# MEMBERS NEWSLETTER

March 2016 - Quarter 1

INCOSE®

President's Corner • Notes from the Board (INCOSE IW) • Highlights - INCOSE IW • Kossiakoff Awardee & Research • Academic News • Career Section - *EWLSE Mentor Initiaitive* • IT Update • In Memoriam - *Stuart Arnold* • Spotlight Section • Update on the INCOSE IS • Note from the Editor

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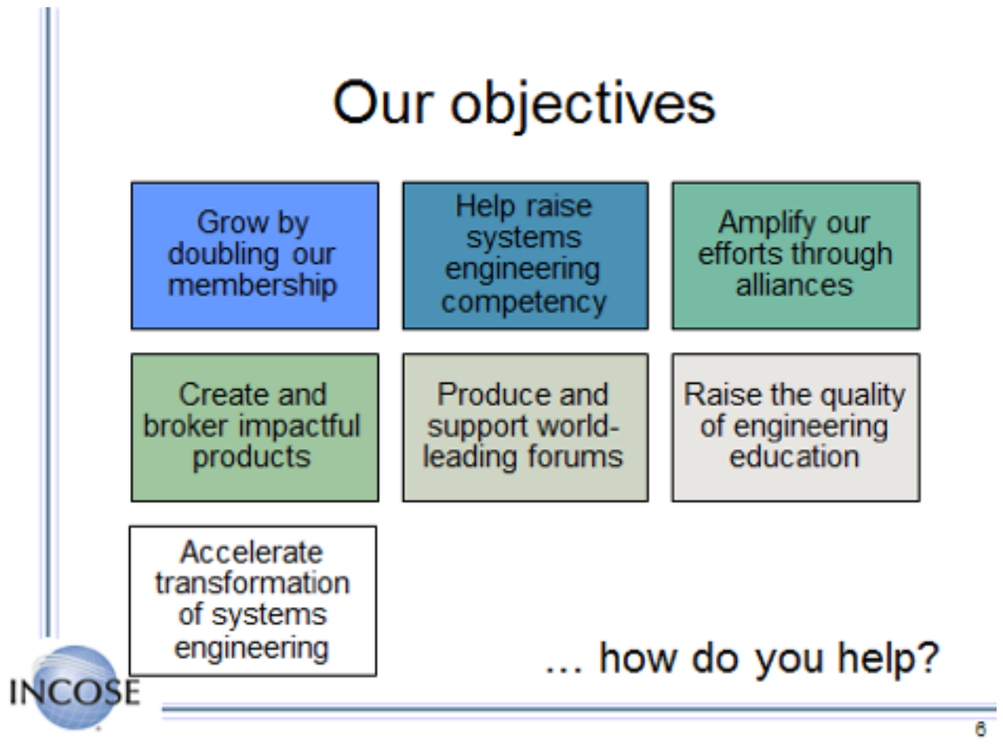
# President's Corner

Alan D. Harding, alan.harding@incose.uk

I am delighted to be writing my first contribution to the INCOSE newsletter at the start of my two-year tenure as President. In doing so I would like to warmly thank David Long for his incredible contribution to INCOSE for the last two years as President and before that as President-elect. He brought tremendous passion, insight and skill to the role, and leaves INCOSE better and stronger as a result. He is a tough act to follow but I will do my best!

First a little about me for those of you I haven't met yet. I have been a systems engineer for just over thirty years, since graduating in Physics from Durham University in the UK. My experience is mainly in defence and security, applying systems engineering at all levels from enterprise, capability, systems of systems, services, platforms and individual systems. In my corporate role I am the head of information systems engineering in the BAE Systems Military Air and Information business. It is only right up-front to acknowledge the support provided by BAE Systems both in my Presidential role, and their wider support to INCOSE over many years.

My approach to the Presidency will be to maintain all that is good about INCOSE, while continuing to help develop us as an organisation, and to guide us as we progress towards our shared mission and vision. In particular that means helping us progress towards the strategic objectives that guide our journey. We all own these objectives, as individual members, chapters, Corporate Advisory Board members, and the various committees and groups of INCOSE. I would ask you all to become familiar with these objectives, and to see what you can do to advance them.




I was delighted with the recent International Workshop (INCOSE IW), held this January for a third time in Torrance, CA. We equalled our attendance record of last year, with 458 people from 19 countries involved in many working group meetings, committees and other sessions.

A highlight of the INCOSE IW was the number of cross-cutting conversations and collaborations taking place. Another success was our "mainstreaming" of the MBSE initiative, moving it from a separate activity to a fully integrated part of the workshop.

Looking ahead I wanted to mention our International Symposium which will be held in Edinburgh, UK from 18th-21st July this year. This promises to be a fantastic event for which we have confirmed excellent keynote speakers, and a record number of papers. It is a great opportunity to engage in the breadth of INCOSE activities, hear about the state of practice, to get involved in our wide range of working groups, and of course to network with systems professionals from around the globe. Holding the Symposium in UK is a great opportunity for a strong attendance from our Europe, Middle East and Africa (EMEA) sector, as well as the whole INCOSE family.

*A highlight of the INCOSE IW was the number of cross-cutting conversations and collaborations taking place.*

So that is enough from me for now, apart from to wish you an enjoyable read of our Newsletter which for this issue focusses on the heart of systems engineering - something that was evident in many ways at the INCOSE IW this year.

# Notes from the Board

Rachel LeBlanc, marcom@incose.org

INCOSE President Alan Harding hosted the first Board of Directors meeting of 2016 at the International Workshop in Torrance, CA this January. We would like to acknowledge the great work done by the outgoing board members and welcome the new board members.

**Outgoing Board Members**

| | |
|---|---|
| President: | David Long |
| Treasurer: | Jen Narkevicius |
| Director for Outreach: | Paul Davies |
| Director for Communications: | Cecilia Haskins |
| Corporate Advisory Board Chair: | Max Berthold |
| Director, Americas Sector: | Barclay Brown |

# Notes from the Board – Highlights - INCOSE IW

**New Board Members**

| | |
|---|---|
| President-Elect: | Garry Roedler |
| Treasurer: | Meaghan O'Neil |
| Director, Outreach: | Ian Gibson |
| Director, Marketing & Communications: | Rachel LeBlanc |
| Corporate Advisory Board Chair: | Bob Swarz |
| Director, Americas Sector: | Steve Dam |
| Corporate Advisory Board Co-Chair: | Zane Scott |
| Chief of Staff: | Andy Pickard |

At the board meeting, Andy Pickard was appointed to the newly-created volunteer role of Chief of Staff for INCOSE. This role will primarily assist the President and the INCOSE central office in managing day-to-day activities. In addition, appointments were also made for the INCOSE representative to the SERC Advisory Board, and Associate Directors for Asia-Oceania, Latin America, and MOUs.

Back-briefs were provided by the strategy workshop leads and actions have been agreed upon for furthering the important initiatives in Recruitment and Retention, Training, and the Global Chapter Governance and Finance Model. Many INCOSE leaders from around the globe contributed to these productive workshops at the International Workshop.

# Highlights - INCOSE IW

## Introduction

Lisa Hoverman, newsletter @incose.org

The 2016 INCOSE International Workshop (INCOSEIW) kicked off early for attendees on Satruday morning, January 30, with an opening plenary that included inspiring forward looking comments and observations by both the outgoing and incoming INCOSE Presidents, David Long and Alan Harding. Paul Schreinemakers, Technical Director encouraged all in attendance to work together and using the best in themselves, systems engineering and systems thinking to tackle the big problems in the world, like the potential Zika Virus epidemic that is facing the Americas. With this charge, over 450 people went to work - in one of over 40 Working Groups (WGs), as a volunteer of INCOSE or as part of the INCOSE Board. Here we highlight two WGs from the INCOSEIW that are working on big solutions to issues that can improve the world and both speak to the heart of systems engineering.

