PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 9583

, "Front Matter: Volume 9583," Proc. SPIE 9583, An Optical Believe It or Not: Key Lessons Learned IV, 958301 (13 October 2015); doi: 10.1117/12.2208540

SPIE.

Event: SPIE Optical Engineering + Applications, 2015, San Diego, California, United States

PROCEEDINGS OF SPIE

An Optical Believe It or Not: Key Lessons Learned IV

Mark A. Kahan
Editor

10 August 2015
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 9583

Proceedings of SPIE 0277-786X, V. 9583

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

An Optical Believe It or Not: Key Lessons Learned IV, edited by Mark A. Kahan, Proc. of SPIE
Vol. 9583, 958301 · © 2015 SPIE · CCC code: 0277-786X/15/\$18 · doi: 10.1117/12.2208540

Proc. of SPIE Vol. 9583 958301-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *An Optical Believe It or Not: Key Lessons Learned IV*, edited by Mark A. Kahan, Proceedings of SPIE Vol. 9583 (SPIE, Bellingham, WA, 2015) Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781628417494

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) • Fax +1 360 647 1445

SPIE.org

Copyright © 2015, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/15/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a six-digit CID article numbering system structured as follows:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

v	<i>Authors</i>
vii	<i>Conference Committee</i>
ix	<i>Introduction</i>

SESSION 1	LESSONS LEARNED FROM FAILURES IN STRATEGIC PLANNING, EXECUTION, AND COMMUNICATION
------------------	--

9583 03	Acquisitions: developing a successful integration process [9583-2]
9583 04	Execution and executability [9583-3]
9583 05	Lessons learned in aligning an organization: two-way communication is key [9583-4]

SESSION 2	KEEPING THINGS ON TRACK AND DEBUGGING THE FAILURES
------------------	---

9583 06	They never told me about this in engineering school: lessons from the front line [9583-5]
9583 08	What to do when your CTQs (critical-to-quality characteristics) turn into WTFs (what-the-flig): a guide to root cause analysis and correction action (Invited Paper) [9583-20]

SESSION 3	SYSTEM LEVEL TAKE-AWAYS
------------------	--------------------------------

9583 0A	Lessons not to make light of (when designing optical systems for space) [9583-8]
9583 0B	Requirements management lessons learned: fuzzy "most likely" versus clean shaven "not to exceed" [9583-9]
9583 0D	The beam rotation that almost was in the National Ignition Facility [9583-12]

SESSION 4	DESIGN, TOLERANCING, FABRICATION, AND ASSEMBLY: ENGINEERING LESSONS LEARNED
------------------	--

9583 0F	The art of planning for optical systems integration and alignment [9583-10]
9583 0G	Trials and tribulations of optical manufacturing: asphere edition (Invited Paper) [9583-15]
9583 0H	Polarimeter calibration error gets far out of control [9583-16]
9583 0I	A quintuple of painful lessons from surface inspection to high-speed imaging [9583-17]

SESSION 5 LESSONS IN STAFFING AND TRAINING

9583 OK **The sage is on the stage, and the audience is texting** [9583-19]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Arenberg, Jonathan W., 06
Bradford, Robert W., 04
Chipman, Russell A., 0H
Coleman, Lance B., 08
DeGroote Nelson, Jessica, 0G
Donnelly, Judith F., 0K
English, R. Edward, Jr., 0D
Frisch, Gregory, 0G
Hahlweg, Cornelius, 0I
Harrison, Denise, 03, 04, 05
Kendrick, Stephen E., 0A
Light, Brandon, 0G
Lightsey, Paul A., 0B
Medicus, Kate, 0G
Rothe, Hendrik, 0I
Schickler, Mark, 0G
Sullivan, Joseph F., 0F
Weyer, Cornelia, 0I

Conference Committee

Program Track Chairs

José Sasián, College of Optical Sciences, The University of Arizona
(United States)

R. John Koshel, College of Optical Sciences, The University of Arizona
(United States)

Conference Chair

Mark A. Kahan, Synopsys, Inc. (United States)

Conference Program Committee

George Z. Angeli, LSST (United States)

Paul Atcheson, Ball Aerospace & Technologies Corporation
(United States)

Steven J. Battel, Battel Engineering, Inc. (United States)

Robert P. Breault, Breault Research Organization, Inc. (United States)

James T. Carnevale, Raytheon Company (United States)

William J. Cassarly, Synopsys, Inc. (United States)

Daniel R. Coulter, Jet Propulsion Laboratory (United States)

Charles D. Cox, UTC Aerospace Systems (United States)

Marc T. Daigle, Optical Alchemy Inc. (United States)

Alan E. DeCew, Jr., MIT Lincoln Laboratory (United States)

Ronald G. Driggers, U.S. Naval Research Laboratory (United States)

Mark A. Ealey, University of Kansas (United States)

David F. Everett, NASA Goddard Space Flight Center (United States)

James L. Fanson, Jet Propulsion Laboratory (United States)

G. Groot Gregory, Synopsys, Inc. (United States)

Alson E. Hatheway, Alson E. Hatheway Inc. (United States)

Joseph B. Houston, Jr., Houston Research Associates (United States)

Tony Hull, The University of New Mexico (United States)

Gary W. Matthews, Exelis Inc. (United States)

Duncan T. Moore, University of Rochester (United States)

Harold Schall, The Boeing Company (United States)

Robert R. Shannon, College of Optical Sciences, The University of
Arizona (United States)

Michael J. Sholl, University of California, Berkeley (United States)

H. Philip Stahl, NASA Marshall Space Flight Center (United States)

David A. Thomas, David Thomas Consulting (United States)

