MEMBERS NEWSLETTER

December 2019 - Q4

INCOSE

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President's Corner

Garry Roedler, garry.j.roedler@lmco.com

It is hard to believe that this is my final President's Corner article. The 4 years as President-Elect and President have flown by. During my term, I stressed the need to look forward to identify and prepare for the future needs of systems, systems engineering, and INCOSE. Over the course of the last four years, we have made several accomplishments worth highlighting.

Future of Systems Engineering (FuSE) initiative—We established an industry-wide, global collaborative initiative focused on defining the needs and developing a roadmap to address systems engineering for dynamic, nondeterministic, evolutionary systems. The initiative has over a dozen organizations and associations working together. The team spans all the INCOSE sectors. Projects have been established for: artificial intelligence used in systems engineering and systems engineering for systems applying artificial intelligence; systems engineering foundations (more below on this); and horizon scanning to track advancements in technology that will impact the conduct of systems engineering. FuSE will initiate other projects as they define prioritized needs.

Systems of Systems Engineering (SoSE)—We have published the SoS primer (free to download from the INCOSE store); led the development of three new international standards for SoSE, the first in the industry; been a technical cosponsor of the SoSE Conference; and continued the highly popular SoSE webinar series.

Systems Engineering Foundations—The need to strengthen the foundations of systems engineering is a priority in both the INCOSE Vision 2025 and the FuSE initiative. In mid-2016, the INCOSE Fellows took on a project to review and refine the definitions for system and systems engineering to better support the future needs. That effort included comprehensive analysis of the world views and resulted in a revised set of definitions and a supporting paper presented to the Board of Directors for approval and published in the beginning of 2019. Concurrently, INCOSE participated to develop a set of systems engineering principles. The project team leveraged work started by NASA and others. After a workshop in December 2018, a team documented, presented, and published a draft set of systems engineering principles in 2019. Although there is still additional work needed to mature and evolve the principles, it provides an initial baseline.

Digital Engineering—As INCOSE has been working towards the transformation of systems engineering into a model-based discipline, we have realized that we also need to evolve in a way to integrate with the other disciplines to have the ability to share the engineering information and analysis across the boundaries of the disciplines—i.e., an integrated and holistic engineering capability. One significant success in this area is the establishment in 2018 of the Digital Engineering Information Exchange Working Group (DEIXWG). This is an INCOSE-led joint working group with the National Defense Industrial Association (NDIA) Systems Engineering Division (SED) and the US Department of Defense (DoD). This group is identifying and defining the needs, especially the digital artifacts, required across the life cycle to support system definition and communication among stakeholders.

Agile Systems Engineering—As we continue to move more into evolutionary and dynamic environments with respect to system capabilities, it is essential to build an understanding of and guidance for agile systems and agile systems engineering. Here "agile" means the ability to deal with change. INCOSE conducted a series of workshops during 2016-2017 to analyze industry experiences and extract a set of fundamental principles. This resulted in a set of papers and webinars to help others gain from learnings in this area.

Systems Engineering Vision—We have planned the kick-off of a revision project for the INCOSE Vision 2025. We established a diverse Core Team for INCOSE Vision 2035, and the official project kick-off will be at the INCOSE International Workshop 2020 in January.

Systems Engineering Grand Challenges—We are collaborating with international organizations on applying systems engineering and systems approaches to help address grand challenges (such as availability of clean water and sanitation) and other societal issues and system needs.

INCOSE is considering all these highlighted in the upcoming revisions of the INCOSE Handbook, the Systems Engineering Body of Knowledge (SEBoK), and the systems engineering-related international standards, such as ISO/IEC/IEEE 15288, Systems Life Cycle Processes. We need to continue to move the key systems engineering reference and standards forward so that the systems engineering discipline will evolve and continue to be a relevant factor in future system development and life cycle management.

When I ran for President-Elect, I stressed four focus areas, one was the advancement of Systems Engineering, addressed above. Our INCOSE team has been doing an excellent job in looking forward and putting things in place to advance systems engineering. The other three focus areas are: INCOSE In-reach to build a more integrated, global INCOSE; INCOSE Outreach to build beneficial collaborations and alliances with other industry associations, professional societies, and other organizations towards to achievement of common objectives; and Professional Development to build a comprehensive capability to provide assistance in the professional development of those performing systems engineering. The dedicated teams of volunteers in INCOSE have helped to make significant progress in each of these areas.

For INCOSE in-reach, we have revised our policies and procedures for global operations of INCOSE that include how we interact. Additionally, we have ensured that the key projects of INCOSE reach across the geographical boundaries, using chapter

efforts and including diversity in the team representation. The results have been superior. Finally, we have recently worked to update the agreements with all chapters to reflect our organization as it is today and where we are heading soon.

For INCOSE Outreach, we have made huge steps forward in building a set of alliances and collaborations that will positively affect both INCOSE and the systems engineering discipline for years to come. Many of the collaborations focus on the advancement of systems engineering, as described above. For more on this, see the President's Corner article in the final 2018 issue of the INCOSE Newsletter.

And for Professional Development, we have an initiative in place to develop an INCOSE Professional Development Portal (PDP) that is moving in a very encouraging direction. This initiative is on track to supply resources to enable a systems engineering community to interact in a platform environment that facilitates the exchange of ideas, information, training assets, etc. For more on this, see the President's Corner article in the May issue of the INCOSE Newsletter.

In looking forward, it is also essential to focus on the evolution of INCOSE as an organization from a business perspective. Although we are a non-profit organization, we need to ensure the health of the organization from more than its technical focus. Over the past 4 years, we have reviewed all aspects of INCOSE and identified areas that needed addressing to ensure a solid organization that is prepared for growth and ongoing change. The efforts include review and revision (as needed) of the following: all policies; bylaws; global operations; financial models; IT infrastructure; leadership roles; support contracts; membership value; membership types; value streams; agreements with others; and several other things. Your

Board of Directors is a highly dedicated and diverse group who have worked diligently to move INCOSE into a stronger position for the future. I want to thank them for their professionalism and contributions. The level of their efforts is not typically known by the average INCOSE member. Thank You!

My opportunity to serve as the INCOSE President has given me a chance to build many lasting relationships.

We have a great organization of highly skilled and dedicated people who believe in the mission and vision of INCOSE enough to volunteer their time to help make a difference. The teamwork is impressive. It has been my honor to be a leader in INCOSE and to be a part of the many teams that make INCOSE special. Thank you!

2019 Nominations & Elections Results

Alan Harding, alandharding@gmail.com

As this year draws to a close, as chair of the INCOSE nominations and elections (NOMELEC) committee I wanted to take this opportunity to update you on the results of this year's elections to our board of directors. I am delighted to report that on Saturday 25th of January 2020 at the International Workshop (IW) in Torrance California I will be installing five new directors to the board.

Of course the process of finding and developing future INCOSE leaders at all levels continues throughout the year, and so I would encourage anybody interested in both contributing to both our society and systems engineering, and reaping the benefits from the personal development opportunity that comes from volunteer leadership roles, to approach either myself, Bob Kenley (my successor as NOMELEC chair), or any member of the INCOSE board of directors.

2020 INCOSE Officers and Directors

President-Elect
Marilee Wheaton
Systems Engineering Fellow at The Aerospace Corporation, a FFRDC

Treasurer
Mike Vinarcik
Chief Solutions Architect at SAIC

Director for Strategic Integration
Tom McDermott
Dpty. Director of the SERC at Stevens Institute of Technology

Director for Academic Matters
Bob Swarz
Professor of Practice and Co-Director of the SE Program at Worcester Polytechnic Institute

Director for EMEA
Lucio Tirone
Sr. Systems Engineer in Fincantieri S.p.A.,

By Laws Change was Approved
One appointed director position shall be the Services Director. The Services Director shall be nominated by the President and approved by majority vote of the Board of Directors. The term for the position shall be 2 years.

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Cape Town, South Africa
July 18 - 23, 2020

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6 Develop sustainable business relationships

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- Develop sustainable business relationships

16 642
SQ FT

4
DAYS

2
SOCIAL EVENTS

11
BREAKS & LUNCHES

Lots of possibilities to interact with systems engineering communities

Visit **www.incose.org/symp2020** and contact us **TODAY** - The IS2020 Organizing Team

Notes from the Board

Lisa Hoverman, marcom@incose.org

The INCOSE Board of Directors (BoD) held their fourth quarter meeting in London, GB. The focus of this BoD meeting was on finalizing the 2020 budget, approving the Annual Operating Plan, planning and setting strategy for 2020, including a focus on our 30th Anniversary. Other important topics covered were details for the IW, IS, and our special initiatives, specifically working on some of the Engineering Grand Challenges that align with the United Nation's Sustainable Development Goals.

A few other highlights of the meeting included:

- The Italia and AISE Chapter MOAs were signed.
- Alan Harding presented an overview of the paper he and Andy Pickard wrote in the latest issue of INSIGHT (free for download to anyone through March!) to the BoD, and noted that we do well as a global organization in Engineering for diversity, and we could do much better, to become the premier diverse Engineering organization in the world.

- The Board reviewed in detail:
  - Progress in each of our value streams as they align with our strategic objectives
  - Strategic alliances
  - CAB needs
  - Accreditation of systems engineering curriculum by ASEE following a report from Academic Matters

HSI 2019: The First INCOSE International Conference on HSI Was a Success!

Guy André Boy, guy.andre.boy@gmail.com

On 11-13 September 2019, the INCOSE Human Systems Integration Conference (HSI 2019) took place in Biarritz, FR, a beautiful, proactive city where engineering education, innovation, and tourism are main assets. In this setting, the conference inspired and engaged researchers, innovators, and practitioners in productive discussions of how they can reshape technologies, organizations, jobs, and responsibilities of operations actors, engineering designers, certifiers, trainers, maintainers, and many other technology stakeholders to meet near and long-term goals of safe, efficient, and comfortable operations. In all, 150 experts attended. The standard of keynotes, panels, and contributed papers was extremely high. The INCOSE HSI 2019 was a unanimous success from several perspectives: (1) we gathered 150 experts on the domain from all over the world, (2) we continued an in-depth discussion on what HSI is about today in systems engineering, and (3) we made significant progress on the content of the HSI chapter of the next edition of the INCOSE Systems Engineering Handbook. The HSI 2019 Conference received a nomination for the INCOSE Working Group Awards Product of the Year.

HSI 2019 outreach for the INCOSE HSI Working Group was extremely high with 22 countries represented, and the International Ergonomics Association (IEA), in cooperation with the Association for Computing Machinery (ACM) and the Air and Space Academy, endorsed the conference. Participation was at the highest level both institutionally and at the individual level (several highly-recognized IEA members participated in HSI 2019). Consequently, we have decided to organize HSI workshops in 2020 in several countries including France, Canada, US, India, and Israel. In addition, we are collaborating with the HSI Technical Committee of IEEE, which will join us for the HSI 2021 Conference (location and date still to be determined).

During HSI 2019, participants defined the purpose of HSI as the integration of technology, organizations, and people in systems engineering practice during the whole life cycle of a human-machine system. HSI emerges from the combination of human-centered design (HCD) and systems engineering as a highly participative and incremental process. The scope of HSI consists of addressing design and engineering, certification, and legal issues, as well as product usages and maintenance.