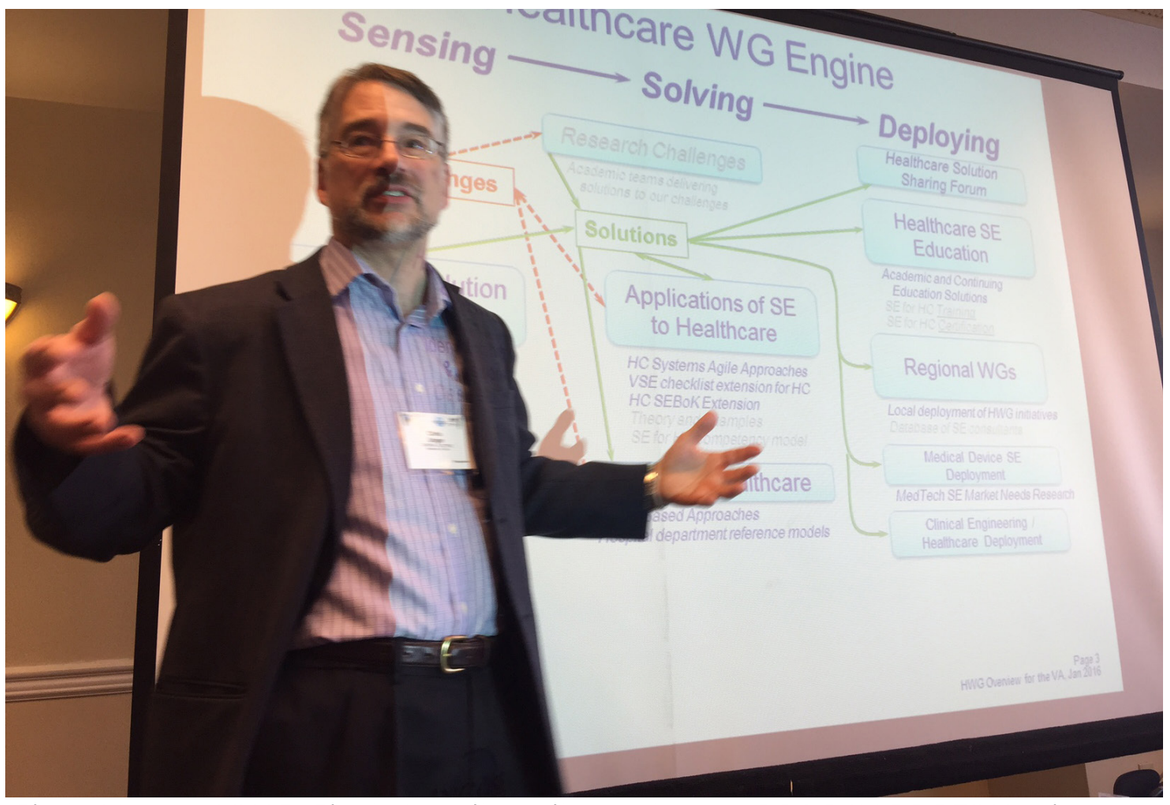
## The Healthcare Working Group

Cary Bryczek, cbryczek@jamasoftware.com

The INCOSE Healthcare Working Group (HWG) at the 2016 INCOSEIW focused on developing examples of how systems engineering can benefit healthcare providers, specifically the hospital Emergency Department (ED). Sessions were very lively and addressed perspectives from stakeholders, systems engineers, and healthcare professionals.

The discussions spoke of the pressing human problem in healthcare. Challenges run the gamut from malpractice fears, terminology barriers between engineers and clinicians, to even diverse hospital policy controls. There is also wide variation from one hospital's ED to another. "If you've seen one hospital...you've seen one hospital," explained Pat Baird from Baxter. Providers want to know, "Why is one hospital emergency department doing better than another?" Systems engineering techniques in hospitals don't always follow the top down driven V model; one must balance top down and bottom up. The goal is to keep people healthy (not just treat disease) and to save money. The waste in the $7 trillion healthcare sector is many billions!

Dialogs took place with healthcare stakeholders to identify the most important system issues in a hospital ED. This included a walk-through of the typical process for treating a patient that arrives in the emergency room including problems that impact a doctor's ability to treat patients quickly, safely, and effectively. Summaries of Lean studies identifying the critical limitations to the efficiency of ED operations were reviewed as well.




*Chris Unger, HWG Chair Leading discussion at 2016 INCOSEIW; photo credit: Cary Bryczek*

More sessions examined the state of systems thinking, systems engineering, and MBSE as it applies to the hospital ED. Bob Malins, PhD, President, Eagle Summit Technology Associates, Inc. presented work of the INCOSE MBSE Challenge Team in modelling the ED workflow.

# Highlights - INCOSE IW

There were also sessions that explored applications of modeling and simulation to healthcare process improvement and discussions for how systems engineers and healthcare system simulation professionals could collaborate to yield enhanced benefits to healthcare delivery. Pat Baird from Baxter suggests alignment of Patient, Products, Practice, and Policy (including process) creates an ideal state. Misalignment causes adverse events to take place. All agreed that there is a need better alignment between hospital operations systems engineering and medical device systems engineering.

One challenge regularly raised its head, "How do we show stakeholders what systems engineering can do?" ED operations are complex, dynamic, and people-dependent, resulting in errors, delays, and variability in time of care, which makes them a prime opportunity for applying systems engineering methods. Several good examples of modeling and simulation were shown, and while we agreed they would be helpful acceptance by the clinical care community has been very limited. Come join the INCOSE Healthcare Working Group as we continue taking on these tough challenges in our next sessions focusing on the operating and intensive care departments. A key next step is that our work has to have clear value to the decision makers in terms that speak to them. We also agreed that a priority is to include the people in the modeling approach, to model the average value (to establish standards and show 'value on average', but also include expected variation and robustness).

Come join the INCOSE Healthcare Working Group as we continue taking on these tough challenges in our next sessions focusing on the operating and intensive care departments.

# EWLSE Update - INCOSE IW

Lisa Hoverman, newsletter @incose.org,
Alice Squires, alice.squires@wsu.edu

Systems engineering, at its heart, tackles complex and pressing issues working towards a solution of maximum benefit. This heart is strongly evident in the INCOSE Committee/Working Group "Empowering Women as Leaders in Systems Engineering (EWLSE)." EWLSE kicked off at the International Symposium (IS) 2015, and while still 'on the left side of the V' is going very strong. EWLSE held a very successful meeting at the 2016 INCOSE International Workshop (INCOSE IW) , which set up exciting plans for the EWLSE offering in Edinburgh at the 2016 INCOSE International Symposium (INCOSE IS).

Founder Alice Squires kicked off the meeting with a round robin discussion of valuable resources for empowering women as leaders. The most common response was 'mentors' – specifically other women and included volunteering and getting feedback. This comment on 'mentors' led to a direct action item for EWLSE to begin working on a Mentor-Mentee Initiative. The article from EWLSE member Claus Nielsen on EWLSE Mentor-Mentee Initiative in this newsletter is the start to fulfillment of that action item. Women attending the meeting shared published resources in the round robin that empowered them in their systems journey – some of these we list at the end of this write up for those interested in accessing.

