trust.'*** From the fourth stanza of the Star Spangled Banner, by Francis Scott Key, 1814



*Thirty years later, at the Brussels Sheraton, performing duty as a table cover.*

# Explicit Knowledge for Product Estimating: Linking Cost Density to Performance over Time

BY BRUCE FAD, PRICE SYSTEMS LLC

## ABSTRACT

**A**ny product can be effectively estimated on the basis of its weight and required performance at the time it is introduced if the estimate results from explicit knowledge. In many cases, nothing captures explicit knowledge better than a multi-dimensional cost density metric based cost model. Unfortunately, some in the cost-estimating community resist use of a metric, preferring instead to use the raw cost data from which the metric is produced. By disregarding use of the cost density metric, we often fail to uncover explicit truths that can improve estimating performance.

## COST DENSITY

Determining the exact cost of a product is a mathematical exercise: sum up the bill of materials cost, add the labor cost to it, throw in overhead, general and administrative rates and there's your cost. This isn't estimating. Estimating is required whenever any part of the mathematical process isn't exactly known, as is the case when a product requires some amount of development or modification. Then, we are talking about estimating.

Over the past 40 years, weight driven parametric estimating has become popular and credible as a way to estimate product cost. It's sensible and intuitive; the more of something you buy, the more it will cost. We all understand this from everyday life experiences, such as food shopping. If I purchased two bagfuls of groceries last week and three bagfuls this week, I can expect to pay more this week. The same principle applies when making or buying any product: the bigger it is, the more it weighs and the more it costs to make. Extra material and labor are not free.

**Is it really this simple?** Not quite. Cost density must be dealt with for one thing. Cost density is exactly what its name implies: a measure of cost per unit of weight (e.g. dollars per pound, Euros per kilogram, etc.). If we don't account for cost density, it is likely to produce an inaccurate conclusion. Back to the shopping example; suppose those two bagfuls I purchased last week were entirely devoted to stocking my freezer with meat, while this week I concentrated on stocking my pantry shelves with canned goods. The weight-to-volume density of meat is not much different from that of canned goods, so the weight of each bag is about the same. However, the cost density of meat is anywhere from 5 to 15 times that of canned goods, depending upon the specific meats and canned goods considered. Before I head out to the market, I need to take this into account so that I have adequate funds for my purchase. If I spent \$100 on two bagfuls of meat last week, I can expect to pay between \$10 and \$33 for three bagfuls of canned goods this week, depending upon my specific purchases. Cost density is a vital counterbalance to weight in estimating cost. When estimating 24 pounds of product, cost density answers the question, "24 pounds of what?"

**So, all I need is weight and cost density and I can estimate any item, right?** Yes and no. Yes, if you don't care to take into account things like escalation, quantity made/bought, quality of materials, reliability demanded, and a host of other cost driving issues; no, if you do want to account for these things. Let's take just one of these issues, quality, and try to relate it to our shopping example. By not identifying the quality of meat purchased last week or the quality of canned goods planned for purchase this week, I have little idea if this week's purchase will be closer to \$10 or \$33. That could pose a problem if I am worried about carrying too much or too little cash. If my meat purchase was low-end quality (chicken thighs, skirt steak, and ground beef for instance), then we would be dealing with relatively low cost density, something like \$4 per pound. At the high-quality end, where filet-mignon, Kobe

beef, and prime rib sit, the relative cost density is much higher, perhaps \$12 per pound. Let's say my tastes include a little of both high and low ends, but mostly the middle-end of the quality scale. We could reasonably estimate that \$8 per pound would describe this purchase.

The same logic can be applied to the canned goods example. Therefore, we estimate that I purchase \$ .80 per pound canned goods. So, if my meat cost density is 10 times my canned goods cost density (\$ 8 versus \$ .80) and I buy 50% more canned goods than meat by weight (three bags versus two), I will need about \$15 for the canned goods based on spending \$100 for the meat last week. This is much better information for me to use in managing my grocery money. I got it because I included quality in the cost equation.