Linda C. Usher, Executive Search Group (United States)

James C. Wyant, College of Optical Sciences, The University of
Arizona (United States)

Introduction

This conference is the fourth SPIE conference dedicated to the sharing of key optical lessons learned. Nearly all optical engineers, scientists, researchers, or managers have dealt with the unexpected. Many of these situations in hindsight are quite funny, and have buried within them key optically related lessons. The problem with simply listing lessons learned is that as a simple listing, they are hard to remember clearly. Thus, much to our collective debit, history repeats itself. This conference was configured to allow a bit of humor into the mix. By presenting a collection of small interesting stories or optical, managerial, and/or project-related parables, it helps us all remember the important takeaways. Though we allowed each presentation to be somewhat embellished by the author (within editorial limits), with names, places, and dates sometimes changed to protect those involved, this year there was also an emphasis on hard truths. Please note that even when humor is used, all presentations have a basis in truth as self-avowed by the author and "the devil's advocate" by the Chair, and all talks included at least one, if not more than one, lesson learned that have serious optical content.

Papers were specifically requested on past, current, and/or evolving optically related developments that satisfy the following criteria:

- Have been subject to surprises, anomalies, and/or unanticipated business factors which, in hindsight, are funny and which have a key optical lesson learned/takeaway
- Where (optically related) specifications went terribly wrong
- Any aspect of the build-cycle could be included be it in conceptualization, design, development, fabrication (any somewhat optically related process), test, or end-use
- Any discipline could be included if/as it ties to optics (e.g. project management, principal investigator roles, opto-mechanics, thermo-optics, electro-optics, optical-physics, etc.)
- Any personnel problem could be included if/as it relates to an optical truth (this could include hiring, training, or the lack thereof).
- Any optically related piece-parts could be included, from raw materials to heat treats, to coatings, to mechanisms, etc.
- Any optical environment was acceptable, e.g., from underwater to outer space to child-proof toys to shot-from-a-gun
- Any size was acceptable, e.g., from nano/MEMS, to deployable multi-meter optics
- Any unusual scheduling and/or financing problem was acceptable as long as it was optically driven
- Aspects that tied to IP, patents, and/or other legalities could be the subject of interest, and

- Inter-company relationships and/or relationships with clients, suppliers, and or vendors could be included—if the author so dared, and could sanitize the text to avoid liability (and as long as there was a key optically related takeaway, though these could be in an optical business-based sense).

Of special interest were stories where, despite any humor, the optically related lessons learned were serious and would help to form a body of knowledge that can grow and be used as an evolving checklist for other ongoing or future optically related adventures.

Again this year, we had some exceptional speakers that have had direct, hands-on involvement in a tremendous amount of important and diverse roles in optical history. These sessions are a chance for us to share this information and capture key takeaways that can be used by all, whether new to the industry or a seasoned veteran. Our hope is that these talks will help to keep us out of trouble, even if only to clarify our own thoughts and/or help justify budgets so that management will adequately fund our endeavors.

We won't trivialize the punch-lines by doing a simple summary here. The authors' papers deserve serious attention and a set of crib-notes doesn't do these sometimes complex subjects justice. It's not so much that the concepts are so terribly complex; it's that the situations that lead to some of the lessons learned have slippery-slope contextual aspects that are relatively subtle, or there are logical short circuits that come into play. Just one past example would be from HST. End-to-end testing was eliminated to save money. The presumption was that as long as two totally different piece-part tests agreed, all would eventually be well. But then schedules got tight, and logic gave way to what folks knew in their hearts was right—that the reflecting null corrector used to finalize the primary mirror was all that really mattered, and that the supposedly less accurate refracting null could be ignored (not!). Of course in ignoring the refracting null's test results the initial premise was violated that required two different tests which had to agree, and agreement should mean quantitatively match-up accounting for the respective tests' tolerance bands. (As we know, although on paper the reflecting null corrector was better than the refractive null corrector which was used to rough-in the primary mirror, the reflecting null corrector was not built to specifications.)

By not shorting out your need to examine the papers presented, we're actually invoking a lesson learned. Simple summary charts often can lead to a false sense of understanding. But with that stated, we do intend to keep tabs on the various lessons learned, and this may well become a future rolling scorecard, albeit with a somewhat intentional time delay to encourage the real-time readers to delve into the details and find the devil that's hiding in wait for them.

The Chair would like to provide a special thank you to all the speakers, as well as the advice of his Committee Members. All the talks were truly exceptional!

For those speakers who wish to be "judged" (and where no 2nd place finishers are noted), we sometimes give a technical or a management award. Award ceremonies, if any, are held in an appropriate following year. This year, so many talks were judged to be 10s on a 10-point scale that there were both technical and managerial ties. The chair will sort this out with the help of the presenters and the members of his committee, and report the results at the next Lesson's Learned session, whenever that may be, though it's possible that at some point additional information will also be released in SPIE's Members News. (Don't worry if you were a speaker; you won't be surprised. We'll close the loop with all involved ahead of time. For those of you who participated last year, please be patient, and we'll announce more information when logistics allows.)

After the conference cut-off date, and thus after conference rooms had been assigned and the overall timing of all the SPIE sessions had been established, several (nearly 60!) speakers inquired about presenting in 2015. Of course it was too late to accommodate these requests, but because of this apparent (TBD, I'll believe it when it comes true) pent-up demand/desire to continue in the regular sharing of this type of information, we are releasing an out-of-cycle call for papers for 2016. The response to this call will determine if we hold our next Lessons Learned session in 2016 or revert back to the alternate year schedule that we have used to date.

Thanks also to the audience for engaging questions and discussion, and to the SPIE staff for their help.

Mark Kahan