Following the informational requirements gathering (or round robin), Claus Nielsen provided a short demonstration of the external EWLSE website. The website is under construction and ideas generated by participants included a 'resource page' with a list of empowering resources and a description of how the resource benefitted the member, a list of EWLSE liaisons to similarly chartered groups in other professional societies and networks, and the start of the EWLSE mentor/mentee group.

Next, EWLSE member Heidi Hahn provided an overview of current INCOSE Women in Systems Engineering (WISE) chapters and requested those interested in establishing a WISE chapter to contact her. You can reach Heidi at: Hahn@lanl.gov with Subject Line: WISE Chapter. Member Donna Rhodes discussed EWLSE outreach activities, the idea of establishing regional directors, and the need for being selective and leveraging existing efforts and relationships with other women in engineering groups. Regina Griego led the finalization of the 2016 INCOSEIS Workshop on Sunday Afternoon: July 17, 1:00 – 5:15 PM with a panel Beyond the Resume: Personal Journey of INCOSE Women Leaders and a round robin activity to extend throughout the conference.

When asked what is it that EWLSE wants to accomplish, the following responses flowed:

- "Make women aware of successful strategies to develop into systems engineering leaders."
- "Leverage initiatives like the INCOSEIS workshop that is planned – share with women in systems engineering your story – Similar to an 'Introductions Necessary' for EWLSE."
- "Be the systems integrators of efforts to raise awareness of the value of empowering women as leaders in engineering and systems engineering around the globe."
- "Participate with other professional societies / programs in progress that support women in STEM fields."
- "Develop engaging content and delivery approaches to bring systems engineering, knowledge, skills, abilities, attitudes, and values to women across cultures, locations, and domains."

*EWLSE Update - INCOSE IW continued on page 11.*

# Kossiakoff Scholarship Awardee Research

from the Johns Hopkins University Applied Physics Laboratory & INCOSE Foundation

Ali Raz, akraz@purdue.edu; *Introduction by Lisa Hoverman,* newsletter@incose.org

## Introduction

Every year at the INCOSE International Workshop, someone who exemplifies the heart of systems engineering is recognized with the Alexander Kossiakoff Scholarship through Johns Hopkins University Applied Physics Laboratory (JHU-APL) and the INCOSE Foundation. The award recognizes and encourages promising applied systems engineering research by students in a Masters or Doctoral program. The award carries a $5,000 grant to the student along with an optional paid internship at JHU working on relevant systems engineering problems. The selective criteria demand the winner and their research show:

- Rigor and creativity of proposed applied research
- Potential application to Applied Physics Laboratory systems engineering interests
- Strength of resume and bio sketch
- Strength of academic recommendations, and
- Additional attributes noted in the applicant's materials that go beyond the application requirements.

This year the winner is Ali Raz, a Ph.D. candidate in Aeronautics and Astronautics at the Purdue University Center for Integrated Systems in Aerospace. His research interests are in System-of-Systems Engineering and Information Fusion. Prior to joining Purdue University, he worked for six years as a systems engineer at Honeywell Aerospace developing flight control and flight management system for military and civil aircraft. He holds a Bachelors and Masters of Science in Electrical Engineering from Iowa State University and is an INCOSE Certified Systems Engineering Professional (CSEP). He is the current president of the INCOSE student division of Purdue University. Mr. Raz's research follows.

## A System-of-Systems Perspective on Information Fusion Systems

This research proposes a System-of-Systems Engineering (SoSE) architecting process for the design of Information Fusion Systems. The research introduces the concept of an Information Fusion System-of-Systems, and develops guidelines to characterize the Information Fusion System-of-Systems design space. Furthermore, this research formulates an agent-based model for the IF-SoS architecture performance evaluation with statistical performance evaluation approaches based on Design of Experiments to explore the large design space.

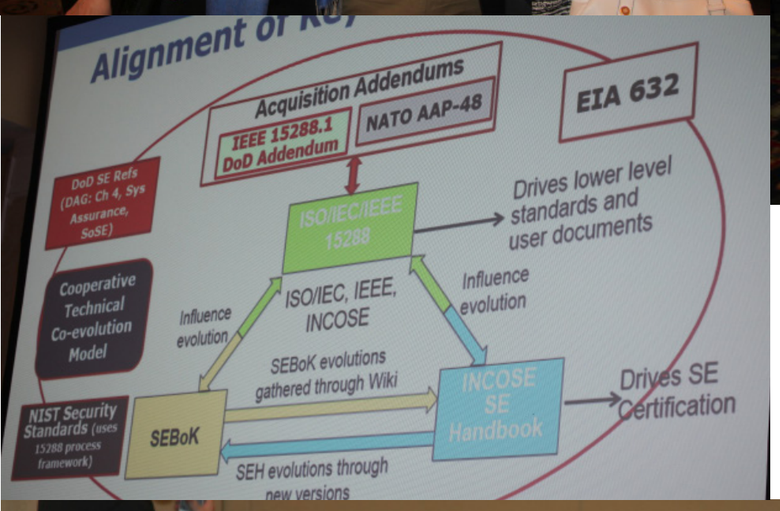
Translating observation to information and extracting knowledge from information for enhancing situational awareness, reducing uncertainty, and improving decision making is a prime objective of information fusion. A system designed to accomplish these objectives is called an Information Fusion System (IFS). The IFSs find their application in various domains, such as reconnaissance and surveillance systems, weather monitoring and forecast systems, explosive detection systems and more.

*Kossiakoff winners exemplify additional attributes noted in their applications that go beyond the requirements.*

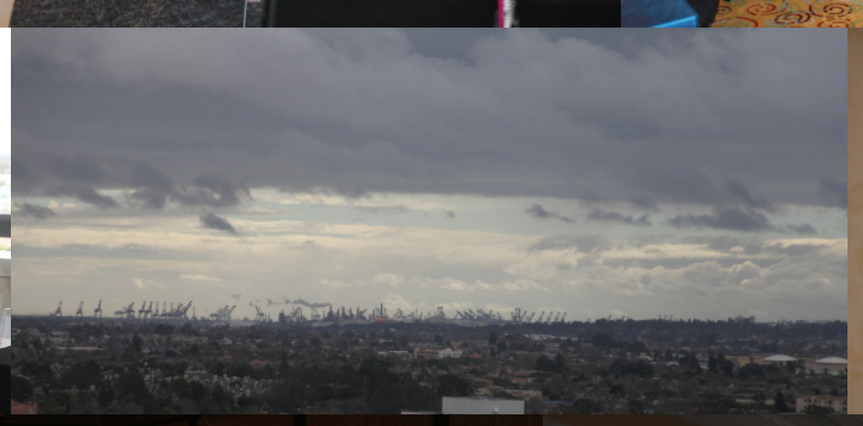
It is not surprising that the constituent systems of an IF undergo independent and incremental design and development. For example, an IFS with a mission objective of tracking objects across a wide geographic span will likely include information systems distributed across the globe including ground, water, air, and space-based resources. Typically, one acquires these resources over time with their independent lifecycles. Furthermore, the operation and management of these systems usually falls under different organizational entities (or agencies) with their own agendas, requirements, and financial budgets. The IFS achieves its mission objectives when these independent systems collaborate with another and the information fusion functions distribute across these systems. It is this collaboration of distributed, heterogeneous, and independent systems spanning multiple organizational entities that corroborates the System-of-Systems nature of an IFS.