HSI requires creativity (synthesis and integration) as well as experience, awareness, and validation (experimental tests, operations quality analysis, discovery of emergent properties, standards, and so on). Modeling and simulation capabilities tremendously improve possibilities of considering human factors during the early stages of design and throughout the entire life cycle of systems. Operational personnel can be involved in virtual operations tests to determine appropriate requirements for effective design and development. A particularly important question at this point is the physical and figurative tangibility of highly digital systems undergoing design, development, production, and use.

The current economic environment puts additional pressure on all of us to make industrial operations more efficient and affordable. We reviewed and discussed innovative methods, techniques, tools, and technology that can lead the way in HSI, such as laboratory research and field investigations, industrial developments, and perspectives, ranging from design, evaluation, certification and rule-making, training, maintenance, in-service experience to incident/accident investigations.

Figure 1 shows that HSI is at the intersection of, at least, human factors and ergonomics (task and activity analysis, human and organization performance, as well as evaluation and metrics), systems engineering (systems of systems including people, agile development,
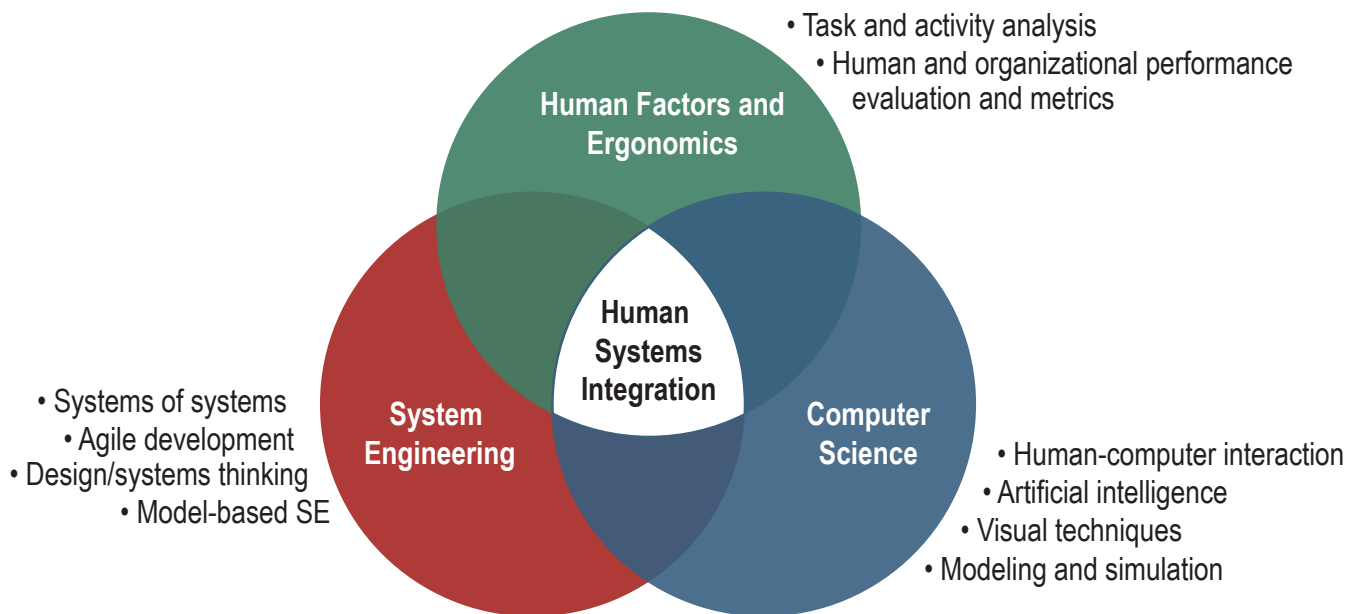
Figure 1. HSI as an intersection of three disciplines

design and systems thinking, and model-based systems engineering) and computer science (human-computer interaction, artificial intelligence, visualization techniques, modeling, and simulation).

The INCOSE HSI Working Group is about to complete the roadmap that we started in 2016 (Figure 2). Let us keep going! We have a great endeavor in front of us for the development of HSI as an integrating approach that considers the human element as well as organizational and societal issues at the center of engineering design and systems engineering.
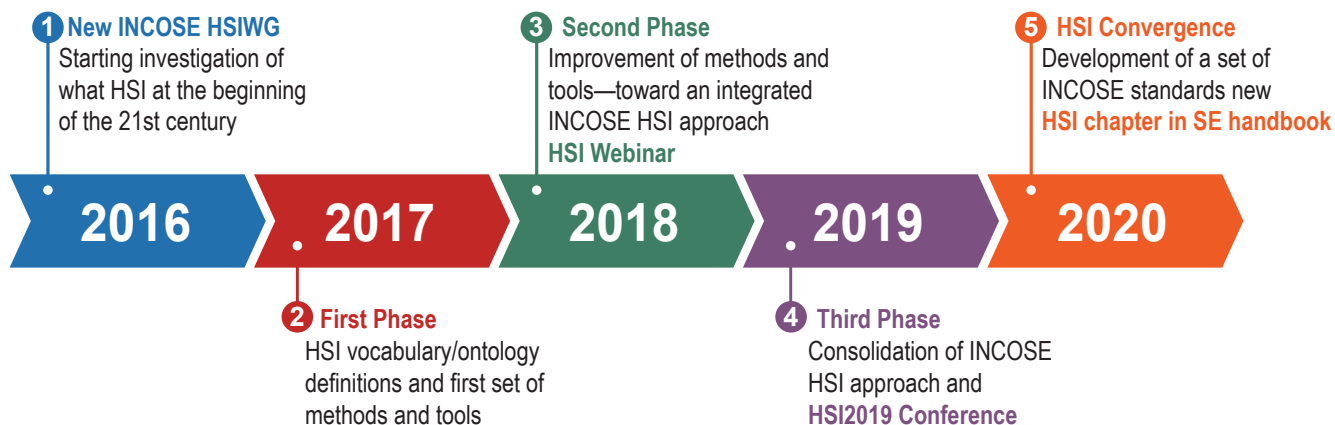

1 New INCOSE HSIWG
Starting investigation of what HSI at the beginning of the 21st century

2 First Phase
HSI vocabulary/ontology definitions and first set of methods and tools

3 Second Phase
Improvement of methods and tools—toward an integrated INCOSE HSI approach
HSI Webinar

4 Third Phase
Consolidation of INCOSE HSI approach and
HSI2019 Conference

5 HSI Convergence
Development of a set of INCOSE standards new
HSI chapter in SE handbook

2016 2017 2018 2019 2020

Figure 2. INCOSE HSI Working Group roadmap

2020
Annual **INCOSE**
international workshop
Torrance, CA, USA
January 25 - 28, 2020

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January 25 - 28, 2020
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2019 KEY NUMBERS

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576h
of Productive Workshop

10h
of Social Events

Visit **www.incose.org/iw2020** and contact us **TODAY** - The IW2020 Organizing Team

Applying Systems Engineering to the Grand Challenges and the United Nations' Sustainable Development Goals

Alan Harding, alandharding@gmail.com

Earlier this month (18 October 2019), I gave a keynote at INCOSE's Asia Oceania Systems Engineering Conference (AOSEC) in Bangalore, IN on systems engineering and sustainability. During this talk, I highlighted the importance of sustainability (meeting the needs of the present without compromising the ability of future generations to meet their own needs) as the wide context in which we as systems engineers operate. I also argued that fully embracing sustainable thinking will make us better systems engineers and will help ensure the success of the systems we help create and sustain.

While discussing sustainability, I talked about its relevance at different levels of abstraction: from the planet, to nations, enterprises, and finally the developers and operators of engineered systems.

Part of the aim of the keynote was to raise the profile of the United Nations Sustainable Development Goals (SDGs) with systems engineers, because they are the best possible formulation of the "better world" in the INCOSE Vision of "a better world through a systems approach." The UN agreed upon these 17 goals comprising 169 specific targets in 2015 as part of the 2030 Agenda, which marks the first time in human history that the nations of the world have come to agreement on a comprehensive vision, with clear goals and targets, for the development of our civilization on planet Earth.

Although the UN established the SDGs four years ago, they resonate strongly with today's climate emergency conversation, especially with SDG 13, climate action.

In my speech, I went on to talk about INCOSE's activities across the spread of the SDGs and where I see even greater opportunities for INCOSE to champion and enable sustainability thinking. As a result, INCOSE will further progress its vision of "a better world through a systems approach."

THE GLOBAL GOALS
For Sustainable Development

Earlier this year, I was part of a workshop at the 68th United Nations Civil Society Conference in Salt Lake City, US-UT. Here, as part of a team from INCOSE and the IEEE Society on Social Implications of Technology (SSIT), we promoted how systems approaches can contribute to the SDGs and other grand challenges. The IEEE SSIT focusses on the effect of technology on society and the response of society to technology. With advances such as the Internet of Things, artificial intelligence, and facial recognition, this viewpoint is especially important and is relevant to INCOSE because we are striving to apply systems engineering in new and relevant ways to address complex socio-technical problems.

The event was a great opportunity to highlight the value of systems approaches to non-engineers, and, in particular, people from a worldwide collection of nongovernmental organisations (NGOs) who are very much at the softer end of things (charities, faith groups, single-issue groups).

To support these conversations, we boiled down systems approaches to their essence:

• We think about the whole system, in context.

• We help people follow an organised approach to make changes.

INCOSE was highlighting how we can apply systems approaches to help address the SDGs, focusing in on SDG 6 (clean water and sanitation) and SDG 11 (sustainable cities and communities). Engaging with the UN and its SDGs

is part of INCOSE's long term vision to achieve "a better world through a systems approach." Over three days, the team raised the profile of systems approaches, and systems thinking, with a diverse audience and identified several opportunities for potential joint projects.

INCOSE has adopted SDG 6 as a focus, building from the National Academy of Engineering Grand Challenges and has held a workshop at its recent International Symposium (IS) looking at the issues surrounding the pollution of the Ganges water basin. Practitioners applied systems thinking techniques and engaged with stakeholders, helping to identify and rank issues, discuss the underlying system, and identify and discuss the types of intervention that could help improve things. Interestingly, these changes are both social/legislative and technological.

Sector Updates—Americas

Hampton Roads Area Chapter

Ben Hudson, bjhudsonincose@gmail.com

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Figen Baysal, former Hampton Roads Area (HRA) chapter president, and her daughter Celine Baysal, membership director, were part of a team that received the Model of Excellence Award from Newport News Shipbuilding (NNS) 2019 for their systems engineering on completion of an audit with the government customer. The Model of Excellence is NNS's highest honor and recognizes individuals and teams for their performance and accomplishments that align with the NNS Strategy. NNS provided the following description of their project.

Defense contractors must maintain acceptable accounting systems and periodically undergo audit for compliance. This team devised a successful new strategy for managing business system audits. The Accounting System Audit Response Team served as the primary interface with the auditors to manage information requests, ensuring complete, comprehensive, and timely responses. While the process proved more efficient and effective for everyone, the significant value of the new approach was the shipyard's ability to interpret and explain our data in a way that made sense to the auditors. As an added benefit, it provided useful documentation for training new employees.

Celine Baysal, left, and her mother, Figen Baysal, both received Model of Excellence awards for the same project. Photo by Matt Hildreth

Mother and daughter duo Figen Baysal (E47) and Celine Baysal (E47) had no idea they would receive Newport News Shipbuilding's highest honor for serving on a team tasked with devising a new strategy for managing business system audits. "Mapping the processes was a new approach for an audit, and we had a very short time," Figen Baysal said before the award ceremony. "We did the best we could."

