When Historically Developed CERs Fail

BY RAYMOND P. COVERT, MCR, LLC,
rcovert@mcri.com

Introduction

Cost estimates are probabilistic relationships formed by statistically summing individual cost estimating relationships (CER) and their uncertainties. CERs are typically developed using historical cost and technical data that are gathered at the end or near the end of a program. When the independent variables (typically representing the historical technical data) are regressed against the dependent variable (representing the historical cost data), we get a CER and its accompanying fit statistics. In the case where CERs developed from historical data are good estimators of future programs, we have few problems with capturing the completeness of the scope of the estimate, the realism of the cost estimate provided by the CER, or the reasonableness of using the method. When CERs are not good estimators of future programs, we have problems. In this report, we will discuss these three criteria, why CERs sometimes fail these criteria and what we can do about it.

Completeness, Reasonableness and Realism

First, we need to look at what makes a CER "good." We can apply three criteria: Completeness, Reasonableness and Realism. To ensure completeness, the CER should encompass the entire scope of the work to be performed and should have consistent design and programmatic parameters captured in the CER development process. This can be ensured by reviewing the documentation provided with the CER. As a minimum, CER documentation should describe how well the CER fits the data, where the data came from, what the scope of the data is, when the data were generated[1], and how they were normalized. [Ref. 1]

A CER should use a reasonable approach to estimating cost. Reasonableness in a CER entails verification of the applicability of cost drivers, minimal use of individual judgment and estimates, and maximal use of actual and factual data.

Finally, a CER should provide a realistic result. The proposed cost should be independently verified. Independent verification of the costs produced by CERs should place the

CHAIRPERSON'S ADDRESS

BY MADELINE ELLIS

Your Board of Directors along with several ISPA members headed off to New Orleans early in February to our 2007 Conference site, the New Orleans Marriott at the Convention Center. Our two day meeting had a packed agenda.

You will find more details elsewhere in this issue about upcoming society elections, award nominations, regional activities, membership, training and certification, and joint activities with SCEA, the Parametric Estimating Handbook and the 2007 Joint ISPA-SCEA Conference.

I have said many times in the past that our society does not run by itself. ISPA does not have a full-time paid staff. We are deeply indebted to those members of our society who have volunteered their time and talents to support the operation of ISPA. Among our numerous volunteers, is our membership chair Diana Patane. Diana has worked tirelessly to energize our organization. Her ideas are both creative and innovative. She introduced networking sessions at chapter workshops so that new attendees could meet long-time members. She initiated the "Distinguished Author's Program" so that new and experienced authors could be paired together. She introduced a mentor/mentee program so that less experienced members could call on an experienced parametrician for assistance. She started a Speaker's Bureau so that chapters would have a list of speakers to contact for presentations. She has redesigned the Membership Directory which should be in your hands shortly. She has, also, been very actively involved in organizing the newly chartered Southwest Chapter and is currently serving as the Chapter Vice-President. She has continued to support these activities in spite of being seriously injured while participating at the 2006 ISPA Conference in May. Her support to ISPA over the past several years has been invaluable. Thank you, Diana for all of your support.

BY NINA TAHIR

Hello my friends,

This year is starting off with a bang. There will be two ISPA chapter workshops in the first quarter of 2007 and another in April. Details can be found in the Chapter News section.

The 2007 ISPA/SCEA Joint Conference in New Orleans is taking shape. Read about the program highlights, training programs, and points of contact on Pages 16–18.

Also in this issue on Page 19 is information about an aeronautical tutorial and a "save the date" article about the 2008 International Conference to be held in Noordwijk - The Netherlands. Because of the favorable feedback we received about the very successful 2000 ISPA Conference and location, it was chosen again for next year's venue. The European Space Agency's Research and Technology Centre (ESA/ESTEC), conveniently located in the coastal resort town of Noordwijk, will be our principal sponsor.

Be sure to check out Bill Brundick's status report on the Parametric Estimating Handbook (Page 5) which is in the process of being formatted for the final draft phase.

In a repeat performance, Ray Covert of MCR wrote an excellent article on why some CERs fail and what to do about it featured on the cover.

On Page 5, Doug Druley, Certified Parametric Professional (CPP) Certification Chair writes about our first joint ISPA/SCEA training program making its debut at the 2007 Conference in New Orleans.

To help us locate ISPA Life Time members who have seemingly disappeared, this issue resurrects the **"Have You Seen Me?"** column.

Herve Joumier will no longer be our European Perspectives voice. I enjoyed working with him very much, but he must "turn over the reins" to someone else because he has his hands full as 2008 Conference Chair. This issue will not feature the European Perspectives column, but we have a replacement coming soon — Andy Nicholls.

Until April....

Chairperson's Address
   Continued from page 2

Don't forget to check our website www.ispa-cost.org often. We will continue to post updated information about society activities, regional meetings, workshop presentations, by-laws changes, employment opportunities and the 2007 ISPA-SCEA Conference. Also, check the 2007 Conference website www.ispa-scea.org for the latest conference information. It's not too early to make your hotel reservation.

Please do not hesitate to contact me or any of the members of the Board of Directors or committee chairs to offer your help or ideas. Tell us how we can help you. We look forward to seeing you at chapter workshops and the 2007 Conference.

Madeline Ellis
ISPA – Chairperson
(562) 797-4424
madeline.ellis@boeing.com

BY SHERRY STUKES

I am pleased to accept the appointment of ISPA Publications Chair replacing the position recently vacated by Dan Ferens. I would like to congratulate Dan on his retirement and thank him for his contributions to the ISPA publications as well as his many years of service to the Board of Directors.

I am looking forward to working with our two editors: Nina Tahir, Parametric World (PW), and Steve Book, The Journal of Parametrics (JoP). I'll also be working with the Membership Chair, who is responsible for organizing and creating another of our important publications, the Membership Directory.

Dan has documented a thorough process for the creation and publication of PW and the JoP. I intend to continue using this effective process.