For these reasons, we hypothesize that the SoSE architecting process is the appropriate path to pair information fusion functions with multiple physical systems in the form of an allocated architecture, called the Information Fusion System-of-Systems. The performance of an allocated architecture – the Information Fusion System-of-Systems – to meet the information fusion operational concept depends upon the information fusion functional dynamics and the physical dynamics of the constituent systems, which may be outside the control of the Information Fusion System-of-Systems architect due to their independent development, operation and management. In this research, we propose a Design of Experiments methodology to find promising solutions in a large design space of the Information Fusion System-of-Systems and characterize the impact of independent system design decisions on the overall information fusion mission objectives.






What a productive International Workshop this year !



# 26th annual INCOSE international symposium

**Edinburgh, UK**
July 18 - 21, 2016

## Achieving excellence through Systems Engineering

Engage with your colleagues from the Systems Engineering community!

Learn about state-of-the-art methods and essential skills for Systems Engineers.

Find out how people are making a difference with Systems Engineering.

Help create some online Buzz by tweeting #incoseIS, @incose_org

## Keynote Speakers

Plan to be stimulated and challenged by our exciting keynote presentations given by experts!

**Prof Larry Leifer**

**Prof John Loughhead**

**Julie Alexander**

**Kevin Robinson**

**Dr Emma Langman**

## Join us as a Sponsor or Exhibitor

Building on last year's highly successful 25th Anniversary celebrations, the INCOSE International Symposium is returning to Europe, taking place at the Edinburgh International Convention Centre on 18-21 July.

This event has already established a new record for the number of paper submissions, and promises to be a well-attended event attracting a diverse cross-section of the global Systems Engineering community, including delegates from adjacent disciplines.

**Mark your calendar now!**
July 18 - 21, 2016

Visit **www.incose.org/symp2016** and contact us **TODAY** - The IS2016 Team

# Academic News

## 2016 World Wide Directory of Systems Engineering and Industrial Engineering Academic Programs Now Available

The International Council on Systems Engineering (INCOSE) and the Systems Engineering Research Center (SERC) at Stevens Institute of Technology have developed a worldwide directory of systems engineering and industrial engineering programs as a resource for the industrial and systems engineering communities.

The information contained in this directory primarily draws from university websites around the world. For each university, the directory lists the name and address of that university, the degrees offered by that university, the academic unit that offers those degrees, the head of the academic unit offering those degrees, and a URL for additional information.

The latest edition is now available on the INCOSE website at http://www.incose.org/AboutSE/SEEducation/SEProgramDirectory

Please contact us if your university has a degree program in SE or IE and is not currently included, or if you wish to make an addition or correction to their existing information in the directory.

Contact for information: ISEDirectory@stevens.edu

## Sigma Theta Mu Charters Its First Three Chapters

Thomas Gannon, tgannon@wpi.edu

The founding of Sigma Theta Mu coincided with the 25th Annual International Symposium of the International Council on Systems Engineering. INCOSE supported the establishment of Sigma Theta Mu to recognize those who confer honor upon the university they are currently attending or their alma mater by distinguished scholarship in the study of systems or the field of systems engineering. This is an important milestone in the maturation of our field and parallels the establishment of other comparable discipline-specific honor societies.

At the 2016 International Workshop, the Founding Board provisionally approved the charter requests for the first three chapters of Sigma Theta Mu:

- Michigan Alpha: University of Detroit Mercy (UDM)
- New Jersey Alpha: Stevens Institute of Technology
- Virginia Alpha: Old Dominion University

On February 11, Michael Vinarcik, President, conducted an induction ceremony for Robert Kraus, Arun Sivan, and George Papaioannou. They are graduating from the UDM MS Product Development Program (MPD) and have the distinction of being the first three student members of Sigma Theta Mu.

Universities with undergraduate and graduate programs in systems-related disciplines may petition the Board to establish a local chapter of Sigma Theta Mu.

Sigma Theta Mu's Founding Board members are:

- Michael J. Vinarcik, ESEP-Acq, President and Founder
- C. Robert Kenley, Ph.D., Secretary and Founder
- Art Pyster, Ph.D., Treasurer and Founder

For more information, visit www.sigmathetamu.org.

## INCOSE Student Division, Motivating Students to Attend the Regional Mini Conference (RMC16)

The INCOSE Student Division program motivated students from universities across three states and six universities to attend the RMC16, which has an agenda to support students in the southwest United States to attend this 2-day conference. Currently, students from the U.S. Air Force Academy, University of Arizona, Arizona State, Cal Poly Pomona, University of Southern California, and Loyola Marymount University will be attending the conference and presenting papers and possibly posters.

These students will participate in several workshops and networking opportunities. Additional opportunities for student participation include career panel discussions, mentoring network activities, and women in engineering discussions. Conference organizers encourage the students to present their research in the form of presentations and posters. Students will be competing for financial awards for best papers and best posters. The financial awards for best paper are $500, $250, and $150 for 1st, 2nd, and 3rd awards respectively.

The location of RMC 2016 will be on the campus of Loyola Marymount University on April 9 and 10, 2016. The event sponsors are the Los Angeles, San Francisco, San Diego, and Central and Southern Arizona Chapters of INCOSE with the Los Angeles Chapter hosting the event.

For more information, visit www.rmc16.net.

## OPM Adopted as ISO 19450

*Shared by Dov Dori, INCOSE Fellow, IAPR Fellow*

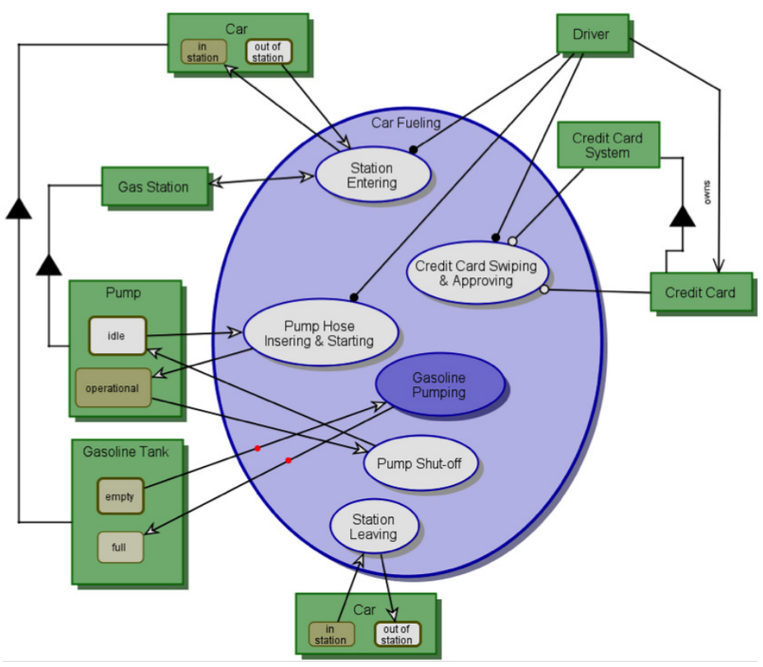
Object-Process Methodology (OPM) has been adopted by the International Organization for Standardization, ISO, and on December 15, 2015, it was published as a normative ISO 19450 document at https://www.iso.org/obp/ui/#iso:std:iso:pas:19450:ed-1:v1:en. Approval of this standard, which is the first of its kind to be adopted by ISO, marked the end of a six-year effort by a working group under the auspices of ISO Technical Committee TC184/Sub-

Committee SC5, led by Mr. Richard Martin, with active participation of Professor Dov Dori, Mr. David Shorter, and Dr. Alex Blekhman, whose PhD dissertation under Professor Dori's guidance was an offspring of this endeavor. The work to prepare ISO 19450 included yearly meetings starting in 2009 at various locations around the world, including Tokyo, Paris, Tampa (FL), and Haifa, at the Technion. Even before its official publication, OPM is in use in newly developed ISO standards, serving as a basis for the new generation of standards, which will be model-based, rather than text-based, enabling their systematic review for completeness and integrity.