Celine Baysal, left, and her mother, Figen Baysal, both received Model of Excellence awards for the same project. Photo by Matt Hildreth

The effort was successful, and about one year later, members of the Accounting System Audit Response Team–including the Baysals, both systems engineers–received Model of Excellence awards. "After working here for only three years, I wasn't expecting it," Celine Baysal said. Her mother inspired her to become a systems engineer and to come to work at NNS.

Even outside of the project that earned them Model of Excellence awards, the Baysals embrace the opportunity to work together and take pride in the fact that their work contributes to the nation's defense. "A lot of people are surprised, but I think we work well together," Celine Baysal said. "We're so honest with each other, and there's so much trust."

Mary Ellen Nealy (O19), who also was a member of the Accounting System Audit Response Team, said she saw firsthand how Figen Baysal mentors her coworker and daughter, who Nealy said is brilliant in her own right.

"They work so well together," Nealy said. "Figen obviously has more experience, but I saw her hold back to let her daughter shine. I knew what she was doing both as a mom and as a leader in the company, and it was awesome."

INCOSE Los Angeles Chapter

Phyllis Marbach, prmarbach@gmail.com

Redondo Beach's Northrop Grumman Corporation hosted the INCOSE-LA's November Speaker meeting on November 12, 2019. Members met to learn "Human Systems Engineering" from John Clark. Several chapter members volunteered at the INCOSE Engineering Women Leaders sponsored exhibit at the Society of Women Engineers (SWE) Conference held at The Anaheim Convention Center on November 7-9. The fourth quarterly Strategic Planning (SPM) Meeting at the Manhattan Beach Community Church on November 23, 2019 concluded the month. Our board members discussed future events and the overall chapter operation with other members who joined us for the day.

Dr. Rick Hefner of Caltech spoke about "Systems Engineering: An Enabler for Artificial Intelligence" at our October 8th speaker meeting held at The Aerospace Corporation.

September was a busy month for the chapter. We held our quarterly Strategic Planning Meeting on September 7. The monthly speaker meeting was Tuesday, September 10 at The Aerospace Corporation where Sean Marques presented "OpenMBEE: An open source Model-Based Engineering Environment". A discussion regarding open source and SysML followed the presentation. The INCOSE WSRC 2019 kicked off on Thursday September 12 at LMU. See the next paragraph for more details about WSRC. The following weekend the chapter participated in "The 8th Annual Mars Rover Update and Professional Society Expo" on September 21, 2019 at the Northrop Grumman Corporation. Hundreds of middle school, high school, and college level students, and their parents, attended the expo, learning about science, technology, engineering, and math (STEM) opportunities. Twelve professional organizations attended in addition to the Los Angeles Air Force Base Youth Programs who hosted several outdoor rocket and robotic hand-on STEP activities. See the newsletter for more information.

On September 12-15, 2019, INCOSE-LA hosted the second annual Western States Regional Conference (WSRC) themed, Systems Engineering Relevancy: Time for a Sea Change! The Technical Program included a speakers, tutorials, panel discussions, and keynote speakers at Loyola Marymount University's (LMU) lovely campus. The conference banquet was Saturday night at the Renaissance Hotel, near LAX where we heard from Lt. Col. Kellie Brownlee the Materiel Leader, Future Ground Integration for the United States Air Force Space Command. Don McMillan, a Stanford engineering graduate and now comedian got us all laughing to top-off the evening. The last day of the conference opened with keynote speaker Dr. George Angeli, Chief System Engineer, Giant Magellan Space Telescope, and ended with a tour to Northrop Gruman Corporation (NGC) in Redondo Beach to see the James Webb Space Telescope, hosted by INCOSE-LA's President Emeritus and NGC employee, Stephen Guine. One hundred twenty attendees came from 14 states, Canada, and Washington D.C. Plan to attend INCOSE WSRC 2020 in Seattle, WA on Sept 19-21. See www.incose.org/wsrc2020 for more details.

Many dedicated volunteers make our chapter events and this conference possible and the chapter thanks them for their service in spreading the word about our profession and the difference it makes in our many domains serving humankind.

INCOSE Orlando Chapter in 2019

Michael Goodman
Michael.Goodman@INCOSE.org

Despite everyone having busy work/life circumstances, the INCOSE Orlando Chapter achieved a fruitful year of support toward the goals of the International Council on Systems Engineering. Chapter members actively attended and passionately participated in variety of monthly chapter meetings, provided a robust team of volunteers to support the 2019 International Symposium (IS) in Orlando, and geared up to promote INCOSE at the premier modeling and simulation conference, the Interservice/Industry Training, Simulation and Education Conference (I/ITSEC).

As a cornerstone-level partner to the National Center of Simulation, INCOSE continuously has a booth in the world-class I/ITSEC Conference Exhibit Hall—we have for nine consecutive

years. At this annual conference, the 10,000 plus I/ITSEC attendees from around the world are prime candidates to learn about and become disciples of INCOSE. I/ITSEC has consistently proven to be a superb event to have INCOSE representatives to converse with a full spectrum of engineers and other professionals and share with them the benefits of INCOSE membership.

The INCOSE Orlando Chapter is preparing for– and looking forward to another beneficial year in 2020, beginning with annual the Defense Forum breakfast in early January 2020. The Combined Professional Association Group (CPAG) of which the INCOSE Orlando Chapter is an active member hosts the Defense Forum breakfast. This event includes briefings from the senior service members of the four military branches who are resident in and neighbors to the INCOSE Orlando Chapter within the Central Florida Research Park. Through this event, industry can gain valuable insight into the individual military branches visions, priorities, challenges—and of course their funding for the coming year. It is always a sold-out event.

Date	Topic	Presenter/s	Location
17 January 2019	Orlando International Airport System of Systems, briefing and behind-the-scenes private tour	Tom Draper, Greater Orlando Aviation Authority's Sr. Director of Airport Operations	Orlando International Airport, GOAA Executive Board Room
21 February 2019	Defense Advanced Research Projects Agency (DARPA), discussion	Darin Smith, DARPA	Fairwinds Headquarters
21 March 2019	Human Side of Cybersecurity–Cybersecurity through a Human-Centric Lens	Dr. Matthew Canham, University of Central Florida (UCF) Institute of Simulation and Training and Dr. Clay Posey, UCF College of Business	Fairwinds Headquarters
18 April 2019	Building and Integrating an Information Security Trustworthiness Framework for Aviation Systems	Anna Baron Garcia, graduate student at Embry-Riddle Aeronautical University, Spain.	Leidos, 12901 Science Drive
16 May 2019	Two Technologies Changing Everything	Dr. Dale Brill, Orlando Economic Partnership	Leidos, 12901 Science Drive
20 June 2019	The Drake Equation and the Fermi Paradox	Joe Vandeville	Leidos, 12901 Science Drive
18 July 2019	Thought Leader and High-Precision Innovation-Modernization Implementer	Link Parikh, Founder/CEO, Rocket Technology, Inc.	Leidos, 12901 Science Drive
15 August 2019	A Regional Economic Perspective	Dr. Dale Brill, Orlando Economic Partnership	Leidos, 12901 Science Drive
19 September 2019	Information Lifecycle Diagrams and Model-Based Systems Engineering	Ian Phillips	Leidos, 12901 Science Drive
17 October 2019	Planning Now for Future Transportation Needs	Grant Begley, Rocket Crafters, Inc.	Leidos, 12901 Science Drive
21 November 2019	Introduction to the Hybrid Cloud	Gilda Alvarez	Leidos, 12901 Science Drive
12 December 19	INCOSE Orlando Holiday Party	INCOSE Orlando members	Leidos, 12901 Science Drive

INCOSE Orlando Chapter's Monthly Meeting Information, 2019
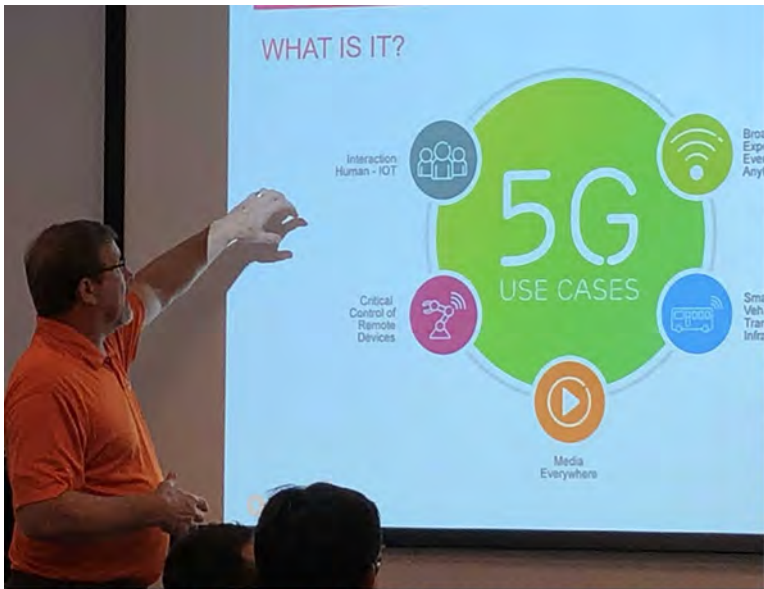
INCOSE Western Region Updates

Renee Steinwand
steinwand_renee@bah.com

As part of the America's Sector initiative, regional directors have visited chapters to reach out to gain knowledge about operations, challenges, and best practices. I visited four chapters in the Western Region earlier this year–San Francisco/Bay Area, Wasatch (Utah), San Diego, and Los Angeles–to meet with chapter leaders and collect information on the chapters' successes and challenges. San Francisco and Wasatch are smaller chapters that are continuing to enhance their presence in their geographical areas. San Diego and Los Angeles are larger chapters that have frequent member meetings and have robust member participation.

Membership engagement was a key discussion item for both the smaller and larger chapters. When there are only a few members from the chapter engaged in activities and meetings, the chapter is not as successful. Paul White, Wasatch, shared some ideas that he used to stimulate engagement in the Wasatch Chapter. Paul started by hosting social gatherings at the chapter, providing dinner, which he said really boosted attendance. He also sends out a monthly email to the chapter with a three-month outlook for upcoming activities to include other local professional organizations.

Andrew Wiedlea, San Francisco, has been trying to overcome the geographical spread of his members in the Bay Area, which can be quite challenging. He says that the chapter struggles to find good meeting locations and attract membership attendance. He has tried different tools to reach out to members, such as G-Suite, to share documents and conduct polls. Andrew would like to host a meet and greet with the local Corporate Advisory Board (CAB) companies and the members to help leverage participation. He also noted that it would be beneficial to encourage two-year terms for the local Board of Directors, since it takes time to come up to speed and helps with board continuity.

Ted Mulder and Abbas Rostami, San Diego, had several suggestions for chapter engagement. San Diego hosted an event at a local restaurant to celebrate their Platinum Award as the Best INCOSE Chapter. Many members and non-members attended the gathering. Members encouraged the non-members to sign up for chapter emails and membership at the event. Ted's key recommendation is for chapter leaders to review the criteria for the circle awards and formulate a plan around it. Ted created an initiative to establish an ambassador program with local companies. San Diego typically conducts its meetings at the same location each month and has also established both a cohort for studying for the Systems

Engineering Professional (SEP) exam and hosted the written SEP exam.