We are currently working on our Winter issue of Parametric World which will be published at the end of February 2007. In addition, the JoP is in the final stages of completion and should be published in January 2007; our goal for the following issue is a joint journal with the Society of Cost Estimating and Analysis (SCEA). However, the issue of a joint journal is still in the works. The Jointness Committee is hammering out the details to define what it means to be joint. I will closely monitor this progress and report to you what this means in terms of joint publications. The hope is that by joining the journals of the two societies, we will be able to have a more extensive journal with more frequent publications.

Also, we are in the process of finalizing the Membership Directory and it should be available in March 2007. Remember, as you change your contact information, please provide it to the ISPA Business Office, and we will make sure that it gets published in the next issue of Parametric World.

I look forward to filling this important position!

Sherry Stukes
Publications Chair
sherry.a.stukes@jpl.nasa.gov
(818) 393-7517

CALENDAR OF EVENTS

March 7, 2007
ISPA SoCA Chapter Workshop
Hosts: PRICE Systems and AF SMC (Ft. MacArthur)
Information: Sherry Stukes
               Sherry.a.stukes@jpl.nasa.gov
               (818) 393-7517

March 14, 2007
ISPA Southwest Chapter Workshop
Western International University, Chandler, AZ
Information: Diana Patane
               S_Diana_Patane@raytheon.com
               (520) 545-6117

April 24, 2007
SCAF Workshop
Theme: Through Life Capability Management
Information: Arthur Griffiths
               Arthur.Griffiths@hvr-csl.co.uk

April 24, 2007
ISPA Mid-Atlantic Chapter Workshop
Host: PRICE Systems, Rosslyn, VA
Information: (703) 740-0087

April 24–25, 2007
EACE Workshop
ESRIN - Frascati, Italy
Information: David Greves
               David.Greves@esa.int

April 27, 2007
Aeronautical Tutorial — Embry Riddle Aeronaut. Univ.
Info/RSVP: Diana Patane
               S_Diana_Patane@raytheon.com
               (520) 545-6117

May 16, 2007
SSCAG Meeting
Host: Canadian Space Agency, Montreal
Information: David Pine
               dpine2@cox.net
               (757) 766-7931

June 12–15, 2007
ISPA/SCEA Joint Conference
New Orleans Marriott/Convention Center
Information: Lita Schulte
               elizabeth.a.schulte@boeing.com
               (714) 372-4186

ISPA-SCEA Joint Training

THE ISPA/SCEA Conference 2007 will be the first offering of our joint ISPA-SCEA training program. We anticipate there will be 1.5 hour time slots for training and a 30 minute break. This matches closely with the 2 hour presentations, so attendees can shift between training and presentations more easily. This newly integrated training program will consist of three components and can be mixed and matched depending on your experience level and/or interest. The training tracks are divided into the following three tracks:

· Fundamentals Track
· Practitioner Track
· Integration Track

The Fundamentals Track is the training material centered on basic knowledge required for estimating including parametric analysis.

The Practitioner Track expands on the fundamentals and introduces advanced skills needed for modeling and analysis.

The Integration Track is an integration of multiple fundamentals both basic and advanced in solving more advanced estimating problems including Parametrics.

Material from each of the individual society training programs spans across all three components. I look forward to seeing this new and exciting training program implemented that brings the best practices from both societies. This new training program will strengthen the individual society certification programs by providing additional and complementing course curriculum and also eliminating some duplication.

Details on the Joint ISPA-SCEA Training are still being developed. More information about the program will be available in the next issue of Parametric World. I look forward to seeing you at the conference.

Douglas Druley, CPP Certification Chair
douglas.druley@baesystems.com
(858) 592-5382

Parametric Estimating Handbook Status Report

The Fourth Edition of the *Parametric Estimating Handbook* (PEH) will be released in concert with this year's Conference. Recent, and near future, PEH activities include:

1. Initial chapter drafts were completed around October 1st.
2. Chapter drafts were reviewed by a team of the authors and editors at the DCAA Central Regional Office in early October.
3. Based on feedback obtained at that meeting, chapter authors rewrote their chapters and re-submitted them to the Handbook editors in mid-December.
4. An independent content review team met at the same location in early January to review the revised draft for overall content.
5. Currently, the Handbook is in the hands of the editorial team for the development of the final draft.
6. An independent technical editor will edit the final version sometime in April, and CD copies will be "burned."
7. CD copies of the PEH will be available at the Conference for all Conference attendees.
8. The PEH will also be available on the ISPA and SCEA websites. More on this later.

As it currently stands, the outline of the PEH is:
· *Introduction:* Executive summary of the Handbook including purpose, contents and endorsements. It stresses the benefits of using parametrics.
· *Chapter 1* The World Class Parametric Estimating System: Describes the "world class" parametric estimating process and the procedures, roles and responsibilities, and techniques for implementing it.
· *Chapter 2* Cost Estimating Relationships: This chapter describes the development and application of CERs, including various examples of simple to complex. Includes basic math.
· *Chapter 3* Complex Parametric Tools and Models: Describes some of the complex tools that have been developed in-house or those that are available for license.
· *Chapter 4* Parametric Applications: This chapter is devoted to a discussion of the various parametric applications, with an emphasis on the benefits of the use of parametrics in each application.
· *Chapter 5* United States Regulatory Compliance: This chapter defines the U.S. oversight requirements necessary to ensure parametric estimating systems' compliance with all Laws and Regulations.
· *Chapter 6* International Use of Parametrics: This chapter depicts how the International Community uses parametric estimating tools and techniques and the differences as compared to the approaches used in the U. S.
· *Appendices*

See you in New Orleans!
Bill Brundick

ISPA INTERNATIONAL BOARD ELECTIONS 2007

BY SHERRY STUKES,
ELECTIONS CHAIR

It is my pleasure to announce the preliminary slate of candidates for the 2007 ISPA Board of Directors Election. The Candidates list, in alphabetical order, currently includes:

· Thomas Coonce (current board member)
· Jason Dechoretz (current board member)
· Madeline Ellis (current board member)
· Bruce Minett (current Treasurer)
· Andy Nicholls (current board member)

If you would like to nominate an individual or would like to nominate yourself to add to this candidate list, please complete the Petition for Nomination form provided on page 7 and mail or fax the information to me. You will need to include the signatures of five members in good standing and a short biography/statement of qualifications along with your photograph. This Petition for Nomination form may also be downloaded from the ISPA web site located at: http://www.ispa-cost.org.