Over the past two decades, Professor Dov Dori of the Faculty of Industrial Engineering and Management at the Technion has been developing OPM as a language and method for conceptual modeling of complex systems of any kind, be it artificial or natural. An OPM model expresses both graphically and textually the architecture of the system: Interconnected diagrams at varying levels of detail, from a bird's eye view to any desired number of "nuts and bolts" views, specifying any conceptual and logical aspect of the system. Each graphic expression translates on the fly to a corresponding textual specification in a plain subset of English. Thanks to its simplicity, OPM serves as a common language for all the system's stakeholders, who can take part in creating the model from the very early requirements engineering phase. At any stage, the model can be visually simulated to examine the system's operation and verify that it behaves as expected on its way to becoming an actual product or service.

A basic premise underlying OPM is that one can build a model of any system in any domain and at any level of complexity with the most minimal set of building blocks: stateful objects (objects with states) and processes that create or consume objects, or change their states. Over the last decade, Technion students at the Enterprise Systems Modeling Laboratory developed OPCAT (Object-Process CASE Tool)—a software package that is available freely from the Lab's website http://esml.iem.technion.ac.il/ and translates the user's graphic input into simple English in real time. This enables quick model development jointly by the customer and the system architects and engineers, and reliable verification of the model as the user(s) creates it.

As an example, the diagram below demonstrates animated simulation of a Car Fueling process. At this stage, the driver performs the Gasoline Pumping subprocess, changing the state of the object Gasoline Tank of Car from empty to full. The sentence, which OPCAT generates in response to this, is: "Gasoline Pumping changes Gasoline Tank from empty to full."




OPM is applicable also to scientific research. Since 2007, a multidisciplinary team of Technion researchers published a series of articles related to the mRNA lifecycle in the living cell in the prestigious open access journal PLOS ONE. Using OPM and OPCAT, they built a comprehensive, detailed model of this system in yeast cells. Simulating this model enabled identification of knowledge gaps, hypotheses generation, their in silico testing via simulations, and directs efforts to promising research directions regarding the RNA decay and return of its constituents back to the nucleus. The group included Dr. Judith Somekh, who is currently a postdoctoral fellow at Harvard Medical School, Professor Mordechai Choder from the Technion's Faculty of Medicine and Professor Dov Dori, who were joint advisors of Dr. Somekh.

For more information about OPM contact: Professor Dov Dori (dori@ie.technion.ac.il).

## Systems Engineering for Cyber-Physical Systems – School of Systems and Enterprises, Stevens Institute of Technology

*Shared by Prerna Dar, School of Systems and Enterprises, Stevens Institute of Technology*

The 21st century is all about software - from our phones, to our cars, to medical equipment – software is the building material of choice in the computer-controlled world of today. It affects almost every aspect of our daily lives, and it lies behind the most basic and the most complex systems of human society.

Coupled with the growth in software is the explosion impact of networking which is transforming embedded systems into cyber-physical systems (CPS), which the National Science Foundation (NSF) has declared as a national priority[1]:

"[CPS are] engineered systems that are built from, and depend upon, the seamless integration of computational algorithms and physical components. Advances in CPS will enable capability, adaptability, scalability, resiliency, safety, security, and usability that will far exceed the simple embedded systems of today. CPS technology will transform the way people interact with engineered systems -- just as the Internet has transformed the way people interact with information. New smart CPS will drive innovation and competition in sectors such as agriculture, energy, transportation, building design and automation, healthcare, and manufacturing.

As CPS become more pervasive, so too will demand for a workforce with the capacity and capability to design, develop, and maintain them."

Stevens took the first step in addressing the emerging educational needs by creating a new graduate level program that blends core systems and software engineering with the full product lifecycle of CPS-based technology. The design of the Systems Engineering of Embedded/ Cyber-Physical Systems (CPS) four-course certificate program provides engineers with systems engineering skills such that they can be effective in small, agile teams in the development of such systems. This certificate provides students with a solid foundation in the fundamentals and practical use of tools for the conception, design, implementation, and sustainment of embedded and CPS from a systems perspective using an integrated, intensive team-based project experience throughout the lifecycle. The skills obtained will be applicable to the systems engineering of systems in other domains, but focus on systems with the attributes of embedded and CPS.

The first cohort, from one of Stevens' partners in the aerospace industry, recently completed the program with very positive feedback. Stevens' has several new cohorts scheduling for initiation this spring. A presentation on the description of the program occurred at an international workshop on CPS[2].

For more information about the program, contact Dr. Mo Mansouri (mo.mansouri@stevens.edu).

*[1]NSF Program Solicitation 15-541 on Cyber-Physical Systems: http://www.nsf.gov/pubs/2015/nsf15541/nsf15541.htm*

*[2]"Systems Engineering of Cyber-Physical Systems Education Program," Jon Wade, Roberta Cohen, Mark Blackburn, Eirik Hole*

## INCOSE Academic Forum Program 2016: Systems Engineering Knowledge and Skills in the Education of All Engineers

INCOSE, the Systems Engineering Research Center (SERC), the American Society of Engineering Education (ASEE) and a number of universities are working together to increase the use of systems engineering knowledge and skills in the education of all engineers.

As part of this work we will hold a number of Academic Forum Workshops in 2016, building on work done in 2015. Three specific themes emerged from previous workshops:

1. Why are systems engineering knowledge and skills of value to the education of all engineers?

2. What systems engingeering knowledge and skills are important to achieve this value?

3. How do we facilitate the integration of these knowledge and skills into engineering education?

You can find a discussion of these themes, the background and motivation for our joint activities, and a description of recent forum activities at http://www.wpi.edu/research/seli/incose61.html. If you are an academic faculty member already delivering systems engineering education to engineering students; if you are involved in systems engineering education and would like to learn more about the value of systems engineering knowledge and skill, or if you are a non-academic with an interest in engineering skills and competencies; you should consider finding out more about this initiative and attending our Academic Forums.

The Academic Forum workshops will bring together systems engineering academics and invited engineering faculty to share current work and ideas around these three themes. Three Forum workshops are planned for 2016:

- 2-3 May 2016 at the George Mason University (GMU) Arlington Campus (http://arlington.gmu.edu/).
- 13-14 July 2016 in the UK in conjunction with the INCOSE IS in Edinburgh on 18-20 July
- 7-8 November at PES University, Bangalore, India (www.pes.edu), in conjunction with APCOSEC 2016 (www.apcosec2016.org) on 9-10 November 2016 in Bangalore.

Please put these dates in your calendar if you would like to attend. The Forums will be free to attend but places will be limited and attendees must register closer to the date. To enquire about spaces at the May forum send your name and affiliation details to seor@gmu.edu. Details on how to register for the other two workshops will be available as part of the INCOSE IS and APCOSEC registration pages.

The aim of the May Forum is to build on work started in 2015 and begin the process of creating useful material to support engineering faculty who want to integrate more SE knowledge and skills into their teaching. The July and May Forums will report on the work done so far and consider the European, Middle East and Africa (EMEA), and Asia-Oceanic perspective on these themes. Among the questions we will be considering at these forums are: What unique challenges do these regions raise and what challenges do they share with the rest of INCOSE? What can we learn from the ways that engineering education is delivered in these regions? How can we take practical steps to increase the integration of SE knowledge and skills into worldwide engineering education?