At the Western Sates Regional Conference (WSRC) in Los Angeles, Paul and I presented "How to Give Your Chapter a Boost," which highlighted some of the region's best practices, along with providing information about resources that INCOSE provides to local chapters. The briefing also included key findings from the INCOSE demographic survey, provided by Don Boyer. The survey identifies how it is critical to retain members who are new to INCOSE to retain them long term. Mark McKelvin, Los Angeles, pointed out how it is important to continuously provide speakers and high-quality meetings for the members to attend and stay involved. Los Angeles hosted the WSRC (chaired by Phyllis Marbach) where many of its members worked diligently for over a year to assemble a great regional conference

that benefited many attendees. Another key takeaway from the demographic survey is that the top benefit of being an INCOSE member is "networking with peers."

The INCOSE International Workshop (IW) on 25-28 January in Torrance, US-CA will host a Chapter Leader Training track to assist new and current chapter leaders to implement best practices and exchange ideas about chapter operations. The workshops will take place on the 27th and 28th of January.

It has been my pleasure getting to know more of the chapter leadership and members in the Western Region this year. It makes me realize how much we all have in common as systems engineers. I look forward to continuing to network and assist wherever I can in improving chapter membership engagement.

INCOSE Australia Chapter SESA Updates

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Yarlini Aravinthan, yarlini@gmail.com

The third quarter of the year has been very eventful with the following highlights.

In August, Professor Vernon Ireland conducted a 3-hour workshop in Syndey on Complex Systems Leadership for Infrastructure Development. During the workshop, he divided over 100 attendees into 6 groups to study approaches to complex infrastructure cases in different domains including: asset management, construction engineering, biomedical engineering, public transport, and business refresh.

SESA held its 3rd quarter National Speaker Program in Melbourne, organised by the Victorian Transport Group along with Transport Australia Society and Victorian Civil College. The speaker was Philip Blake who gave a speech entitled, "The Uncertain Future of Engineering Disciplines through a Transport Lens."

SESA Strategic Planning

SESA held the 2019 SESA Strategic Planning Day on 27th October in Melbourne, the day prior to Australian Systems Engineering Workshop (ASEW). Discussions covered a wide range of current topics including:

- Which professions employ systems thinking? Is it only engineering, or does it happen in many other professions? How do systems engineers contribute?
- How can SESA reinvigorate its brand and provide value to its members? From this question, SESA approved a proposal to develop a new website, which we are extremely excited about.
- How can we provide support for early career systems engineers through piloting a mentoring program including streams on fundamentals of systems engineering in SESA events?
- How can we best provide information to our members on available certification options?

Australian Systems Engineering Workshop (ASEW)

The strategy day was followed by a sold out ASEW which ran across two days in Melbourne. Keynote speeches were followed by breakout sessions which included presentations, panels, and workshops covering a range of pursuits from telecommunications, education, aviation, transport, healthcare, and human machine interface (HMI) as highlighted on the Figure 1.

Figure 1. ASWE Breakout Sessions

In addition, Kerry Lunney conducted a workshop on two of the National Academy of Engineering Grand Challenges, clean water, and sanitation. ASEW concluded on the second day with a keynote presentation by Rick Dove, "Agile Systems Engineering–A Life Cycle Strategy and Model."

As part of the brand invigoration for SESA, a videographer attended ASEW to interview attendees and obtain footage of SESA activities. Over the next six months, look out for the new SESA website which will host a series of videos that will cover a variety of topics.

SESA is looking forward to an exciting year ahead with 25th Anniversary events in Melbourne, Sydney, Canberra, and Brisbane!

Kerry Lunney presents on two Grand Challenges

Great location and catering

ASEW Dinner

Telecomms Working Group session

India Chapter Updates

Ramakrishnan Raman
ramakrishnan.raman@hotmail.co.uk

Following a successful Asia Oceania Systems Engineering Conference (AOSEC) 2019, an energized India Chapter executive committee, which included a few new committee members from the Summer 2019 elections, met face to face on Sunday, the 20th of October. The committee met at PES University, which is also the chapter's newly registered office. Outgoing and new committee members made this a well-attended meeting where they discussed chapter practices, mandatory legalities, and goals. For the second half of the day, Stueti

Gupta, India Chapter President, challenged the team to think of five things that would make the chapter successful in 2020 and to focus their energy these goals throughout the year. With this objective in mind, the team held an engaging and interactive discussion on a white board. Matching feedback from chapter members, the team will focus on systems engineering trainings, certifications, membership, and academic forums as the top focus areas. If you are in India and would like to contribute to these chapter goals, please reach out to the chapter committee by sending an email to IncoseIndiaChapter@gmail.com.

INCOSE India Model-Based Systems Engineering Local Working Group

Ramakrishnan Raman
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With the kickoff on 5 May 2019, the group has met monthly to discuss the definition of model-based systems engineering, share insights, and take on a challenge problem. The team members come from diverse backgrounds, so we wanted to the problem statement independent to any company's domain, yet interesting for all involved. With these parameters, the group decided to take on a challenge to develop an architectural proposal for a smart parking lot that could support Indian Government's smart city objective. To maintain rigor, we divided the team into two sub teams, both working in parallel and meeting weekly to discuss and share progress.

Another initiative by the group is called #SysML4Fun and you can find it on LinkedIn (http://tiny.cc/SysML4Fun). Here we release Bollywood-themed fun quizzes to guess what the given SysML diagram depicts. This initiative is to increase awareness about SysML and how its use can describe almost any system.

The group is open for all to join in person or virtually, and anyone interested can send their interests or concerns to najoshi@gmail.com.
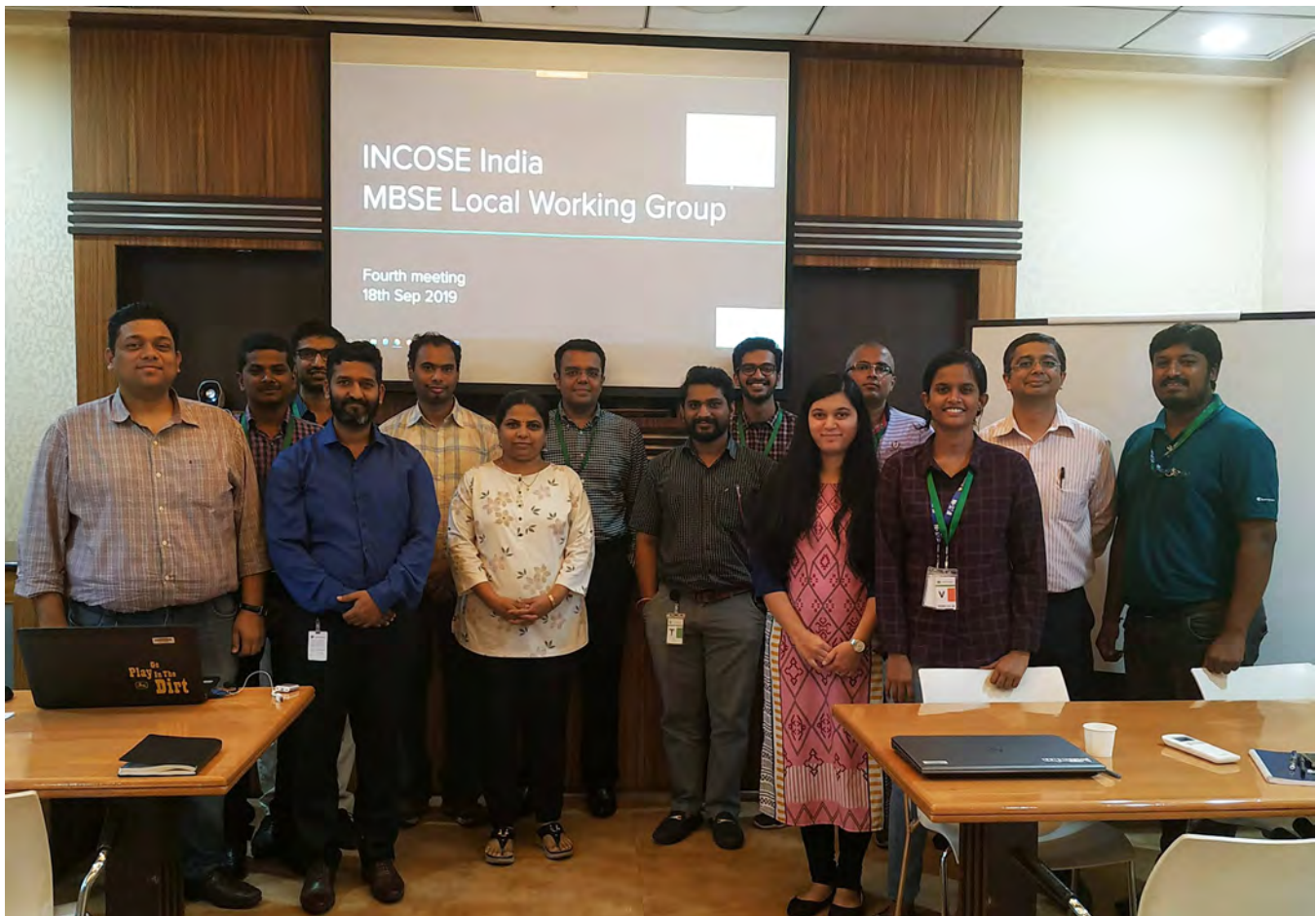
INCOSE Brings Cyber and Systems Security to Engineering Education

Alice Squires, alice.squires@incose.org

The INCOSE Academic Council continues to focus on systems education for all engineers by bringing experts on cyber- and systems security engineering education to engineering educators at the American Society of Engineering Education (ASEE) Annual Conference in Montréal, CA from 20-24 June. A panel of active leaders and faculty in cybersecurity programs will explore cybersecurity from multiple perspectives, including how current educational programs are meeting the new Accreditation Board for Engineering and Technology cybersecurity criteria, where cybersecurity programs can be found in the university (systems engineering, information technology, computer science, electrical and computer engineering, among others), how systems engineering educators are integrating cybersecurity into the curriculum, what approaches others have used to deliver cybersecurity education, the role of professional societies such INCOSE in cybersecurity education and training, and how cybersecurity programs are meeting cyber workforce demands. Alice Squires from Washington State University will moderate the panel and challenge the panelists to address emerging trends in cyber- and systems security needs. Panelists will include Radu Babiceanu from Embry-Riddle Aeronautical University (ERAU), Doug Jacobson from Iowa State University, Dick Fairley from Systems and Software Engineering Associates (S2EA), and Peggy Brouse from George Mason University.

INCOSE Awards Two Prizes at the 2019 ISEF

Dorothy McKinney, dorothy.mckinney@icloud.com

Continuing a tradition started in 2009, INCOSE sent a team of judges to the International Science and Engineering Fair (ISEF) in 2019. Bill Mackey and Dorothy McKinney awarded the two INCOSE prizes, as seen in Figure 1.

In 2019, the team of INCOSE judges consisted of (left to right in the picture below) Chandru Mirchandani, INCOSE Fellow; Dorothy McKinney, lead, INCOSE Fellow; Regina Griego (seated), INCOSE Fellow; Shazad Contractor, INCOSE San Francisco Bay Area Chapter member; Eileen Arnold, INCOSE Fellow; Judy Walker, INCOSE Southern Maryland Chapter member; John Walker, INCOSE Southern Maryland Chapter member; and Bill Mackey, INCOSE Fellow.