Update on Joint Society Activities

BY HANK APGAR

In our last *Parametric World*, I reported on several initiatives between the ISPA and SCEA Boards of Directors to plan joint activities, services, and administration. The immediate goal of both boards is to improve the responsiveness, quality, and efficiency of membership support.

Your ad hoc Jointness Committee, reporting to the ISPA Chair and the SCEA President, has reported continual progress with respect to joint conferences, a mutual journal, shared training, and a common professional certification program.

At a December meeting in the SCEA Business Office (in Virginia), ISPA Deputy Chair Jason Dechoretz, Business Manager Tom Coonce, and Treasurer Bruce Minett began detailed planning for a Joint International Business Office. Our goal is to assure a responsive full-time staff that provides full membership services, efficient conference administration, local chapter support, and tailored publishing to be overseen by a single point of contact within each society.

MEMBERSHIP UPDATES

Have You Seen Me?

Over the years, we have lost track of several ISPA Life-Time members. We are seeking a way to contact these members so the we can ensure they receive Parametric World, the Journal of Parametrics, the Membership Directory, as well as other information about our society.

Our lost members include:
· **Bryant Barnes** (our first ISPA Board of Directors Chair)
· **Donald F. Gordon**
· **William F. Kendig**
· **Akio Iso**
· **Jake Sachs**

If you have any contact information on the members listed above, please pass it on to:

Nerisha Hihn
ISPA Business Office
(818) 957-2340 (v/f)
ispa-office@earthlink.org

New Membership Directory to be out in March.

Sherry Stukes
903 Calle Collado
Thousand Oaks CA 91360
Fax: (805) 499-2090

Dear Election Committee:

I would like to nominate _____

to serve as (director) (treasurer) on the ISPA Board of Directors. A copy of his/her qualifications and photograph is attached. The Nominee is a member in good standing and is willing and able to contribute his/her time and talents to ISPA. In accordance with ISPA bylaws, a total of (5) ISPA members must sign this petition, affirming the nomination.

1. _____, Member in Good Standing
       Signature   *Printed Name*

2. _____, Member in Good Standing
       Signature   *Printed Name*

3. _____, Member in Good Standing
       Signature   *Printed Name*

4. _____, Member in Good Standing
       Signature   *Printed Name*

5. _____, Member in Good Standing
       Signature   *Printed Name*

The 2007 Elections Committee includes:

· Bill Brundick
· Kurt Brunner

The Elections Committee looks forward to receiving your nomination!

BY HANK APGAR

Now is the time to nominate one of your peers for any of ISPA's three 2007 professional awards, described below. Nominations will be verified and reviewed by the Awards Committee and the final recommendation will be submitted to the ISPA Board of Directors for approval. The nominator need not be an ISPA member. Nominations must be received not later than **May 31, 2007** by Hank Apgar, Professional Awards Committee Chair. Winners will be announced at the 2007 Joint Conference Awards Banquet in New Orleans.

The Clyde Perry Parametrician of the Year Award

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 during prior years, but for a minimum of two years.

This award typifies a leader in the activities of practicing or promoting the use of parametrics. This award was renamed in 2004 to honor Clyde Perry, an ISPA Founder and Service Contractor, and has been presented 23 times. The nominee need not be an ISPA member.

The Keith Burbridge Service Award

The Keith Burbridge Service Award is presented to an ISPA Member (or group of members) who has provided substantial volunteer service to ISPA in a manner supporting the principles and goals of the Society. This award was renamed in 1996 to honor Keith Burbridge, an ISPA Founder and former Secretary-Treasurer, and has been presented 20 times.

The Frank Freiman Award

The Frank Freiman Award is our highest honor and is presented 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. A Freiman candidate is expected to have left a legacy to the profession for at least five years and can receive the award only once in a lifetime. This award was originally named to honor Frank Freiman for his pioneering work in the development of parametric models and for his role in the founding of the Society. It has been presented 17 times. The nominee need not be an ISPA member.

To Submit a Nomination...

Provide the following information by email to hapgar@mcri.com:

· Full name of the **nominee** plus professional affiliation, postal address, and work telephone number.

· Full justification for the award with factual and concise substantiating information, corresponding with the award's description. Identify previous awards, society affiliations, publications, and professional achievements. Attachments and endorsements are encouraged.

· Full name of the **nominator** plus postal address, email address, and telephone number.

Previous ISPA Professional Award Winners

YEAR PRESENTED	CLYDE PERRY PARAMETRICIAN OF THE YEAR AWARD	KEITH BURBRIDGE SERVICE AWARD	FRANK FREIMAN AWARD
1981	Robert Gafney		
1982	Keith Burbridge		
1983	Jim Wilder		Larry Putnam
1984	Darryl Webb		Randy Jensen
1985	Sylvan Pinsky		Bill Cheadle
1986	Henry Apgar		
1987	Clyde Perry		
1988	Alan Mayer	Jack Griffin, Seb Botta	Barry Boehm
1989		Henry Apgar	
1990	Dan Ferens	Cindy Castellana	Gerald McNichols
1991	Marilee Wheaton	Clyde Perry	Don Reifer
1992	Peter Korda	Charles Mauro	Keith Burbridge
1993		Nina Tahir	Peter Korda
1994	Gary Constantine	Madeline Ellis	
1995	Bruce Fad	Seb Botta	
1996	Meinolf Wenzel	Marilee Wheaton	
1997	Sherry Stukes	Ron Larson	Tony DeMarco
1998	Pierre Foussier		Henry Apgar
1999	William Rutledge	Paul Lubell	Dan Ferens
2000	Georg Reinbolt	Sherry Stukes, Karen Davies	Don MacKenzie
2001		Tom Brents	Dan Galorath
2002	Arlene Minkiewicz, Karen McRitchie	Gary Constantine	Charles Hopkins
2003	David Eck	Clyde Perry	Darryl Webb
2004	Jairus Hihn	Giancarlo Filippazzo	Joe Hamaker
2005		Georges Teologlou	Steve Book
2006	Richard Stutzke	Quentin Redman	