If my world includes no one but me, I can pull \$20 from an account and set off for the grocery store confident I have enough to cover three bagfuls of canned goods. In reality, my world includes many others who have demands for that \$20 and who may even control the money. I must be prepared in the event I am asked, "Why do you think \$15 to \$20 is enough for 3 bags of groceries when you spent \$100 on two bags last week?" The question is an invitation to transfer my tacit knowledge into explicit knowledge.

### **Tacit Knowledge vs. Explicit Knowledge**

What's the difference between tacit knowledge and explicit knowledge? First of all, what do we mean by knowledge? Knowledge is the awareness of facts or situations resulting from data analysis. Data is the measured information used to construct a cost model. Meat and canned goods costs and weights are the primary data of this example. Knowledge gained includes the fact that my tastes result in a meat cost density that is about 10 times greater than my canned goods cost density. Simply stating this as fact with no explanation makes it tacit knowledge, i.e. know-how that is highly personal and not well communicated. I shouldn't be surprised if it is viewed with suspicion. However, if I guide others through the analysis presented earlier, the validity of the 10x factor becomes explicit. Explicit knowledge is formal, systematic, documented, and easily shared. Like any other conclusion drawn from analysis, a cost estimate is more likely to be believed if it is accompanied by explicit knowledge.

Let's move from grocery shopping to the more complex world of developmental products, where circumstances tend to become more convoluted. More considerations need to be injected into the estimating mathematics, so much so that the result is usually called a cost model. The model simulates cost driver effects due to changes in weight, changes in cost density, changes in quality, changes in technology, changes in degree of new design, and changes in any other realities of the cost environment. It isn't a simple situation, but ironically, there is evidence that this complex situation can be significantly simplified with knowledge resulting from use of a comprehensive model that deals with cost density as a variable that is both time and performance dependent. The hypothesis is that any product can be effectively estimated on the basis of its weight and required performance at the time it is introduced if the estimate results from explicit knowledge.

Before an example is presented to support the hypothesis that product cost can be effectively estimated on the basis of weight, time, and performance, let's pause to question the premise. We have already covered weight through the grocery analogy. There should be no question that for a specific item, the larger it is, the more it weighs and costs. What about time and performance? Time affects all costs in at least two ways; one is the time value of money (inflation, escalation, etc.) and the other is technological improvement. Technological improvement is what makes today's 42-inch HD LCD flat panel TV less expensive to make and to buy than it was last year, even in the face of a years' worth of inflation. Since we see price fluctuations in what we buy every day, it's not unreasonable to expect there are similar cost fluctuations to match. Therefore, time should be considered an important cost driver in the estimation process.

This leaves us with the assertion that performance is a cost driver. The effect of performance on cost is somewhat pervasive, which makes it almost impossible to isolate. We will be looking at an example dealing with Turbo-jet fighter aircraft in a moment, so let's talk performance as it relates to that product. Among the many candidates for

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turbo-jet fighter performance measurements are: maximum speed, rate of climb, maximum altitude, and payload capacity. If you want a jet fighter that flies faster or climbs at a higher rate than any other, you expect it will cost you more. This greater performance requires bigger engines, more lift surface area, and possibly more fuselage in order to get the increased performance we want. We may be able to improve performance slightly, but generally speaking, increased weight for anything that flies is bad news. Significant performance improvements usually require new materials and/or engineering approaches i.e. new technology. So it is reasonable to look at performance as a cost driver, but only if it is connected with time to discern the use of existing technology from the need for new technology.

**Still not buying into the cost, weight, performance connection?** You should, as it is really more a truth than notion. Consider these extracts from a promotional advertisement for the lithium-ion (Li) battery published in *USA Today*, December 20, 2007:

- *This small wonder has revolutionized consumer electronics, enabling devices we use every day to weigh less and run longer (weight & performance);*
- *Lithium-ion batteries are smaller, lighter, and have the potential to be more cost-effective than current batteries (weight & cost);*
- *Researchers have used hydrocarbon-based polymers to develop a new separator film that greatly improves the safety, power, and reliability of larger lithium-ion batteries for hybrid vehicles (need for new technology).*

### Example

An example of a cost-density based model driven by time and performance will illustrate two important points:

- The value of using all pertinent available information in tailoring a cost model;
- The necessity of having a comprehensive modeling framework to capture the knowledge embedded in available information.