From a field of over 1800 high school student projects from over 100 countries around the world, the INCOSE judges selected 14 honorable mentions and 2 winners in 2019:
- Best overall systems-engineered project winner: Piotr Lazarek for a "Prototype Vehicle which Takes Preventive Measurement of Soil Condition Autonomously"

Figure 1. Presentation of the 2019 INCOSE ISEF awards

Figure 2. INCOSE's 2019 ISEF team of judges

- Best systems-engineered prosthetics project winner: Noam Yakar for "Design and Construction of a Cost-Effective Full Arm Prosthetic with Computer Vision"

Descriptions of the winning and honorable mention projects follow below. If any INCOSE members are interested in serving as judges for ISEF in 2020, which requires being in Anaheim, US-CA from the evening of 11 May to the evening of 13 May 2019, please contact Regina Griego at drgriego@comcast.net or Dorothy McKinney at dorothy.mckinney@icloud.com.

The winner of the best overall systems-engineered project was Piotr Lazarek from Poland, who designed, developed, and tested a "Prototype Vehicle which Takes Preventive Measurement of Soil Condition Autonomously." We invited Piotr to join us at the INCOSE International Symposium (IS) 2020 in Cape Town, ZA. One of the most impressive aspects of this project is that Piotr did not start with much understanding of farming and its challenges. He asked locals for their biggest problems and chose to tackle the biggest problem local farmers faced. Feeding increasing populations with degradation in the environment and farmlands seemed to him an opportunity for systems engineering.

Piotr aims to help farmers autonomously monitor soil conditions. His project encompassed many disciplines as it includes a Google interface to map the data points desired and an autonomous vehicle that responds and

Figure 4. Noam Yakar's project

takes soil samples, then analyzes the sample on its way to the next data point. Results are available to the farmer via a browser. This very impressive systems engineering project required Piotr to study various disciplines, make trade-offs, and optimize the interfaces to demonstrate results from his prototypes' validation. The INCOSE judges gave this project the Systems Engineering Award at the ISEF, as usual with stiff competition.

The second prize INCOSE awarded was for the best systems-engineered prosthetics project, which went in 2019 to Noam Yakar of US-NJ for "Design and Construction of a Cost-Effective Full Arm Prosthetic with Computer Vision." Noam designed and constructed a low-cost prosthetic arm which is controlled by a combination of muscle impulses and computer vision. The hand opens and closes based on the muscle signals from the user's body using an electromyography sensor to capture the bodily input. A camera with a depth sensor captures the article the hand is trying to grasp, and an edge detection algorithm uses artificial intelligence to determine the best way to grasp the item. The prosthetic arm has 12 different specific gripping mechanisms, so it can grasp a wide array of types of objects. The operation of the prototype was impressive.

Figure 3. Poitr Lazarek's project

Figure 5. Braden Milford's project

In 2019, INCOSE also awarded 14 honorable mention awards; the recipients were:

Braden Milford for "SymBead Aquatic Technologies: The Development of a Low-Impact, Cost-Effective, Multi-Pollutant Bioremediation." Remediating heavy metals from aquatic ecosystems is a hard problem. The need for system-designed solutions is becoming more wide spread across the globe. Braden Milford's project, "SymBead Aquatic Technologies: The Development of a Low-Impact, Cost-Effective, Multi-Pollutant Bioremediation System," is one such solution. Using specific algae and bacteria encapsulated in a polymer, water treatment plants worldwide could implement Mr. Milford's project. His results are impressive, and he is getting feedback and encouragement from his local water treatment plant. The INCOSE judges were very impressed with the impact and societal need for this project.

Bradley Xu for "A Novel, Self-Balanced Robot with Leading Technology in Crossing All Angles of Transmission Lines." Inspections of power lines by robots in the past have been limited to wires running in straight lines. Bradley Xu designed and built a cost-effective remotely controlled robot which can maneuver on one line, over obstacles, and move to another transmission line even if it is at a different angle. His prototype hangs from the power line with two motorized wheels, each connected to a separate deck via an arm. He connected the two decks with a rotatable ball bearing, which separates them into an upper and lower deck. This ball bearing lets the decks turn 360 degrees laterally. Attached to each deck is a continuous track, which moves weights up and down the deck laterally. Shifting the weights moves the center of gravity, allowing the robot to raise and lower the motorized wheels from the power line. This enables to robot to rotate to any desired angle. Future versions will support live-inspection capabilities with cameras and support attachments for de-icing and obstacle removal. Thus, this power line inspection robot will eliminate safety hazards of current power line inspection processes, and significantly decrease the cost and time required to complete power line inspections.

Mackenzie Hunt for "Welcome to 'Sistance:' A New Form of Base Communication for Deaf-Blind Children." Mackenzie chose to design and develop a pocket-sized unit which provides learning opportunities for children with visual and auditory deficits, including those who may have problems vocalizing. Such children can show signs of frustration and aggression because of their limited connection to the world. Mackenzie collected needs and wants from those working with deaf and blind children. She then designed an app, plus a simple physical guide which you can attach to a smart phone to improve tactile discrimination. This combination provides the ability to stimulate three different senses of the children (touch, sound/vibration, and sight), providing feedback even mostly or totally deaf or blind children can sense.
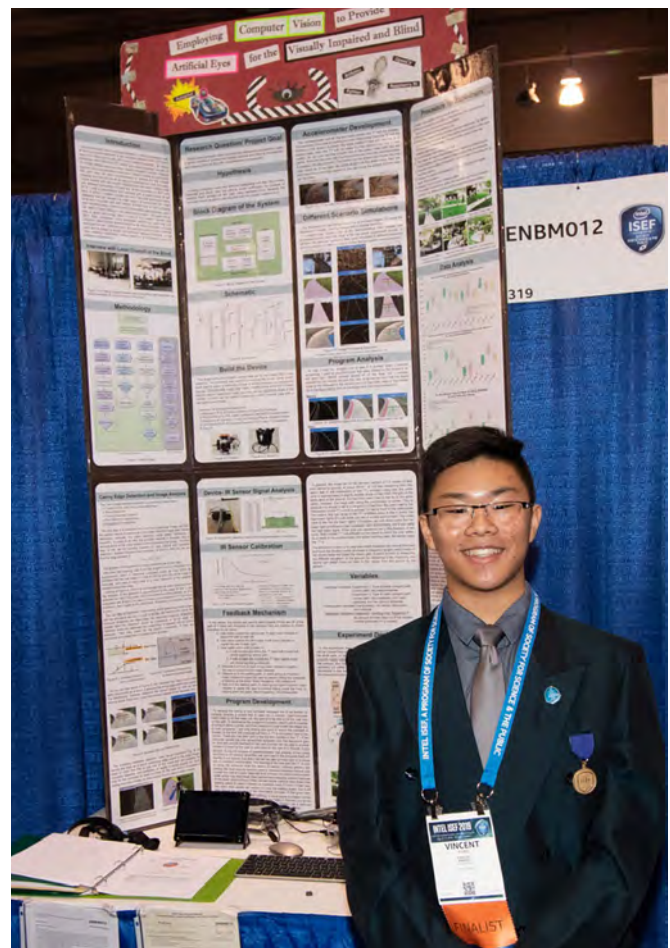
Figure 6. Mackenzie Hunt's project

Figure 7. Vincent Yang's project

Vincent Yang for "Employing Computer Vision to Provide Artificial Eyes for the Visually Impaired and Blind." Vincent designed and developed a device which uses computer vision to provide an "autopilot" for blind and visually impaired people. He adapted approaches the industry is currently using for self-driving cars to provide a device which alerts a person if they are about to walk past the edge of a sidewalk, or if there is an obstacle in front of them. He tested the device with and without the use of a white cane. Test results showed that use of the device is more effective than white cane, and the blind or visually impaired person can also use it together with a white cane to offer greater confidence as they walk.

Melissa Woo for "Rapid, Smartphone-Based Diagnosis of Skin Melanoma through Differences in Tumor Cell Thermal Regulation Combined with Diffuse Spectroscopic Analysis." Melissa Woo has produced an interesting concept which all societies can implement without huge expense. Current diagnosis
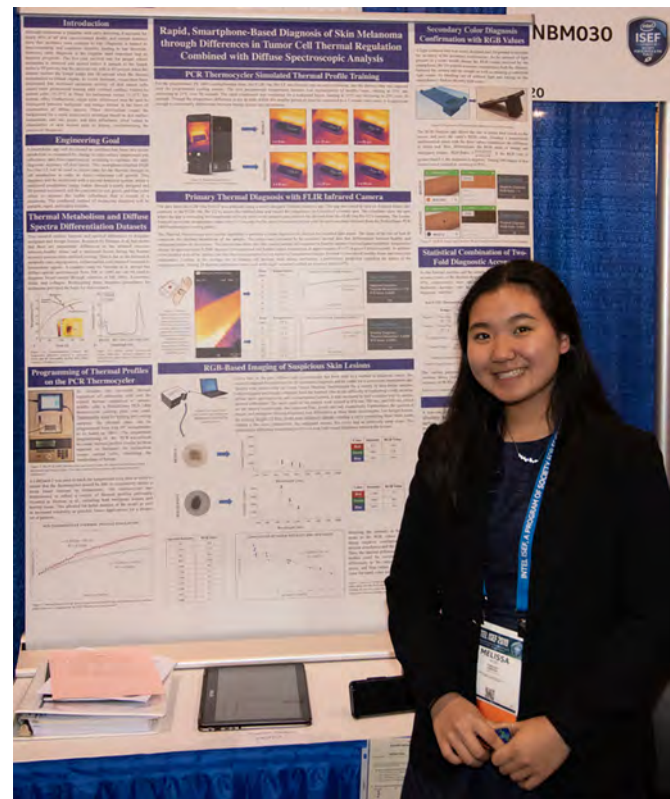
of melanoma requires time-consuming and

expensive biopsies. Instead, she chose two cell growth characteristics which she used to implement a noninvasive technique to determine whether a skin lesion is benign or malignant. She demonstrated the use of systems engineering principles in conducting this project. She demonstrated utility, novelty, and potential major impact in biomedical engineering. She measured temperature differences as well as rates of temperature change to identify malignant lesions. By also measuring the intensity of reflected white light, she was able to reach a combined sensitivity of 94% and a specificity of 97%, thus yielding an overall accuracy of approximately 98.8% versus present medical techniques which yield an accuracy of approximately 70%.

Nicolas Fedrigo for "Improving Spinal Fusions: Redesigned Pedicle Probe to Prevent Vertebral Breaches." Pedicle probes are medical devices used during spinal fusion surgeries for patients with scoliosis or spinal fractures. The probe creates pilot holes to guide placement of pedicle screws in vertebrae, which the surgeon then connects with metal rods to stabilize the spine. Twenty-nine percent of patients who undergo spinal fusions suffer from vertebral breaches–accidental damage to the spinal cord–which cause infection, motor defects, and paralysis. Nicolas aimed to make spinal fusions safer by designing an innovative pedicle probe which provides instantaneous tactile and visual feedback to the neurosurgeon, warning them when the device is contacting the denser cortical bone (which leads to injury when breached) instead of the target cancellous (spongy) bone. This device will give a neurosurgeon confidence that spinal fusion surgery will not cause the patient any further injury, reducing the medical risk to the patient while reducing the risk to the surgeon of malpractice claims. Several surgeons to whom he demonstrated the device told Nicolas they wish to use the device as soon as it is approved for use. Nicolas conceived the system himself and defined stakeholder requirements. He followed through with implementation and verified the system by conducting trials with lamb vertebrae, a proxy for human vertebrae. Bill Mackey believes this project will have a major effect on future spinal surgeries just

Figure 9. Parthiv Krishna's project

as the DaVinci robotic system has had on gall bladder and stomach surgeries.