On Winning Best 2006 ISPA Conference Paper

BY STEVE BOOK

I was surprised and pleased at having my paper, "IRLS/MUPE CERs are Not MPE-ZPB CERs," selected as the Best Paper of the ISPA Conference held in Seattle last May. The subject matter of the paper, statistical techniques for CER development, has been one of my major professional interests for the past 20 years. I have long believed that the 18th Century techniques of the linear least squares additive-error CER form $y = a+bx$ and the logarithmic transformation log $y = log\ a + b(log\ x)$ of the curvilinear multiplicative-error CER form $y = axb$ are inappropriate for use in cost estimating today. Specifics of my opinions on this are well known, and have been addressed by me in many venues, and need not be further discussed here. I hope, however, that any publicity generated by the paper's receipt of the Best Paper Award will be reflected in more members of our profession becoming familiar with the modern methods of regression analysis such as IRLS and MPE-ZPB. We must bring cost estimating into the 20th Century! (IRLS was introduced to the statistical community in 1968.) There are still a lot of unanswered questions associated with both IRLS and MPE-ZPB and a need for research studies to resolve them.

I look forward to hearing and reading future papers by other ISPA members that advance the application of these methods to CER development and other issues in cost and schedule analysis.
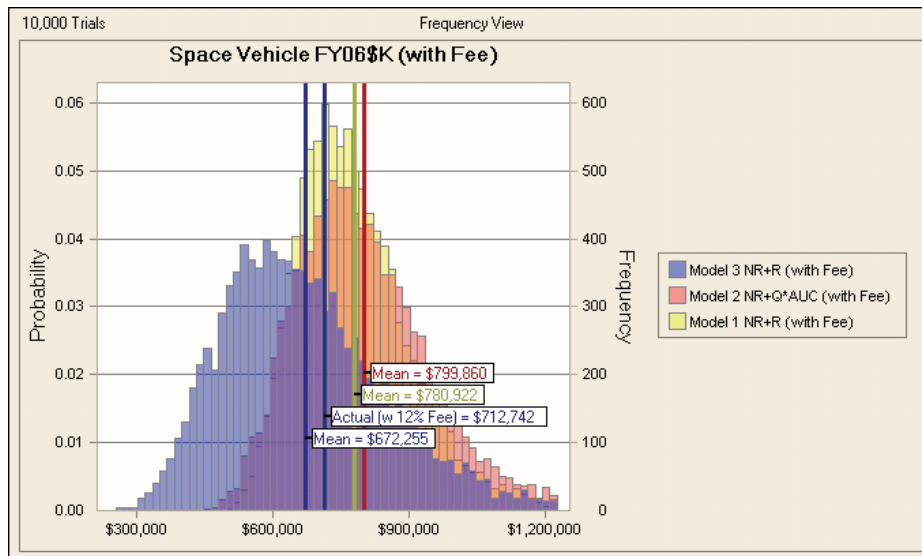
Figure 1. Comparing Model Results for Reasonableness

estimates produced within the error bounds of the CER. If we can't verify the CER, we can't ensure that it is reasonable. Figure 1 shows a comparison of probabilistic costs of a completed satellite program's actual cost plus fee for three satellites with three different cost estimating methods. Note the actual costs fall within the probabilistic range of all three models.

How and Why CERs Fail

It is true that some of our best CERs fail or are waiting to fail. There are several reasons CERs fail to accurately estimate cost. Here we will go through some scenarios and how to combat the issues associated with the failure of CERs.

1) **Obsolescence:** The historical data used to derive the CER does not apply to the current use of the CER due to changes in technology, business practices, or application. When design, manufacturing or application technology changes, CERs developed under an existing or evolving way of doing business no longer apply. As a result of such changes, the critical cost elements also change, such as the basic design method, material types and quantities, amount of labor, and amount of automation. In this case, the scope of the estimate will change and thus the applicability of the CER to the scope of the work will be vitiated.

2) *A Posteriori* **Cost Drivers:** Cost drivers used to create CERs are based on *a pos-*

teriori information (known after the fact) rather than *a priori* information (known before the fact). We develop CERs based on data that are collected at the end of a program, normalize them and regress them against cost drivers that are collected at the end of a program. Some of the most widely used cost drivers, such as weight (for hardware) and effective source lines of code (ESLOC), are collected and calculated after a program is complete (*a posteriori* information), not when it is in the conceptual design phase (*a priori* information). However, CERs estimate *a priori* costs. This makes CERs fail the reasonableness criterion. Although CERs may be selected from a group of viable candidates, often CERs with the best fit statistics are selected for use based on fit statistics alone and not the reasonableness of cost drivers. When weight and ESLOC are chosen as cost drivers, we must ensure that we can accurately derive these parameters. This is often not the case. The Aerospace Corporation has published two reports that show weight and ESLOC growth of satellite and software programs. [Ref. 2] Weight and ESLOC are *a posteriori* values, which are not accurately known at the program's conception. Perhaps better cost estimating relationships for the costs of hardware and software could be produced using *a priori* data; however in the meantime, the analyst must ensure that a probabi-

listic expected growth is included in the estimate.

3) **Normalizing for Quantity:** Often CERs are based on regression of total lot cost data - including many single- or few-unit data points, and a few multiple-unit data points and are regressed to a theoretical first unit (T1) cost. When we use a CER developed under this approach, we need to assume a learning curve slope and theory. Applying this CER to a multiple unit estimate may result in errors in the T1 cost and in the final estimate at quantity. [Ref. 3] One solution to this is to re-regress the data with quantity as an independent variable or QAIV. [Ref. 4] Using this approach, the learning curve assumption is eliminated and the resulting CER may have a better, if not more reasonable and realistic result.