This example deals with turbojet fighter aircraft and uses information collected from public sources (Data Search Associates *Weapon System Costs Handbooks*, Aviation Studies International Limited, Jane's *All The World's Aircraft* are examples). The information collected covers procurement history, technical and performance specifications, and physical characteristics of 13 turbojet fighters introduced between 1947 and 1980. A sampling of the information is displayed in the figure that follows. Although this information may appear dated, historical data is an extremely reliable source of information when conducting an estimate of this nature.

Colloquial Name	System Designation	In Service Date ISD	Unit Cost UC - 2001 \$ US	# Produced	Mass MTO (lbs)	Total Installed Power (kw)	Max Velocity VMAX - kts
Sabre	F-86A/D	1947	\$2,076,487	3,058	16495.338	1491.402	679
Scorpion	F-89D	1950	\$5,216,630	332	40988.415	3120.47188	630
Voodoo	F-101 A/C	1951	\$14,025,808	124	45487.144	8317.43423	1236
Thunderchief	F-105B/D	1951	\$14,520,627	685	39988.698	6739.98981	1245
Super Sabre	F-100 A/C/D	1952	\$4,501,973	1,953	40988.415	4588.92923	1064
Starfighter	F-104A	1953	\$11,264,095	170	28770.869	4531.56762	1300
Crusader	F-8	1953	\$5,960,306	1,359	27542.216	4847.0565	1000
Phantom	F-4A-J	1960	\$10,587,871	2,905	61777.54	9263.90088	620
Tiger II	F-5E/F	1970	\$3,627,844	163	24715.015	2868.08077	1112
Falcon	F-16A/D	1978	\$34,054,764	1584	23803.273	6834.63647	1650
Tornado	F2/F3	1979	\$49,819,248	378	59983.047	9177.85846	920
Hornet	F/A-18A/D	1980	\$42,365,868	404	49210.092	9177.85846	1386
Eagle	F-15A/E/D	1980	\$101,744,284	1,077	67980.787	13634.856	1650

**Example: Turbojet Fighter Aircraft Information**



Most cost estimates of aircraft like these would be the result of decomposing the system into subsystems and further decomposing of subsystems to assemblies. These are all turbojet fighter aircraft, but there is a significant lack of homogeneity among them that causes estimators and program managers to decompose until they reach a comfortable level of product definition. Comfort may be at the level of propulsion subsystem, fuselage subsystem, landing gear subsystem, avionics subsystem, and so on, or at a level even lower than that. Certainly, customer evaluation of proposals and invoices will drive the costing activities to levels lower than the aircraft system as a single entity. However, as this example suggests, there is no reason to believe that credible financial planning requires a breakdown lower than the aircraft entity. In fact, if all available information about the entity is included and if the knowledge conveyed by the analysis is applied, the system entity estimate is likely to be the most credible, substantiated estimate for program financial planning purposes.

Four different estimating methods (models) were used to analyze the data above. Each model is described in the table below. You will note that the amount of information used to formulate each model increases as you move down the list.

Estimating Model	Model Description
UC (Unit Cost) Direct	Simple direct relationship to predict Unit Cost (UC) as a function of time (ISD) & performance (VMAX); created thru data regression
Metric based UC	Simple direct relationship to predict <b>Cost Metric</b> as a function of time (ISD) and performance (VMAX). The cost metric is normalized by quantity produced using a constant 90% learning curve. The natural logarithm (ln) of the resulting normalized cost per pound defines the metric.
Rate Metric based UC	Exactly the same as Metric based, but with a variable learning curve that is weight and quantity produced dependent.
Multi-Dimensional Cost Density Metric based UC	Multi-dimensional parametric cost model to simulate technology improvement, variations in learning curve with quantity produced, engineering change effects, inclusion of recurring and non-recurring costs within the UC; employs a product specific Cost Density Metric.