Parthiv Krishna for "Robust Autonomous Micro Aerial Vehicles Navigation with Onboard, Environment-Agnostic, Multi-Sensor Simultaneous Localization and Mapping (SLAM)." Parthiv developed an autonomous micro aerial vehicle (MAV) system that uses a multisensorial localization system to navigate and deliver payloads inside and out of buildings in light and low-light conditions. His systems engineering effort was notable for the process he used to design, build, program, and test various prototypes as he perfected and expanded the system capabilities. A key requirement of the MAV is the challenge of designing to a maximum takeoff weight (MTOW) of approximately four kg to allow for greater lifting ability. Parthiv primarily focused on increased robustness through software combinations of multiple sensing, localization, and mapping methods, considering and evaluating trade-offs. Potential applications of this project include search and rescue, surveillance, and package delivery.

Alan Michael for "Gross Motor Skill Evaluation Tool Using Gesture Recognition and Machine Learning to Reveal Hidden Capabilities of
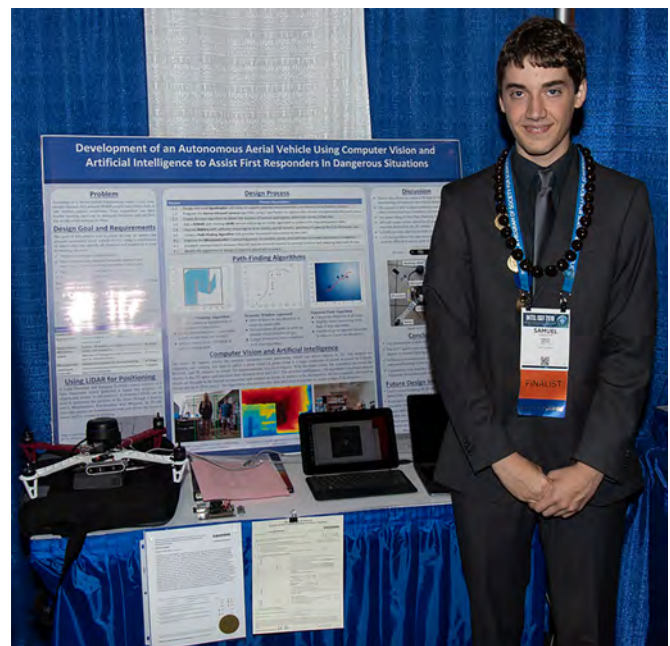
Figure 10. Alan Michael's project

Autism Children." Autism Spectrum Disorder is the fastest growing developmental disability in America with the Center for Disease Control and Prevention labeling 1 in 59 children as being autistic. Alan Michael created a real-time gesture recognition tool which captures and reports autistic children's gross motor skills, emphasizing the positive capabilities during the children's normal activities. His impressive system consists of an integrated and tested machine learning model trained for 52 Early Start Denver Model (ESDM) autism diagnosis standards gestures, a software application, blue-tooth-enabled cloud database reporting which validated data collection from a global test subject in Peru, and a wristband-wearable gesture detection device. The abundant use of systems engineering principles and processes was apparent with his use of requirements, trade studies, capture of predictions, strengths, weaknesses, opportunities, and threats (SWOT) analysis, and verification. Alan recognizes the potential use of his technology beyond autism. His motor-capabilities sensing system

might also prove effective in capturing sports capabilities in addition to other similar uses.

Samuel Cadotte for "Development of an Autonomous Aerial Vehicle Using Computer Vision and Artificial Intelligence to Assist First Responders in Dangerous Situations." Fires and natural disasters such as floods require people to put themselves in harm's way to rescue victims. Samuel Cadotte's project, "Development of an Autonomous Aerial Vehicle Using Computer Vision and Artificial Intelligence to Assist First Responders in Dangerous Situations," responded to this problem. He created a specialized drone that uses computer vision and artificial intelligence to navigate in difficult conditions. This aerial vehicle can navigate with or without GPS and acts as the eyes of first responders in dangerous situations to determine where people may need help. The INCOSE judges were very impressed with the level of systems engineering required for this project and the potential for it to save lives.

Eshika Saxena for "MyRadioloGIST: Early Detection of Lung Cancer from Hidden Gist Signals in CT Scans with Deep Neural Networks and Transfer Learning." Eshika Saxena of Interlake High School, Bellevue, US-WA presented a project that allowed early detection of lung cancer as early detection dramatically increases cure rates. Once cancerous nodules appear on the lungs, treatment becomes more difficult. Es-

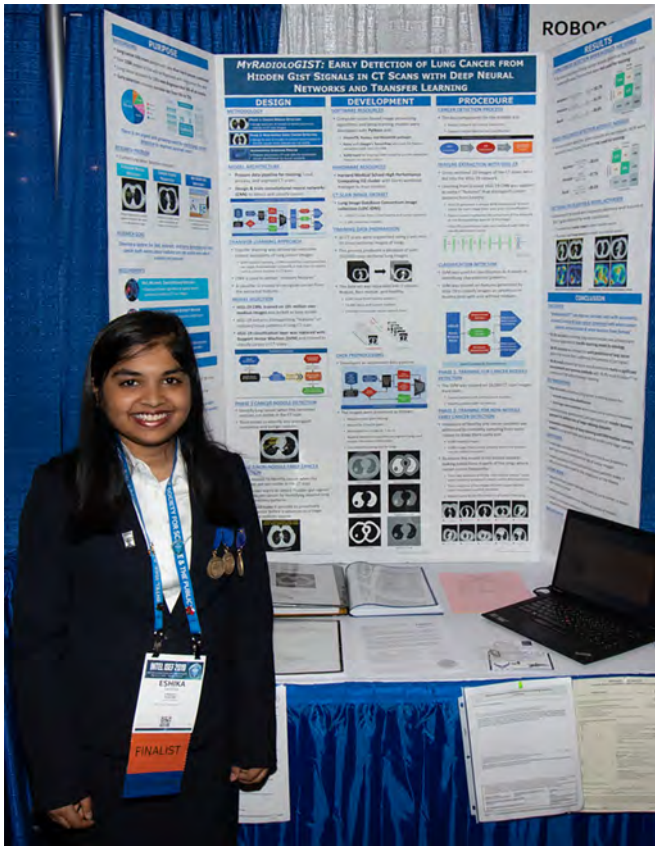hika used a sophisticated deep learning neural

Figure 12. Eshika Saxena's project

Figure 13. Ryan Wescott's project

network model that she trained to extract and identify distinguishing features from lung CT scan images, both with and without nodules (early stage). She used these features to train a support vector machine to automatically classify and detect lung cancer. Her findings suggest that it is possible to identify lung cancer long before cancerous nodules appear on CT scans, as the underlying lung tissue becomes spongy. Radiologists have been aware of this for some time, but before this project, there was no independent way to assess the state of the lung tissue when the nodules are not visible or have not yet appeared. This project has the potential to transform cancer screening and save lives with early, accurate, and fast lung cancer detection. This is the third year in which Eshika received an INCOSE honorable mention at the ISEF. In 2017, her project allowed physicians to remotely monitor two of a patient's vital signs (body temperature and pulse rate) and take the patient's finger prints. In 2016, her project focused on identifying contaminants in human food.

Ryan Wescott for "Development of a Fully Reusable and Autonomously Landing Suborbital Launch Vehicle." Ryan chose to tackle the need for reusable launch rockets for small boosters, since current reusable launch technologies address the needs for large, orbital-class boosters. He designed and developed hardware and software that enables a small booster to propulsively land, ready to be reused. The propulsion system that he engineered utilizes four solid rocket motors, each of which can be gimbaled on one axis. This configuration enables yaw, pitch, roll, and throttle control of the vehicle. He also developed software that utilizes proportional-integral-derivative (PID), sensor fusion, and data filtering algorithms. He determined PID coefficients by developing a mathematical model which simulated the rocket landing. The flight software he developed runs on a 180 MHz Arm Cortex-M4 processor and contains all necessary sensors and control interfaces. He also designed and built additional hardware to support the landing and reusability of the rocket. His analysis indicates that this system shows significant potential to save costs for smaller launch vehicles by enabling them to propulsively land and be reused.

Anish Singhani for "Real-Time Freespace Segmentation Using Deep Learning on Autonomous Robots for Detection of Negative Obstacles." Anish chose to tackle one of the most difficult problems in robot perception: detecting negative obstacles (ditches, potholes, ledges, downward stairs, and other drop-offs). He developed a method of terrain safety

Figure 14. Anish Singhani's project

Figure 15 Rohan Wagh's project

segmentation using deep convolutional neural networks. He used the input from a single camera and trained the network using heavy data augmentation. This enabled the network to generalize well, even when using very small hand-labelled datasets. He then deployed the neural network on an embedded graphics processing unit on an indoor robot. The robot successfully ran at 55 feet per second, creating a free-space map which it used for navigation and obstacle avoidance, including both standing and negative obstacles.

Rohan Wagh for "Designing an In-Situ Soil Conductivity Monitoring Systems for Precision Agriculture and Water Management." Rohan tackled the problem farmers face in understanding soil salinity across the entire field they are farming. Knowledge of soil salinity allows farmer to predict crop yields, manage field sustainability, and create a decision support system to improve water management. Existing soil conductivity sensors and measurement tools are time consuming, expensive, and pose a risk of damaging crops in the field. For this project, Rohan designed
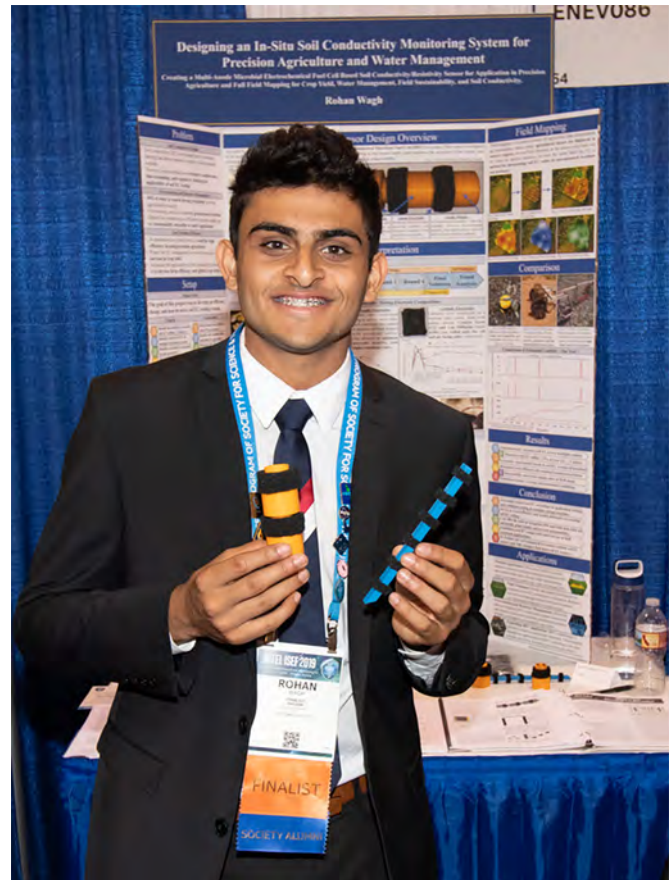
and developed a noninvasive, low-cost, in-situ array of sensors which provides full field soil conductivity measurements and supports an irrigation management decision support system. He used multi-anode microbial fuel cells as sensors and developed an algorithm to transform the voltage-time measurements from these cells to a soil conductivity measure. The sensors proved accurate, and correctly measured soil conductivity over a variety of soil conditions. Since each sensor costs under USD five to produce, the entire system is low cost.