4) **Use of a CER Outside the Range of Data:** In this case a CER is used outside one or more of the ranges of the independent variables in the data set used to develop the CER. There are two approaches to combat this situation:

   a) Use the CER if it is marginally outside the range of the data and expand the CER's error prediction bound based on the extrapolated output of the CER. Book [Ref 5] provides a method of calculating prediction bounds for General-Error-Regression CERs.

   b) Extend the useful range of the CER through re-regression using a normalized cost driver. For example, early CERs for predicting the cost of spacecraft solar arrays relied on solar array area. In the 1990s, solar array sizes for Geosynchronous orbit satellites exceeded the range of solar array areas used to develop the solar array CER. One approach used to account for the use of the CER outside the range of the data was to normalize the solar array area by the number of solar array panels used on each satellite in the database. Since solar arrays are built by attaching multiple solar array sub-panels to create a large solar array, this was a reasonable approach to extend the useful range of the CER.
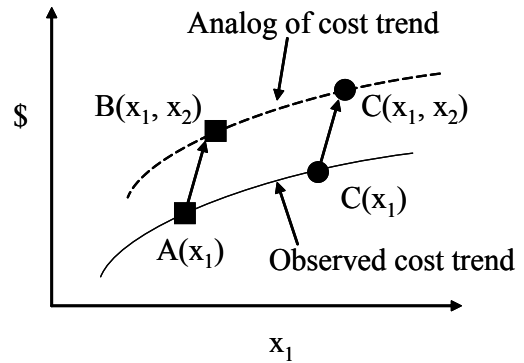

Figure 2. Analog of Cost Trends

5) **No CER Exists:** Sometimes what we must estimate is so different from the scope and applicability of the available set of CERs that can estimate the cost well. In this case, a few alternatives exist:

   a) Apply a scaled analogy

   b) Use a buildup or grass roots approach using estimates at a more detailed level

   c) Re-regress the data with a new data point or set of data points

Scaled Analogs

The first type of estimating method listed above, analogy, refers to comparing the cost of an item to be estimated to that of a similar item. [Ref. 6] Analogs can be either directly applied or through interpolative or scaling techniques. A direct analog is the one-for-one comparison of the historical cost of an activity or product with one being estimated. A scaled analog relies on the scaling of historical cost data points or cost trends based on one or more key cost drivers (Fig. 2).

Scaled analogy-based estimates require two steps. First, an observed cost trend is scaled by comparing a cost data point, A, which has a cost driver, x_1, with a similar cost data point, B, which has an additional cost variable, x_2. The observed cost trend associated with the additional cost driver is scaled to arrive at an analog of the cost trend due to the additional variable. Second, the analog of the cost trend is applied to a third point to be estimated, C, which has two cost drivers, x_1 and x_2.

For example, one can determine an analogous cost for composite structures based on the observed cost trends of structure versus

structure weight using two data points: one for an aluminum structure and one for a composite structure. An analog can be created by finding a scaling relationship between the costs of the aluminum and composite structures with the same weight and applying scaling to the observed trend for aluminum structures.

When analogs and extrapolations are used, we can apply the method described by Book [Ref. 5] to approximate the effect of using the CER out of the data range. Although we really would not know the true answer of how well our CER performed as a predictor until after the program is complete, we can scale the prediction error bound to account for extrapolation of the database beyond the range of the CER.

Build-up Approaches

Grass roots estimates typically involve the build-up of costs of activities (measured in hours and/or monetary units) and the cost of materials at a very detailed level. This approach is usually used by manufacturers with access to effort and material data on a similar program. The grass roots approach is also used due to lack of data to create historical analogs or parametric relationships derived from multiple historical data points. Both manufacturers and non-manufacturers often rely on expert judgment to account for differences from historical programs, if any exist at all. The grass roots approach augmented by expert judgment is typically the most detailed, yet it presumes the outcome to be one of a perhaps large range of potential scenarios. This presumption combined with the reliance on expert opinion often results in an overly optimistic estimate. [Ref. 7] We recommend using a reasonable and realistic approach to quantifying uncertainty in the case of build-up approaches to avoid potential scenario limitations.

Error in Variables (EIV) Regression

CER regression techniques have traditionally been limited to curve fitting of vectors of discrete dependent variables (cost) with vectors of discrete independent variables (cost drivers). We assume the regression variables are discrete and non-random in nature; however, errors in both the dependent and independent variables can arise in the data collection and normalization process. Error-in-variables regression techniques can be employed to find appropriate CERs with errors in either the dependent or independent variables or even when both are random variables. This technique can also be applied to re-regressing CERs with new data where the old data are not available. [Ref. 8]

Summary

CERs are helpful tools when used under the intended circumstances. Unfortunately, there are cases when CERs fail to accurately represent the cost of future programs. We have provided a series of cases in which CERs fail and some recommended approaches to overcome these failures and shortcomings.

References

[1] Covert, R., and Anderson, T., "Establishing Confidence in Bespoke Cost Models", Presented at EACE Workshop, Cranfield, UK, October 21, 2004.

[2] Covert, R., "Ten Common Things Wrong with Cost Risk Analysis", Presented at 76th SSCAG, Hampton Roads, VA, October 22-23, 2002.

[3] Book, S.A and Burgess, E.L., "The Learning Rate's Overpowering Impact on Cost Estimates and How to Diminish It," Journal of Parametrics, Vol. 16, No. 1, Fall 1996, pages 33-57.

[4] Book, S.A and Burgess, E.L., "Quantity as an Independent Variable (QAIV)", 36th Annual DoD Cost Analysis Symposium. 28-31 January 2003.

[5] Book, S.A., "Prediction Bounds for General-Error-Regression CERs", 39th Annual DoD Cost Analysis Symposium. 14-17 February 2006.

[6] SCEA, "Costing Techniques, Cost Programmed Review of Fundamentals (COST-PROF)", Society of Cost Estimating and Analysis (SCEA), 1:2, p.1-37.

[7] Peeters, D & Dewey, G., "Reducing Bias in Software Project Estimates", Crosstalk: The Journal of Defense Software Engineering, April, 2000.