Please feel free to pass this note on to colleagues who might wish to participate. If you have specific ideas or information to add to this work and would like to be more directly involved, please contact: Rick Adcock, INCOSE Associate Director for Education, R.D.Adcock@Cranfield.ac.uk.

# Career Section

## *EWLSE Mentor/Mentee Initiative*

Claus Nielsen, c.nielsen@cranfield.ac.uk

The Empowering Women as Leaders in Systems Engineering (EWLSE) Working Group has held a number of meetings at the INCOSE International Symposium (IS) 2015 and the International Workshop (IW) 2016, with participation of women and men working at different levels and different areas of systems engineering.

From these meetings, the discussions, and the personal stories shared, it is clear that many woman in an early career in an engineering role, are seeking guidance on navigating the systems engineering field. In many organisations, a preferred way of providing this guidance is through a mentor program. However, in a field with a high percentage of men there is a high likelihood that the mentor will be male. Now, this is not at all an issue for the vast majority of guidance needed on aspects such as career planning or on navigating the organisation.

However, from the EWLSE discussions it is evident that women in the systems engineering field come across a lot of questions, observations and perhaps doubts about the role of women in systems engineering and in systems engineering leadership. A fair amount of these may arise because of the existing gender gap in the field and their male counterparts may not have encountered them. Consequently, it can be difficult to find answers to these questions from a male mentor. With a shortage of senior-level women in systems engineering, it can be difficult for early career female system engineers to find mentors that have experience with these questions, especially within their own organisations.

It is from this background that the EWLSE mentor/mentee initiative grew. It is a way for early career female system engineers to become the mentees of a more experienced systems engineer of the same gender. The initiative is not meant as a career boosting mechanism, but instead of as an opportunity for the mentee to seek advice and support from their mentor. It gives the mentors' the possibility of passing on their practical experiences and to share some of the knowledge they have gained from working in the field of systems engineering and in systems engineering leadership. It is meant as a cross-organisation, cross-border and cross-educational activity in which *systems engineering* is the common factor. The relationship will be driven by the mentee, and it is not to be a formal time consuming process with specific goals; instead it is an offer to the mentee to pick up the phone and seek advice from the mentor, to exchange a few e-mails to share an experience, and to potentially meet at the INCOSE IW or IS for further sharing.

Key points for the Mentee

- A mentee driven relationship
- To seek input from a more experience professional that has been in similar situations
- An enabler for getting guidance on the questions for which you have not been able to find answers
- Seek advice, tips and tricks on navigating the Systems Engineering field
- Advance your network

Key points for the Mentor

- Be a champion for more women in Systems Engineering by playing an active part
- Help with the professional development of the Systems Engineering field
- Be supportive of other women
- Advance your network
- Is not a formal process or major time commitment

EWLSE is looking for mentors who are current leaders in systems engineering to volunteer to host one to three mentees, and for mentees who seek advice on navigating the systems engineering field to request a mentor. Please send your mentor or mentee request to ewlse@incose.org to get started.

## *EWLSE Update - INCOSE IW*

*Continued from page 4.* It is clear that EWLSE will bring needed resources and solutions to women in systems engineering, and their mission, will be one that maximizes growth for systems women.

**Empowering resources shared at EWLSE IW Meeting:**

- A Game Plan for Life: The Power of Mentoring by John Wooden et. al
- Become the CEO of You, Inc. by Susan Bulkeley Butler
- Fifth Discipline by Peter Senge
- Introductions Necessary
- Lean In, Sheryl Sandberg
- On Becoming a Leadership Coach: A Holistic Approach to Coaching Excellence", Chapter 23
- Solving the Equation: Variables for Women's Success in Engineering and Computing by Christianne Corbett and Catherine Hill, published by AAUW.
- The Thinking Path - http://www.peje.org/wp-content/uploads/2014/05/Critical-Thinking-Path-Eli-2014.pdf
- Women in Engineering Professional Advocacy Network

To join EWLSE simply add "Empowering Women" to your My Committees / Working Groups.

# INCOSE IT Update

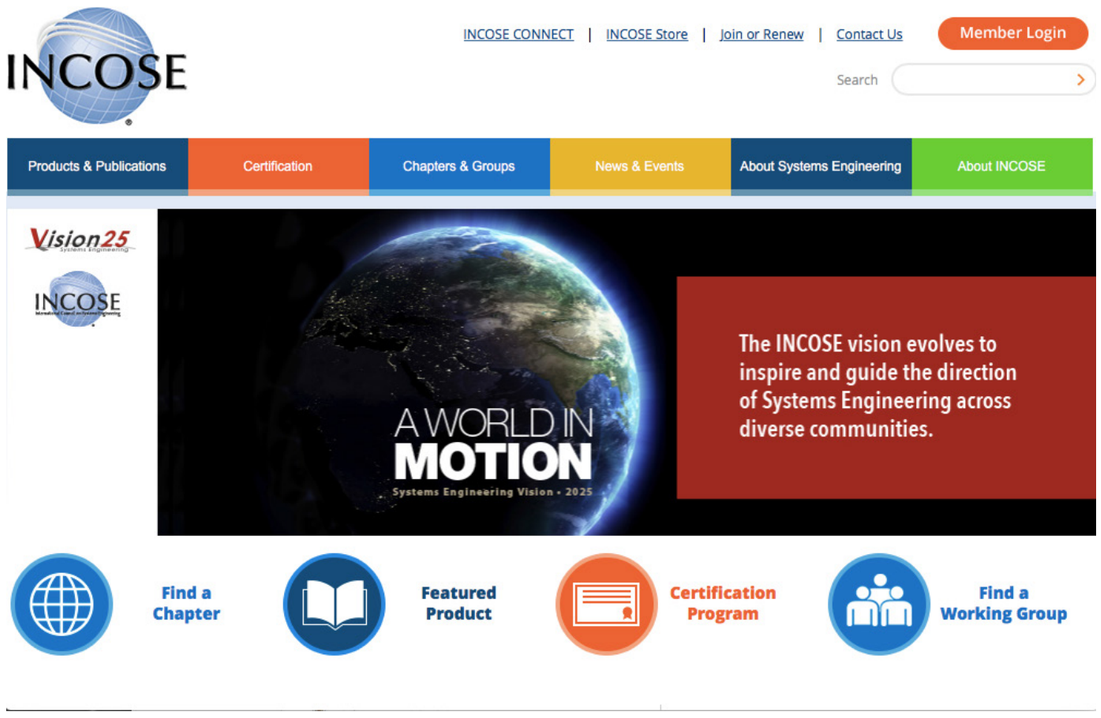
Bill Chown, CIO@incose.org

As I am sure most members now know, our new INCOSE website and associated Connect collaboration areas have been in place for a year, and so we will soon stop thinking of them as "new."

The goal of the IT function is to develop our web presence, supporting tools, and available resources to help INCOSE be recognized as the definitive source for the best information about systems engineering, its practice, and practitioners.

The web site and related services are now largely operating as required, and so the focus is moving on to the review of the major content, overall presentation, and detailed user interaction, with a view to continual upgrade of capabilities and a more attractive member and non-member experience.Tools and resources are now available to the chapters and accessible by the membership as required. More work is being done this year to improve the information, help, and background expertise available to move forward, and provide these capabilities to the needs of any member. These include restoration of the @incose.org email, mailing lists for Chapters and Working Groups, and continuing support improvements for webinars and meetings.