Jingke Hu for "Miniature Underwater Bridge Pier Cleaning Robot." Cleaning and maintaining bridge infrastructure that is submerged in water is labor intensive and expensive, as well as potentially dangerous in deep water. A student from China, Jingke Hu developed a project, "Miniature Underwater Bridge Pier Cleaning Robot," which featured a vehicle the size of a small cooler that could navigate water to effectively clean submerged bridge infrastructure. It featured unique miniature

cleaning nozzles the size of a conical cup that delivered high pressure water for cleaning. This was an impressive challenge to provide the force necessary to clean with pressurized water and remain stable. It featured a camera that allowed the operator to help navigate and determine what needed to be done and where follow-up maintenance might be required. He was able to successfully demonstrate his robot on a bridge pier in China. The INCOSE judges were very impressed with the level of systems engineering and mechanical ingenuity required for this project.
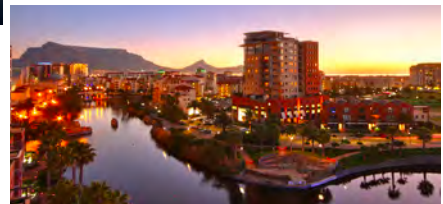

Figure 16. Jingke Hu's project

2020
Annual **INCOSE**
international workshop
Torrance, CA, USA
January 25 - 28, 2020

30th Annual **INCOSE**
international symposium

Cape Town, South Africa
July 18 - 23, 2020

Empowering Systems Leaders in a Neighborhood Near You!

Alice Squires, ewlse@incose.org

Empowering Women Leaders in Systems Engineering (EWLSE) was busy supporting events and systems leaders at two important conferences this fall: the 12th Asia Oceania Systems Engineering Conference (#AOSEC2019) from 17-18 October in Bangalore, IN and the Society of Women Engineers' (SWE) Annual Conference (WE19) from 7-9 November in Anaheim, US-CA. The AOSEC events included an EWLSE-sponsored panel on "The Role of Diversity, Equity, and Inclusion in the Future of Systems Engineering Leadership" held during the main conference, and a Saturday post-conference EWLSE-sponsored workshop on "Thinking Traps and Building Resilience." EWLSE Asia Oceania sector lead Stueti Gupta led the AOSEC EWLSE-sponsored events and kicked everything off with a general overview of EWLSE's vision, mission, and initiatives (see Figure 1).

At SWE, EWLSE, with dedicated support from the INCOSE Los Angeles Chapter, supported an INCOSE EWLSE booth where the volunteers shared their professional experiences, counseled students on careers, and answered a broad range of questions about systems engineering, INCOSE, and career choices. Incoming INCOSE president-elect Marilee Wheaton led the SWE booth activities with a volunteer team comprised of INCOSE Los Angeles program chair Nazanin Sharifi, INCOSE Los Angeles president Mark McKelvin, new INCOSE member Christine Faulkner, Deborah Cannon, INCOSE Los Angeles secretary Phyllis Marbach, Shirley Tseung, and returning SWE booth supporter Federica Robinson-Bryant (see Figure 2). Please see the related articles written by Stueti Gupta and Federica Robinson-Bryant for details on these two events.

Up and coming EWLSE-related news includes:

• EWLSE will be holding their annual working and outreach sessions at the INCOSE International Workshop (IW) 2020 on Monday afternoon, the 27th of January, starting after lunch and ending with a short reception for session attendees and EWLSE members in the evening. Please check the INCOSE IW

Figure 1. Stueti Gupta kicks off the EWLSE-sponsored events at AOSEC 2019

Figure 2. SWE 2019 INCOSE EWLSE booth volunteers from left to right: Mark, Federica, Marilee, Shirley, Nazanin, Phyllis

2020 event schedule and plan to join us at any or all of these events!

• Send your chapter ideas for unique, creative, and innovative leadership approaches for Emerging Trends in Systems Engineering Leadership to ewlse@incose.org and marilee.j.wheaton@aero.org through the end of 2019. These chapter submissions will support the final organization of the book chapters. We will be announcing a formal call for chapters at the INCOSE IW 2020 conference.

• The EWLSE publication team comprised of Lisa Hoverman, David Long, and Alice Squires are excited to announce the themed INCOSE INSIGHT edition, "Diversity in Systems Engineering" that has been released. INCOSE members please see: https://onlinelibrary.wiley.com/toc/21564868/2019/22/3. The document is also available through Wiley at https://onlinelibrary.wiley.com/journal/21564868.

• New for the INCOSE International Symposium (IS) 2020, Technical Operations has added "5.10 Diversity" (cultural boundaries, diverse engineering teams, training underserved groups) to cross-cutting categories. Plan to see submissions in this new category.

• Those interested in supporting the field of systems engineering by becoming a mentor for a systems engineer, or those seeking an experienced systems engineer as a mentor who can help you navigate the field and INCOSE, please email mentor@incose.org or complete the brief survey at https://bit.ly/2G6TJPL.

• Please check out this latest resource on women around the world and their journeys to leadership in engineering in Rising to the Top, sponsored by the International Federation of Engineering Education Societies (IFEES) and the Global Engineering Dean's Council (GEDC) with a chapter from our very own INCOSE academic director, Ariela Sofer (see Journey 28). Ariela adeptly shares her journey with the reader in a way that is encouraging and also shows her and her mother's resilience; we get to know Ariela a bit better, and she offers excellent advice for all women. You can download the eBook here: http://bit.ly/RT-eBook and the PDF here: http://bit.ly/Rising-to-the-Top.

In closing, men and women are invited and encouraged to join EWLSE (see https://www.incose.org/ewlse) and support women in engineering by adding "Empowering Women" to your committee/working groups under your INCOSE profile (click on your name after you log into INCOSE, select Profile, select view to the right of Empowering Women found under Join a Working Group, and at the bottom of the roster that displays, you can select the option to join).

Asia Oceania Sector EWLSE Panel Discussion–The Role of Diversity, Equity, and Inclusion in the Future of Systems Engineering Leadership

Stueti Gupta, stueti.gupta@gmail.com

At the 12th AOSEC, Stueti Gupta, Asia Oceania EWLSE lead, had the opportunity to host a panel discussion on "The Role of Diversity, Equity, and Inclusion in the Future of Systems Engineering Leadership." Alice Squires, founder of INCOSE's EWLSE Working Group, and Stueti planned the panel as part of the conference. The panel addressed going beyond traditional approaches and embracing diversity as a source of insight and skill, inclusion as shared influence and decision-making, and equity as a base requirement that starts with

equitable communication. Panel members shared industry's forward thinking on the role of diversity, equity, and inclusion in building strong systems engineering leaders, and challenges and success stories in this area, including personal stories from the panelists on the topic.

The moderator (listed first) and panelists included (see Figure 3):

- Alan Harding, experienced systems engineering leader with 32 years of experience in defence and security applications. Alan is the head of the information systems engineering discipline for BAE Systems Air. Alan is the immediate past president of INCOSE (2016-2017) and previously led INCOSE UK from 2013-2014. Alan co-chairs the INCOSE Systems of Systems Working Group.

- Seetha Rani, human resources director for HTS Aero and SW Talent. She is responsible for human resources for the HTS Aerospace Engineering organization. She provides strategic leadership across multiple countries and drives close partnership and strategic talent alignment with business and human resources engineering leadership in the US, Europe, the Middle East, and Africa, and Asia Pacific.

- Rema P R, director of engineering at Collins Aerospace, heads the engineering for the Power and Controls Division, spanning the disciplines of systems, electrical, mechanical, and software. Rema is actively engaged in building a strong systems engineering team in India.

- Meenakshi D'Souza, associate professor and warden (women's hostel) at the International Institute of Information Technology (IIIT) Bangalore. She teaches courses in discrete mathematics, design, and analysis of algorithms, software testing, and theory of computation. Meenakshi is a council member of Association for Computing Machinery (ACM) India and drives activities related to gender diversity in IIIT Bangalore and in ACM India.

The panel was not only diverse from a gender lens, it brought together diverse experiences and diverse expertise from human resources to business to academia, and the topics discussed were about various dimensions of diversity from gender to disability to life experience.

The panel discussion triggered very engaging and interactive conversations on the role of diversity, equity, and inclusion (DEI) in the future of systems engineering leadership. The panelists discussed how DEI is vital to business outcomes, how DEI is vital to cope with today's complex challenges, and that it is high time to move away from traditional approaches and embrace diversity as a source of insight and skill, inclusion as shared influence and decision-making, and equity as a base requirement that starts with equitable communication.

Figure 3. AOSEC 2019 EWLSE panel moderator (on left) and panelists

For additional pictures of the event, see: https://drive.google.com/drive/u/0/folders/1duiAgpjo80RgC5oicqwanxxFURM6N3EL.

Thinking Traps and Building Resilience–EWLSE Workshop Organized in Bengaluru, IN

Stueti Gupta, stueti.gupta@gmail.com

EWLSE planned a one-day workshop on "Thinking Traps and Building Resilience" as a post-conference event in conjunction with Asia Oceania Systems Engineering Conference (#AOSEC2019). INCOSE's EWLSE Working Group sponsored the workshop, and Smitha Rao, senior facilitator for The Painted Sky, facilitated the event. Stueti Gupta, Asia Oceania EWLSE lead, and Alan Harding, immediate past president of INCOSE, kicked off the session.

The workshop, targeted at experienced systems engineering professionals, discussed in detail the common thinking traps that overpower our thinking process and impact the way we make decisions. With thinking traps such as fortune-telling, mind-reading, or catastrophizing, we tend to oscillate our thinking to the worst that can happen in each situation. And thinking traps like labeling, over-generalization, or should statements lead us to build strong perceptions about a person or the outcome of a situation and assume unrealistic expectations from the person or situation. Acknowledging and becoming aware of the trap(s) and exercising mental agility will go a long way in helping us to think rationally and stop us from making biased or hurried decisions.

Unlike other leadership workshops, the second half of this workshop was completely experiential, not in the comfort of our seats but moving around the room and using bodily movements (see Figure 4). This provided a heightened experience of noticing our body's reaction to a conflicting situation, our own limiting behavior, and how we can build resilience to respond and react to the situation.

Riya Thakkar, one of the participants, says, "The things which have stayed with me post the workshop are

- Be aware of your beliefs about you and the world around you.
- Recognize the limitations of their application.
- Based on your awareness and recognition, change your perspective when needed."

The premise of the training delivery was a theater-based training concept which all the participants thoroughly enjoyed. The facilitator kept the session so engaging that even though it was the last weekend before Diwali, everyone stayed one and a half hours past the planned end time.