[8] Covert, R., "Error-in-Variables Regression using Monte Carlo Simulation and Optimization", Presented to the Joint SSCAG/EACE/SCAF Meeting, September 21-23, 2006.

Southern California Chapter

BY SHERRY STUKES

Our most recent workshop, held on 6 December 2006, hosted by Tecolote Research, Inc. in Manhattan Beach, CA, had a great turn-out and the speakers were very well received. There were sixty-five attendees present at the workshop and another eight participants connected by WebEx.

Our one-day workshop included an inspirational welcome address presented by **Lee Atkins**, Tecolote General Manager-Los Angeles Division, which discussed the state of the cost estimating profession and the challenges that we face. **Dr. Steve Book**, Journal Editor, presented an overview of the Journal of Parametrics and demonstrated how information contained in the Journal articles can be put to use immediately. There were also five technical presentations. A transcript of Lee Atkin's presentation and the slides from Steve Book's overview are included on the ISPA web site under the Southern California Chapter at: **http://ispa-cost.org/SouthernCal.htm**. The following workshop presentations are also included on the web site:

- **Ricardo Garcia**, *Senior Analyst, Tecolote Research: "Using Traditional Electrical Power Subsystem (EPS) Storage Cost Methods to Estimate Lithium Ion (Li-Ion) Batteries for Space Applications"*
- **Doug Howarth**, *Advanced Development Projects Parametric Estimating Lead, Lockheed Martin: "The Market as Target"*
- **Sam Sanchez**, *Manager Service Operations, Galorath Incorporated: "ASIC Cost Fundamentals"*
- **Brian Benedict**, *Northrop Grumman Space Technologies: "How–to Develop Distribution from Single Point Estimates"*
- **Barry Holchin**, *Consultant: "Code Growth Methodology"*

At the conclusion of the Workshop, the attendees were invited to a "Happy Hour" at McCormick and Schmick's restaurant. Tecolote sponsored appetizers and there was a "no-host" bar available. This event allowed the meeting attendees to network, speak with the presenters, and discuss the presentations in an informal setting. It was also a good opportunity to let the traffic die down before making the trip home! The Happy Hour worked so well that we will attempt to include it as part of future workshops.

Our next Southern California Chapter workshop is scheduled for 7 March 2007. It is being co-hosted by PRICE Systems and the Air Force Space and Missile Systems Center (AF SMC). The meeting will be held at Fort MacArthur located in San Pedro, CA. The agenda is in the process of being finalized and will be e-mailed along with a map and registration instructions to our distribution list.

By popular demand, we are planning to offer WebEx web casting and audio conferencing for attendees that cannot participate in person. If we are able to make this capability available, specific details will be included in the workshop e-mailing. **Madeline Ellis**, madeline.ellis@boeing.com, will be coordinating this activity. Remember, web casting is no substitute for the value that you gain by personal attendance and your networking ability will be limited. However, for individuals who are out of town or unable to travel, this will serve as a way to participate in the workshop.

Mark your calendar for 7 March 2007 and plan to attend the first ISPA workshop of 2007! We will be e-mailing information about the workshop, including an agenda, location map and driving directions, and registration details, at the end of January to all ISPA members and previous workshop attendees. If you did not receive an e-mail and would like to be included in our distribution, please contact me.

Remember, **there is no fee for attending the workshop!** The host organization will provide the meeting facility as well as morning and afternoon refreshments. Due to the logistics of getting in and out of the workshop site, PRICE Systems will also be hosting lunch as part of the March Workshop.

The **Southern California Chapter Board of Directors** elections are complete and the new Board will be announced at the March Workshop by the Southern California Chapter Elections Chair, **Madeline Ellis**. Only ISPA members were eligible to vote in the election, so if you are not a member and would like to have a say in who runs the Southern California Chapter, consider joining ISPA. The $55 per year is a good investment in your career!

I hope to see you at the March workshop!

Sherry Stukes, President
ISPA Southern California Chapter
sherry.a.stukes@jpl.nasa.gov
(818) 393-7517

Southwest Chapter

Success: Building a Chapter One Brick at a Time!

A successful person is one who can lay a firm foundation with the bricks that others throw at him! (David Brink)

The "bricks" gathered during our exploratory phase are transforming nicely into a strong chapter foundation. We reported on the inaugural October 2006 workshop and are pleased at the interest and support that our chapter continues to garner. We've added five new members since the workshop plus had a number of inquiries.

Planning for our second workshop is well under way. We have engaged a world-class keynote speaker, Bill Waddell, an internationally-known lean manufacturing consultant, author, and speaker. Bill, an advisor to Honda's Suppliers' Network, will discuss **"Cost Management for Lean Manufacturing."** The workshop is scheduled for:

Wednesday, March 14, 2007 • 8:00 a.m. to 4:00 p.m. at the Western International University campus in Chandler, AZ

You are invited to exchange ideas with the following workshop presenters:

- **Mike Ross**, CEO of r2Estimating LLC and Southwest Chapter Treasurer/Board member, "Commit to Success" (r2Estimator introduction and demo)

- **Bruce Fad**, V.P. PRICE Systems, LLC "Ten Dumb Statements on Estimating— Confessions of a Cost Lifer"

- **John Whiteside**, Sr. Principal Systems Engineer, Raytheon Missile Systems, "A Process for Developing Design to Cost Goals"

- **Dion Rettberg**, Business Development Manager, Galorath, Inc. and Southwest Chapter Secretary/Board member, "Econometrics Explained"

Special thanks to Vincent Ferrara and the PRICE Systems management team for hosting a complimentary luncheon, followed by a short overview of PRICE Systems products and services during lunch.

If business or personal travel places you in the Phoenix area on March 14, 2007, we cordially invite you to join us! Please RSVP to Diana Patane by close of business on Thursday, March 8, 2007 — S_Diana_Patane@raytheon.com or (520) 545-6117. Driving directions will be provided in a follow-up e-mail.