A small IT Team of volunteers continues working with the INCOSE Administration team and the three primary vendors to improve the new platform for web site, membership administration, and collaboration. We welcome your comments, suggestions, and even participation! The INCOSE IT strategic plan will be developed and presented this year, and with a tactical, annually renewed plan to manage the IT infrastructure, implementation and resources will maximize the accessibility and usability of this resource, ensure applicability to the ever-evolving needs of the consumers of this material, and the essential growth over the duration of our next strategic period.




# In Memoriam
# *Stuart Arnold*

Eileen Arnold, eparnold5@aol.com

Stuart Arnold was one of those people you remember after meeting him for the first time. He was also an incredible systems engineer.

*Stuart Arnold receiving INCOSE Fellows award with Bill Mackey in 2006, photo credit: Robert Arnold, Stuart's son.*

Stuart contributed to systems engineering by first acquiring knowledge as a development engineer, becoming notable and profoundly knowledgeable in systems. His work on international systems engineering standards is well known but he also contributed through his publications and through his service to international bodies like the INCOSE Foundation. Stuart was a master of the written form, an author sought after for writing erudite pieces on systems engineering that needed to communicate succinctly to both general and specialist audiences. Stuart was not only able to synthesize numerous perspectives into pithy statements; he was able to gently persuade a room full of delegates to agree to what he had written: a rare skill indeed.

In 2006 Stuart became one of the first UK Fellow. Primarily, he was the driving force that created the ISO/IEC 15288 international standard for systems engineering. Stuart was most knowledgeable about the application of systems engineering at the corporate level. With his colleagues Richard Stevens, Ken Jackson, and Peter Brook, they produced a great book: S*ystems Engineering: Coping with Complexity*.

After retirement, Stuart joined the University of Hertfordshire as the Royal Academy of Engineering Visiting Professor in Integrated System Design. Stuart's university biography states: "He has many years of experience of research, design, manufacture and management in the engineering industry, having worked in Philips and EMI, and also in government service for the UK MOD. His Bachelors, Masters and Doctoral degrees are all in Engineering. He is engaged in internationally defining and applying system architecture principles." He was loved and admired by many. We invite you to read the full *In Memoriam* piece on the INCOSE Website.

# INCOSE Spotlight on Judith Dahmann

Interviewed by Sandy Young, info@incose.org

*photo credit: Judith Dahmann*

**Name:** Judith Dahmann

**Title:** Senior Principal Systems Engineer

**Organization:** The MITRE Corporation

**Place of Birth:** Schenectady, New York, USA

**Current Residence:** Hollin Hills in Alexandria, Virginia, USA and Scientists Cliffs in Port Republic, Maryland, USA

**Domain:** Systems of Systems

S**tudied in college:** Math and Social Sciences

**Year joined INCOSE**: 2010

**Role(s) in INCOSE:** Co-chair Systems of Systems Working Group

**Years in systems engineering**: 25+

*Why did you become a systems engineer?*

I joined MITRE right out of graduate school to work as a systems analyst. It was only a matter of time until, through some diverse project experiences, my interest grew beyond analysis to the engineering of systems. Initially my focus was on analysis of criminal justice systems and then when I moved into defense, I worked on both the engineering of simulation systems and their application.

My math-based social science background provided a good launching point for addressing many of the current socio-technical elements of most of today's systems and systems engineering environments and for the current trajectory toward model-based engineering.

*What is your favorite part of being a systems engineer?*

My favorite part of working as a systems engineer is the challenge of trying to bring order to complex situations, particularly today as we look to expand the role and application of systems engineering principles and approaches to broader, more complex areas. Systems engineering is all about bringing together diverse views and considerations to achieve a resulting capability. The challenges of diverse stakeholders, diverse technical perspectives and diverse environments are what make systems engineering an exciting field for me.

*What is your least favorite part of being a systems engineer?*

My least favorite part of systems engineering is the discipline's reluctance to reexamine approaches and processes that may have been very effective in the past but that don't rise to the challenges of today's systems and environments. I recognize the need for balance and particularly the importance of leveraging established approaches, but if systems engineering is to achieve its potential with today's complexities, we need as much open thinking and innovation as possible.

*What is the simplest way to explain "systems of systems"?*

Simply put, "systems of systems" (SoS) are systems composed of other systems, which as we often say "have day jobs." That is, these systems are developed and operated independently from the SoS, but when they work in concert with one another, they each provide a new capability not available from the systems alone. Most systems today are a part of one or more SoS whether or not they explicitly recognize this.

*What are the current goals/projects of the INCOSE Systems of Systems Working Group?*

The INCOSE SoS Working Group's goal is to promote application of systems engineering in systems of systems through a range of activities that are designed to share our current understanding of best practices, develop and share new approaches to address SoS challenges and facilitate communication among practitioners and the research community. We host a monthly webinar series, which has been very popular.

The working group events at the recent International Workshop included an SoS research Roundtable and a workshop on SoS Patterns with the Patterns-Based Systems Engineering Working Group. Our current major ongoing activity is development of an INCOSE INSIGHT special issue on SoS, slated for this fall.

# INCOSE Spotlight on Rick Schrenker

Interviewed by Sandy Young, info@incose.org

*photo credit: Marilyn Schrenker*

**Name:** Rick Schrenker

**Titles/Organizations: S**ystems Engineering Manager, MGH (Massachusetts General Hospital) Biomedical Engineering; Senior Biomedical Engineer, MD PnP (Medical Device "Plug-and-Play" Program)

**Place of Birth:** Baltimore, Maryland, USA

**Current Residence:** North Reading, Massachusetts, USA

**Domain:** Biomedical

**Studied in college:** Electrical engineering

**Year joined INCOSE:** 2008

**Roles in INCOSE:** Member and former chair, Biomedical Working Group (2011 INCOSE Outreach Award recipient)

**Years in systems engineering: I**'ve been calling myself a systems engineer for about 20 years.

*What are the biggest changes you've seen in biomedical systems engineering in hospitals over the years?*

That's easy: Recognizing the need for a more formal approach to engineering in hospitals in general and in clinical engineering in particular is rapidly emerging. That's a HUGE change. Systems engineering has a lot to offer, especially in the requirements engineering area.

*What is the biggest challenge you face?*

Discerning what I can and should do over the last few years of my career. I'm used to reinventing my professional self every three years or so, and I'm planning to retire in less than four years. Ironically, the clinical engineering and healthcare technology management (CE/HTM) literature has recently raised awareness of the problems that could arise as we boomers exit, because we make up a large percentage of our community. There could soon be an unfulfilled need. If that is not a systems' problem, I do not know what is.

*What advice do you have for younger colleagues in your field?*

First and foremost, connect and share problems and perspective with INCOSE. As an extension of that, figure out ways to bring industry systems engineers into hospitals to actually see what goes on there and likewise, get invited to industrial sites and meet with systems engineers working in their domains. Systems engineers from outside our domain need to work with clinical engineers and experience healthcare from the inside before prescribing treatments for our problems. It needs to be a joint effort. I also suggest looking into graduate certificate and degree programs in systems engineering.

Slightly tangential, leaders of clinical and systems engineering graduate programs should be talking with each other. Both communities need to get out of their boxes, and my guess is the push for that has to come from younger engineers in both communities.

*Please tell us about your most memorable INCOSE International Symposium experience.*

I attended the one in Las Vegas a couple years ago. I liked it for three reasons: It focused on the practical; it brought together a wide swath of interests; and it enabled me to actually meet people who up to that point I knew only as email addresses.