Figure 4. Experiential portion of Thinking Traps workshop

Figure 5. Workshop facilitator Smitha Rao (left) and Stueti Gupta

Figure 6. Anaheim Convention Center, WE19

For additional pictures of the event, see Figure 5 and: https://drive.google.com/drive/u/0/folders/1ddWXwYioW1NEFLDafjpknC5grzUWgtpQ.

See this LinkedIn post for a video summary of the event - https://www.linkedin.com/posts/the-painted-sky_thinking-inclusion-traps-activity-6593107790452088832-4J3Y.

Join the EWLSE working group to advance its mission to create a systems engineering environment welcoming to all; promote the demonstrated value of women as systems engineers and leaders; engage women in engineering and systems engineering at all levels of education around the world; and enable increased participation and retention of women in systems engineering leadership.

EWLSE at WE19

Federica Robinson-Bryant
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Once again, INCOSE's EWLSE joined around 400 exhibitors at the world's largest conference and career fair for women in engineering. The SWE's Annual Conference (WE19) resulted in more than 14,000 individuals and organizations scattered around the Anaheim, US-CA Convention Center (see Figure 6) to experience programming around this year's theme, "We Live. We Learn. We Lead."

With extraordinary support from the local chapter, INCOSE Los Angeles, the booth welcomed individuals from near and far. Incoming INCOSE president-elect Marilee Wheaton, INCOSE Los Angeles program chair Nazanin Sharifi, INCOSE Los Angeles president Mark McKelvin, new INCOSE member Christine Faulkner, Deborah Cannon, INCOSE Los Angeles secretary Phyllis Marbach, Shirley Tseung, and returning SWE Booth supporter Federica Robinson-Bryant shared their extensive knowledge from industry, academia, and government experiences, as hundreds of conference participants encountered the booth each day (see Figures 7 and 8).

Representing INCOSE as an exhibitor at WE19 was very insightful and motivational. -Deborah

Figure 7. EWLSE booth (left to right): Mark, Federica, Nazanin, Marilee, Shirley, Phyllis

Serving as an exhibitor and INCOSE representative at WE19 was such an invaluable experience. I interfaced with so many different people of different demographics, interests, experiences, and outlooks. This positively influences the way I view myself in the discipline, and ultimately how I choose to navigate my career. I feel that this was reciprocated through my engagement with others. -Federica

Students, professionals, and representatives from exhibiting organizations visited the booth to learn more about INCOSE and systems engineering. Many existing members stopped by to share stories validating the value of membership to their career and expressed gratitude for an opportunity to dialogue with the exhibitors and garner a range of readily available information.

Questions ranged from fundamental ones, "What is systems engineering?" to ways to capitalize from joint membership strategies among related organizations to how to start a chapter in another country to ways to build and sustain relationships with existing chapters to strategies to improve women recruitment, retention, and promotion in systems engineering organizations. Regardless of the reason for stopping at the booth, interested persons had the opportunity to engage in adept conversations about membership, certifications, publications, local chapters, and diversity in systems engineering with the booth volunteers.

It is advantageous for INCOSE to take part in such large conferences to increase awareness about the organization and its presence worldwide on all things systems engineering related. I had the opportunity to meet engineers from Nigeria who, in our conversation, expressed interest to open an INCOSE chapter in their country. I introduced them to another INCOSE contact who will continue the conversation beyond the conference. -Nazanin

Interestingly, many students expressed interests in job placement. This provided an opportunity to highlight INCOSE resources like its job board and the extensive network of individuals and partnerships gained through membership, involvement in working groups, and ongoing EWLSE initiatives.

It was inspiring to see so many students and how SWE has grown over the years. Many students enthusiastically asked about our professional organization, which allowed me to discuss the Jobs link on the INCOSE webpage and their paths to joining INCOSE. -Deborah

On Thursday evening, the incoming INCOSE president-elect Marilee Wheaton received the Advocating Women in Engineering Award (see Figure 9) surrounded by the support of her peers. The award acknowledges her advocacy for women in engineering across several organizations including INCOSE. Marilee serves as a catalyst and role model for women in systems engineering and demonstrated

Figure 8. INCOSE EWLSE booth volunteers (left to right): Mark, Shirley, Federica, Nazanin, Phyllis, and Marilee

Figure 9. Keith and Marilee Wheaton standing in front of award winners board

humility, deep knowledge, and exemplary leadership throughout the conference.

When the announcement of Marilee's award was made, I felt an overwhelming sense of pride. It is important that we continue to acknowledge the work she and others alike are doing for diversity and equity in the discipline. – Federica

Interested in holding an EWLSE related event at your conference? Please send your request to ewlse@incose.org and we will put a plan in place to support your efforts!

PMI Global Conference 2019

VJ Jhaveri, valkandj@gmail.com; Laura Hart, laura.e.hart@lmco.com

The Program Management Institute (PMI), an INCOSE Strategic Alliance partner, held its annual conference at the Pennsylvania Convention Center, in Center City, Philadelphia, US-PA 5-7 October 2019. An international audience of over 2,500 attended the conference. VJ Jhaveri and Laura Hart, Greater Philadelphia Chapter president, represented INCOSE and staffed the INCOSE exhibition booth. Greg Nieman, also from the local INCOSE chapter, helped with the Saturday booth setup and booth coverage.

Our booth was in an excellent location and was located next to the Delaware Valley/ Philadelphia PMI Chapter. Laura spoke with the local PMI chapter about having a few joint chapter meetings together with the local INCOSE chapter. We did receive good inquiries and have collected the details from about 30-40 people who are interested in learning more about INCOSE. The collaborators from PMI and INCOSE have published the book *Integrating Program Management and Systems Engineering* which was a success and drew quite a few PMI members to our table. Many where interested and took copies of our INCOSE cards and other materials including our general brochure, certification flyer, and local chapter information. We collected names and addresses via a signup sheet and business cards to provide general information for those who wanted to learn more about INCOSE. We had good discussions with a few PMI experts about INCOSE's *Systems Engineering Body of Knowledge (SEBoK)* and comparison to the *Project Management Book of Knowledge* (*PMBoK)*. We had few visitors request follow-up engagements to assist with systems engineering and some discussions on the state of model-based systems engineering.

We often noticed people looking at our banner and we could tell that they did not know what we represented. We engaged the PMI attendees by asking them, "Are you interested in systems engineering?" If they said "yes," or "What is systems engineering?" we would introduce them to systems engineering and INCOSE. Some folks kept coming back for more! Laura attended a *PMBoK* session where they were discussing the next upgrade to the publication. She was glad to hear that they were adopting a systems thinking approach to the *PMBoK*. We should keep engaged with this group and be aware of the similarities and between the INCOSE and PMI Book of Knowledge publications.

All and all, it was a successful event. Laura even recruited a potential new hire to Lockheed. Some international people from large companies asked us to help them on their projects (assuming we were like contractors).

PMI® Leadership Institute Meeting 2019
North America

INSIGHT Preview

William Miller Editor-in-Chief, insight@incose.org

Very shortly, INCOSE will also publish the December 2019 issue of *INSIGHT* published in cooperation with John Wiley & Sons as a magazine for systems engineering practitioners.

The focus of the December issue of *INSIGHT* is the French Chapter of INCOSE, Association Française d'Ingénierie Système (AFIS) Doctoral Symposium: New challenges and Advances in Systems Engineering at French Universities. This is our sixth issue devoted to doctoral research in France. The previous issues were July 2008 (Volume 11, Issue 3), December 2011 (Volume 14, Issue 4), December 2013 (Volume 16, Issue 4), December 2015 (Volume 18, Issue 4), and December 2017 (Volume 20, Issue 4). Articles were selected after peer reviews from a larger set of doctoral presentations in collaboration with French universities and industry.

Articles from theme editors David Gouyon and Hervé Panetto, and authors address the following topics:

- Theme Editorial
- Review of AFIS 2018 Academy-Industry Meetings in Nancy: The Celebration of the 20th Anniversary of AFIS!
- RobAFIS Student Competition Actuality: Safety & Security Interactions Between Operators and with the System
- Extended Enterprise Model for PSS within a Systems Engineering Perspective
- Management of the Design Process: Human Resource Allocation and Project Selection in Factories of the Future
- A Monitoring Strategy for Industry 4.0: Master Italy s.r.l Case Study
- Challenges for Autonomous Vehicles (AVs) Engineering Safety Validation of Functional Performance Limitations

- System Engineering and Dependability: Methodology of Model Synchronization between System Architecture Models and Risk Analysis
- A Model-Based Approach to Design, Organize, and Monitor Dismantling and Decommissioning of Nuclear Facilities
- On the Mastering of Modelling Activities Development in Engineering
- Towards a Maturity Assessment Scale for the Systems Engineering Assets Valorization to Facilitate Model-Based Systems Engineering Adoption
- Evaluation of Systems Contractor's Ability to Deliver a Solution to Offer During an Engineer-to-Order Bidding Process
- Coordination of Multi-Underwater Drones: Towards an Integrated Object-Oriented Methodology in an Open-Source Environment.

Note From the Editor

Lisa Hoverman, newsletter@incose.org
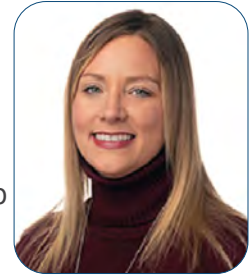
Welcome to the final Newsletter of 2019! We are all settling in for some slower family time (hopefully!) to be followed next month by the exciting INCOSE International Workshop (IW), to be held in Torrance, California in 2020. In 2020 we will be celebrating INCOSE's 30th Anniversary! We have some great initiatives, IT roll-outs, products and projects, all starting, continuing, and/or completing in 2020 to mark this momentous occasion.

As we move into our 30th year, INCOSE is stepping into new areas where systems engineering can aid our complex world. We share some great stories in this newsletter on how we are approaching the Future of Systems Engineering (FuSE) by applying systems engineering and systems practices to the Engineering Grand Challenges and the United Nations Sustainable Development Goals. Further, the INCOSE Board is taking on the challenge to move toward increasing our membership diversity in many ways including all levels of systems engineers, all systems scientists, thinkers, and new domains previously not engaged. A recent and great article in the Q3 2019 INSIGHT— our first Diversity in Systems Engineering themed issue by Alan Harding and Andy Pickard highlights how well INCOSE is doing as a diverse organization and how we can improve. Other articles in this issue show the breadth and power of Systems Engineering. This issue is available for free download from Wiley now through March 2020!

The Newsletter continues to grow to inform our readership on all things INCOSE, both current, upcoming, and historical. There are some interesting previews on the many upcoming and exciting 2020 happenings, including the IW, chapter meetings, working groups, and other initiatives of INCOSE in this last Newsletter of 2019. As stated already, important to this Newsletter are some great articles from practitioners—practitioners tackling both the real and grand challenges of our times that apply to the Future of Systems Engineering.

Please keep sharing your publications with us as we continuously work to improve. I hope that you see some of your suggestions and contributions in this issue. As always, we welcome feedback and contributors at newsletter@incose.org.

We look forward to seeing you participating, networking at, and presenting at, one of the many terrific upcoming INCOSE events. I end with a sincere note of appreciation to all who contributed to this Newsletter. Have a wonderful end to 2019, a terrific start to 2020 and I hope to see you at the upcoming IW!

INCOSE Member Newsletter

*Who are we? I*NCOSE is a 17,000+ 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.

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