Join with us as our "Building Committee" continues work on our strong "brick" foundation!

Diana Patane
Southwest Chapter V.P.

Mid-Atlantic Chapter

BY DICK BASNER

The Mid-Atlantic Chapter will hold its next Regional Workshop in Rosslyn, VA on April 24, 2007. The workshop is being hosted by PRICE Systems at their Rosslyn Office at:

1700 N. Moore Street
Suite 1100
Arlington, VA 22209

PRICE Systems is located in the same building as the Rosslyn Metro Stop – You can take the Orange or Blue Line Metro to Rosslyn and take the elevator up to PRICE Systems.

If driving, parking will cost $12 at nearby parking garage.

Due to space limitations, attendance will be limited to the first 30 registrants.

Please call (703) 740-0087 to secure your spot.

- PRICE Systems will provide a Continental Breakfast from 7:30am to 8:30 a.m. and lunch.

- Workshop will start promptly at 8:30 a.m.

- Afternoon workshop sessions will end at 3 p.m.

Speakers and schedule will be announced in a few weeks.

The Mid-Atlantic Chapter will hold Chapter Elections soon. Therefore, we are looking for interested ISPA members to run for the Chapter Board of Directors . We already have two names, but need three more. If you would like to nominate yourself to run for Chapter office, please call Dick Basner, 410-765-3513, or Martha Spurlock, 804-765-4792.

Korean Chapter

For information please contact:
Kyu Meyung Choi
Prigent Corporation
Hanjin Resort Officetel, Suite 1206
535-4 Bongmyeong-Dong
Yuseong-Gu, Daejeon, Korea
km@prigent.co.kr
82-426-035-885

2007 ISPA-SCEA Joint Conference Cost Analysis: Vital Tool in Today's Competitive Environment

Marriott New Orleans Convention Center
New Orleans • LA • June 12–15, 2007

This year's Annual Conference and Training Workshop promises to be the best yet!

We'll be in New Orleans, one of the most historic and interesting places in the nation! Our conference hotel is located near the world famous and historic French Quarter, the newly renovated and trendy Warehouse District, across from the Riverwalk and Harrah's Casino. As with previous years, we will feature Professional Papers, Training Tracks, Keynote Speakers, and Panel Discussions covering the very latest techniques, accepted methods, the newest software and tools, and hot topics of interest throughout the profession. This year's conference will have 3 Training tracks and many Professional Paper Tracks.

Listen to great speakers and industry leaders

- Jay M. Cohen, Under Secretary for Science and Technology, Department of Homeland Security (DHS)

- Dr. Barry Boehm, TRW Professor of Software Engineering, Computer Science Department, Director, USC Center for Systems & Software Engineering

- Mr. Donald Damstetter, Director, Financial Management and Comptroller, U.S. Special Operations Command (USSOCOM)

- Ms. Patricia Olsen — The Boeing Company — VP, Contracts, Pricing & Estimating (IDS)

- Ms. Susan Cote — Northrop Grumman Corporation — VP, Corporate Contracts & Pricing

Learn from the experts

We are extending the conference on Friday afternoon to accommodate 25% more Professional Papers this year. And this year we are expanding your choices even more! The conference, in conjunction with the University of Alabama Huntsville, will be adding a track containing 10 Contractor Pricing courses.

Catch-up on the Latest in Cost Estimating Tools

One of the most important opportunities of an ISPA-SCEA Joint Conference is the chance to catch up on the very latest in the commercial sector at our exhibitor's booths. Our exhibitor list isn't final at this writing, but in the past it has included such leading firms in cost estimation as Tecolote Research Inc. and MCR, and tool developers such as PRICE

Systems and Galorath, as well as, specialized risk assessment tools like Crystal Ball.

Secure your seat on-line

Register for the Conference on-line at www.sceaonline.net. Credit cards are accepted. Registration fees are $825 for SCEA /ISPA members, $900 for non-members, and $750 for groups of 5 or more (group members must be part of the same organization). Members of groups can register individually, but a company representative must contact the National Office to establish the group in advance.

Training Program: The highly acclaimed annual SCEA Training Program will be taught by outstanding academicians and practitioners. In addition to a thorough review of the basics and the latest state-of-the-art of cost estimating and analysis, there will be comprehensive coverage of Earned Value Management, the use and application of Parametrics in the estimating challenge, as well as ISPA's popular review of the authoritative Parametric Cost Estimating Handbook. The training program is an excellent introduction for those new to the profession and of equal value for the seasoned practitioner to refresh and expand his or her skills. Continuing Education Units (CEUs) approved by IACET are awarded for each course attended. (This program is of particular value for individuals planning to sit for the Certified Cost Estimator/Analyst (CCE/A) examination or ISPA's Certified Parametric Practitioner CPP examination.)

As always, this Conference will also provide you an opportunity to become recognized in your profession through professional certification. SCEA has its Certified Cost Estimator/ Analyst (CCE/A) examination and ISPA will offer the Certified Parametric Practitioner (CPP) examination. The exams will be administered by their respective society on Saturday morning (register separately).

Professional Paper Presentations: This conference currently has over 70 professional paper presentations planned, covering topics such as:

• Information Systems Cost Estimating

• Risk Methodology and Models

• Acquisition Reform

• Earned Value Management

• Applications Software

• CAIV

The conference will feature a Banquet Thursday night, at which ISPA & SCEA will announce their Annual Awards, and we will also present the Best Paper Awards in each track and overall for the Conference. Our Banquet Speaker this year will be Mr. Donald Damstetter.

Panel Discussions: The popular "Renew Your Training" session will be held once again. We will have a panel discussion on the results of the exercise. The panel will be composed of recognized experts and practitioners in our field, and they will address relevant contemporary initiatives of interest to our attendees. Melvin Broder is the Chairperson for this session and can be contacted at Melvin.A.Broder@aero.org. The specific topic and training exercise will be provided by February, 2007. If you, or your organization, are interested in participating in this session please contact Mr. Broder for more information.