*What do you like to do outside of work?*

I am writing this on my first day back from a trip to Aruba with my wife, where we celebrated our 40th wedding anniversary (this is an easy way to get back up to speed). We have three adult children and two grandchildren, with our third on the way (each of our children will have one as of April). In addition to visiting the grandkids, Marilyn and I are active in our church. We also keep busy with music and dance lessons.

# Update on the International Symposium 2016

Ian Gibson, ianthesonofgib@yahoo.co.uk

Anyone who attended the International Workshop (2016 INCOSE IW) in Torrance should have noticed that this year's International Symposium (2016 INCOSE IS) is taking place in Edinburgh, whether they took their cue from the enormous advertising sign by the registration desk, the strategically placed marketing material, the pop-up whisky stall at the reception on Saturday evening, the promotional slot in the closing plenary (including a geography and pronunciation lesson), or indeed the bagpiper – who, it's fair to say was a surprise to all but a handful of people in the room, and certainly proved a hit with delegates.

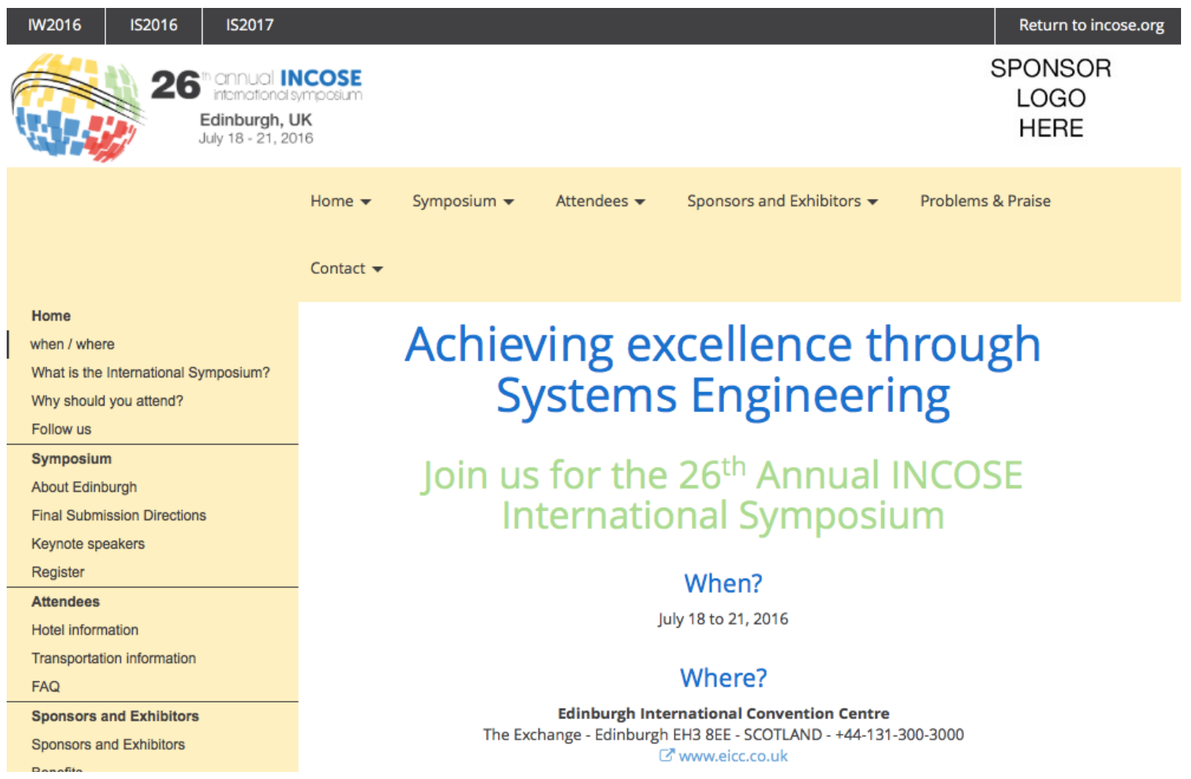
Planning for INCOSE IS has moved on considerably over the last few weeks, with many elements being frozen at the end of INCOSE IW 2016. The Technical Programme selections have all been made, with acceptance notifications due out later in February, and in a change to last year, we are now offering an opportunity for reserve paper authors to have a poster in a dedicated poster track throughout the event. The Technical Programme itself is the most extensive that it has possibly ever been, taking advantage of both the record-breaking number of submissions (222 papers), and the impressive number of rooms on offer at the Edinburgh International Convention Centre (have a look for youselves at www.eicc.co.uk).

*Register and get your hotel reservations in Edinburgh NOW for 2016 INCOSE IS!*

We have also been busy organising the specially invited content – covering topics that fit into our strategic aims (such as industry outreach focussed roundtables and panels, and a fascinating interactive session organised by the INCOSE Institute for Technical Leadership), but also so more lively and light-hearted concepts such as the the new "Tool Vendors Panel Show", and a series of "Fringe" sessions designed to both entertain and enlighten. Finally, the "SE101" and "Practitioners' Challenge" sessions which proved so popular in Seattle are being revised and repeated this year, with some new presenters and a new twist to the challenge taking on an issue of true global importance.

New members are not forgotten either, with the Mentor Connection set to be repeated. Please sign on for this when you register if you would like to be paired up with a new member (or an old one for that matter!). We even intend to create a space for "conference spouses" to congregate after they've dropped off their other halves for the day – although it's fair to say that there is no shortage of things to do in Edinburgh, and the Convention Bureau have kindly offered to supply every delegate with an Edinburgh Rewards Passport (see www.conventionedinburgh.com/attending-a-conference/edinburgh-rewards-passport/) offering discounts at a wide variety of approved restaurants, cafes, bars, shops, attractions, tour companies, and taxi firms.

It's all set to be a fantastic symposium, in a stunning city, and I hope to see as many of you there as possible!



# Note from the Editor

Lisa Hoverman, newsletter@incose.org


## Publication of the International Council on Systems Engineering

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**Who are we?** INCOSE is a 10,000+ member organization of systems engineers and others interested in systems engineering. Its mission is to share, promote, and advance the best of systems engineering from across the globe for the benefit of humanity and the planet. INCOSE charters chapters worldwide, includes a corporate advisory board, and is led by elected officers and directors.



Welcome to the first Newsletter of 2016! I hope your year is off to a great start. I kicked off my systems engineering/ thinking year with theINCOSE International Workshop (IW) as a first-time attendee. It was incredible, and I look forward to going back. It was fun to dive in on working groups (WGs) and to sit back and learn from the sages. If you have yet to attend, I say it is something NOT to miss as an INCOSE Member or systems person!

This newsletter and the upcoming issue of *INSIGHT* really speak to the many applications that systems engineering has for humanity, where we can look for inspriation, and where we can provide guidance.

Thank you to all who contributed for this Newsletter and spoke to "the heart of systems engineering." I look forward to your upcoming contributions (submission dates in the table below!) and articles as we continue to improve the Newsletter.

Have a wonderful March!

| Newsletter Issue – Publication Date | Copy Submission Due Date for General Article Inclusion | Exceptional Copy Submission Due Date for Late Breaking News, Requires Advance Notice | Highlights |
|---|---|---|---|
| Second Quarter 2016 – June 15, 2016 | 15 May | 31 May | INCOSE Midyear & Current News |
| Third Quarter 2016 – September 15, 2016 | 15 August | 31 August | INCOSE International Symposium & Current News |
| Fourth Quarter 2016 – December 15, 2016 | 15 November | 30 November | INCOSE Year's End & Current News |

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