Each of the methods/models is tested for performance within two test domains:

**Test Domain 1:** Consists of 11 cases: excluding the last two aircraft shown in example information above, FA-18 and F-15. These 11 aircraft are used for model tailoring via regression analysis. The prediction equation that results is the mathematical form of the knowledge conveyed by the analysis.

**Test Domain 2:** Consists of 4 aircraft; the last two in the example information above (FA-18 and F-15) along with two contemporary aircraft, F-22 and F-35.

### Test Domain 1 Results

The table below shows the results by model on domain 1. During the analysis, the F-5 Tiger consistently stood alone in terms of its relative cost and cost density (much lower than all others). In similar situations, analysts might discard a data point like the F-5 as an outlier. We choose not to discard it for the following reasons:

- There may be a cause and effect pertinent only to this aircraft within domain 1,
- If there is a cause and effect, we would like to capture it as knowledge since the phenomena of the cause could re-occur,

We want to see if any of the four estimating models can capture the cause and effect.

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Estimating Model	Average Variance (Predicted to Actual) for Domain 1
UC Direct	53% (from -49% to 606%)
Metric based UC	19% (from -37% to 312%)
Rate Metric based UC	17% (from -38% to 276%)
Multi-Dimensional Cost Density Metric based UC	23% (from -38% to 368%)

If we based adoption of an estimating model on the average variance test results above, we would probably choose to proceed with the Metric based UC model or the Rate Metric based UC model over the others, including the Multi-Dimensional Cost Density Metric based UC model. While this test is valuable, remember it is against the data used to build or tailor each model. Making judgments from this test alone would be similar to judging a sports team's performance on the basis of inter-team practice games. It is better than nothing, but not as good as the ultimate test: live performance against a not-previously-encountered opponent. Domain 2 serves the role of a not-previously-encountered opponent for testing our 4 models; results follow.

Estimating Model	Average Variance (Predicted to Actual) for Domain 2
UC Direct	-38% (all A/C under-estimated by 14% – 64%)
Metric based UC	44% (3 of 4 A/C over-estimated by 29% – 86%)
Rate Metric based UC	56% (3 of 4 A/C over-estimated by 27% – 123%)
Multi-Dimensional Cost Density Metric based UC	2% (3 of 4 A/C over-estimated by 6% – 21%)

Why does the Multi-Dimensional Cost Density Metric based UC model perform so much better on the domain 2 aircraft than the others? Because it has captured important knowledge conveyed by F-5 Tiger that other methods cannot. The F-5 Tiger was a privately funded aircraft development designed to use an aircraft engine already in inventory. Touted as a low cost fighter, it lacked military services support and was relegated to training aircraft status. But, it represents a specific business situation more dramatically than any of the other aircraft of domain 1 and that situation is the application of aggressive cost containment practices. Remember, the F-5 Tiger was promoted as a low cost fighter aircraft. Many of the business practices of the F-5 Tiger program have been adopted over the past 15 + years within the US Department of Defense as it struggles to deliver performance with a smaller piece of the government spending budget. Focusing on the two contemporary members of the domain 2 test-set (the F-22 and F-35), we can see dramatic evidence that Multi-Dimensional Cost Density Metric based UC model has the requisite knowledge to deal with this business situation, while the other models are at a complete loss to understand what is happening.

Estimating Model	F-22 Estimate Variance	F-35 Estimate Variance
UC Direct	- 64%	- 12%
Metric based UC	86%	80%
Rate Metric based UC	82%	123%
Multi-Dimensional Cost Density Metric based UC	8%	6%

Note: F-22 and F-35 are active production programs; actual costs for both are based on cost incurred to date plus published estimates of remaining development and/or productions costs.