In addition to the "**Renew Your Training**" exercise and panel, we will feature a panel of senior Industry leaders discussing issues important to program and system cost estimating. Thursday morning will open with Dr. Barry Boehm as our Keynote Speaker and, following a break, a panel discussion among leaders in the software estimating profession from the government and private industry.

Premier Hotel: Opened in the Summer of 2005, the New Orleans Marriott at the Convention Center is located across the street from New Orleans Morial Convention Center, in the revived Arts/Warehouse District. This is a premier hotel constructed in a historic 150-year-old renovated warehouse.

Special Hotel Conference Rate

The conference rate is tied to the Federal Joint Travel Regulation rate. So, whether you book your reservations online at www.marriott.com, or by calling Marriott's Reservation Center at 800.228.2100, be sure to ask for the ISPA-SCEA rate (**Group Code "SCESCEA"**) when you book your reservations.

· Rooms at the Conference Hotel will go fast —

· So make sure you book early! If you book by 1 April 2007, the hotel will provide complementary in-room movies.

· We have also made arrangements with two other nearby properties.

· If you'd prefer, or you do not make your reservations until after the Marriott Con-

vention Center has filled, you may book your stay at either

· the Marriott's Courtyard New Orleans Convention Center, or

· the SpringHill Suites New Orleans/Convention Center.

· Both of these properties will honor the conference rate, so be sure and use the Group Code.

Exhibitor, Supporter, and Sponsorships Opportunities

We are offering new opportunities to support this conference as an exhibitor, supporter, or sponsor. We offer varying levels of recognition, prominent display, acknowledgement, preferred exhibitor space, discounted registration, and more with three sponsorship levels: silver, gold, and platinum.

Guest Program

We are working with the New Orleans Convention & Visitors Bureau and are in the process of providing guest program options. These will be posted on the conference website (www.ispa-scea.org) as soon as they are available.

2007 ISPA–SCEA Conference Points of Contact

ISPA Chairperson Madeline Ellis (madeline.ellis@boeing.com)

SCEA President Dan Nussbaum (danussba@nps.edu)

Conference Co-Chairpersons Bill Haseltine (haseltinew@mindspring.com) & Lita Schulte (elizabeth.a.schulte@boeing.com)

Training Track Co-Chairs Peter Braxton (peter.braxton@ngc.com) & Doug Druley (douglas.druley@baesystems.com)

Program Track Co-Chairs Paul Marston (pmarston@mcri.com) & Sherry Stukes (sherry.a.stukes@jpl.nasa.gov)

Conference Awards Co-Chairs Frank Flett (fflett@aol.com) & Hank Apgar (hapgar@mcr.com)

Exhibitors & Sponsors Co-Chairs Bettye Munson (elizabeth.munson@gd-ais.com) and Bill Haseltine (haseltinew@mindspring.com)

Southwest Chapter's "Aeronautics Tutorial"

Friday, April 27, 2007

Life's second greatest thrill is said to be "FLYING." What is the first greatest thrill you ask? A SAFE LANDING!

The Southwest Chapter invites ISPA members and guests to an "Aeronautics Tutorial," on Friday, April 27, 2007, to experience first-hand life's greatest thrills! For the nominal fee of $35 each, attendees will have access to Embry Riddle Aeronautical University's flight simulators, their AXFAB Engineering Experimentation/Fabrication Lab, and a tour of the beautiful Prescott, Arizona campus. Dr. Javad Gorjidooz, a professor at Embry-Riddle and an author and presenter at ISPA workshops, will host this event.

Proceeds from this Tutorial will go toward the Southwest Chapter's Scholarship Program, and specifically a scholarship for a deserving Embry Riddle Aeronautical University engineering student author of the "best" white paper on a parametric/econometric topic.

Experience Airbus 320 take-offs, landings, and cross-country flight in the flight simulator! Explore the Aerospace Experimentation and Fabrication Building (AXFAB), and tour the university campus. Situated amid Arizona's Bradshaw Mountain Range at an elevation of 5,350 ft., the campus is nestled on the 539-acre campus near Love Field Municipal Airport, the second busiest airport in AZ.

Embry Riddle's Aerospace Engineering Program has been ranked number one for the seventh straight year in the Aerospace/Aeronautical/Astronautical Engineering category (for schools without doctorate programs) by U.S. News & World Report's "Best Colleges." (http://www.embryriddle.com/)

Participation in the Tutorial will be limited to the first 48 to sign up. An agenda will soon be available. Mark your calendars to be part of this exciting event, and reserve a seat for the simulator today!

RSVP to: Diana Patane, Southwest Chapter V.P., S_Diana_Patane@raytheon.com or (520) 545-6117.

Leonardo Da Vinci said it best…"Once you have tasted flight, you will forever walk the Earth with your eyes turned skyward, for there you have been, and there you will always long to return."

Consider spending some time at the Embry Riddle Aeronautical University website. www.erau.edu! It's worth the exploration!

Diana Patane
Southwest Chapter V.P.

2008 ISPA INTERNATIONAL CONFERENCE

NOORDWIJK - THE NETHERLANDS

Back by popular demand, our 2008 International Conference will once again be held in Noordwijk - the coastal resort town in the heart of the world-famous Dutch bulb fields. Our main sponsor will be the European Space Agency's Research and Technology Centre (ESA/ESTEC) also located in Noordwijk. Immediately following the ISPA Conference SSCAG, in collaboration with SCAF and EACE, will hold joint workshops from May 15–16. Please save these dates and note the following:

ISPA Conference:	May 12–14, 2008
SSCAG, SCAF, and EACE Workshops:	May 15–16, 2008
Host Hotel:	Hotel Huis Ter Duin
	Noordwijk - The Netherlands
ISPA Papers Point of Contact:	Sherry Stukes
	sherry.a.stukes@jpl.nasa.gov
ISPA Conference Point of Contact:	Herve Joumier
	Herve.Joumier@esa.int

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Dues Amount (US$):   ❏ $55.00 Annual Member   ❏ $30.00 Student Member   ❏
$550.00 Life Member

Credit Card: ❏ Visa   ❏ Mastercard   ❏ American Express
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