## CONCLUSIONS

**Is More Really Better?** As the example shows, when building or tailoring a cost model, it is usually better to include as

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much pertinent information as possible and to deal with the information with as many cost drivers as reality dictates. However, manageable use of the knowledge gained from the preferred multi-dimensional approach mandates a cost density metric that encapsulates all product knowledge and which can be predicted on the basis of two of the first things known about a new product: when it is needed (time) and how it needs to operate (performance).

**Going from Data to Explicit Knowledge:** The turbojet fighter information is an example of product data. Through the mechanism of a comprehensive parametric cost model, we were able to quickly and simply analyze all of the data to arrive at a simple and high-level knowledge based cost model. Part of the knowledge gained is that cost density, while highly dependent on performance and time, also envelops other not so obvious program characteristics like degree of cost scrutiny. This type of explicit knowledge helps give an analyst confidence in his or her estimate. It also dispels much of the mystery and suspicion on the part of those who rely on the estimate for a business decision.

## ABOUT THE AUTHOR

Bruce Fad is a member/owner of PRICE Systems LLC. He is a member of both ISPA and SCEA. In 1995 he was awarded Parametrician of the Year by ISPA. In his over 30 year estimating career, he has worked on estimates of many sizes and types. He has trained and mentored over 1,000 estimators; served as an expert witness on software system valuation to the US tax court, served as an expert consultant on contested program value; served as an expert advisor to GAO in publication of that agency's Cost Estimating Guide; and been awarded patents for inventions of software and hardware cost models. He is a graduate of the University of Delaware (BS & MS) and served briefly as a junior officer in the US Army during the 1970s. A life-long sports enthusiast, he was a college football and baseball participant, named to the 1970 Academic All-America baseball team.

## CALENDAR OF EVENTS

### August 21 – 23, 2012

NASA Cost Symposium  
Applied Physics Laboratory, Laurel MD  
Contact: [www.nasacostsymposium.info/](http://www.nasacostsymposium.info/)

### September 12, 2012

Fall Joint ISPA/SCEA Workshop  
Science Applications International Corp.  
El Segundo CA  
Contact: [barbaa@saic.com](mailto:barbaa@saic.com), [ANGELA.BARBA@saic.com](mailto:ANGELA.BARBA@saic.com),  
or (310) 524-3164

### September 11 – 13 2012

AIAA Space 2012 Conference & Exposition  
Pasadena Conference Center, Pasadena CA  
Contact: 703.264.7500 or 800.639.AIAA

### September 18, 2012

SCAF Annual Conference, Forecasting for Success  
BAWA Centre, Bristol  
Contact: [ndmorrill@dstl.gov.uk](mailto:ndmorrill@dstl.gov.uk)  
Or call 023 9253 7271

### Fall 2012 (Date TBD)

SSCAG Fall Meeting  
Washington DC  
Contact: David Pine: [dpine2@cox.net](mailto:dpine2@cox.net)

### November 27, 2012

SCAF: Learning from Experience: Interactive and Practical  
BAWA Centre, Bristol  
Contact: Arthur Griffiths, chair [@scaf.org.uk](mailto:@scaf.org.uk)

### February 5, 2013

SCAF: Economics and Estimating  
Royal Institution of Naval Engineers, London  
Contact: Arthur Griffiths, chair [@scaf.org.uk](mailto:@scaf.org.uk)

### April 23, 2013

The 2013 SCAF Estimating Challenge  
BAWA Centre, Bristol  
Contact: Arthur Griffiths, chair [@scaf.org.uk](mailto:@scaf.org.uk)

### June 4, 2013

SCAF: Quantitative Cost and Risk Analysis  
Ashton & Lea Golf Course, Preston, Lancashire  
Contact: Arthur Griffiths, chair [@scaf.org.uk](mailto:@scaf.org.uk)

### June 18 – 21, 2013

2013 SCEA/ISPA Joint Annual Conference & Training Workshop  
Sheraton New Orleans, New Orleans, LA  
Contact:



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