EWLSE Updates

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Empowering Women: An International Collaboration

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Empowering Women Leaders in Systems Engineering (EWLSE) wishes you and yours a safe and healthy new year. We continued to make progress towards our vision of a world equally representing women and men in systems engineering leadership, recognizing the global pandemic has created unique challenges for many. For the third quarter we will address the Conference on Systems Engineering Research (CSER) 2020 panel "Exploring Digitization of Human Bias;" the Japan Symposium 2020 90-minute workshop on "Systems Leadership and Diversity, Equity and Inclusion for Future of Work;" the #IamRemarkable Google initiative and associated 90-minute workshops; and booth support and activities from the Society of Women Engineers (SWE) International 2020 conference. Please see separately written articles for each event following this short update.

Other news includes: Lisa Hoverman, Alice Squires, and David Long, commencing the last initial edits for the Letters to My Younger Self (LTMYS): How Systems Engineering Has Changed my Life, an INCOSE Impactful Products improved publication. Heather Feli, Alice Squires, and Marilee Wheaton are working through several abstracts, annotated outlines, and draft chapters submissions for an engaging new addition to an existing Springer Hill book series for women authors: Emerging Trends in Systems Engineering Leadership.

For those new to systems engineering or those who have practiced for decades, if you are looking for a systems engineering mentor or ready to be a systems engineering mentee or both, please sign up here: https://bit.ly/2G6TJPL. How do you advocate for women leaders in systems engineering? Please send your stories to ewlse@incose.org.

Exploring Digitization of Human Bias: CSER 2020 Panel

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At the 18th Conference on Systems Engineering Research (CSER) 2020, Dr. Shamsnaz Virani Bhada, Worcester Polytechnic Institute (WPI) assistant professor and EWLSE lead, joined a panel discussing "Exploring Digitization of Human Bias." Dr. Bhada developed the panel idea based on her research experience, and Rosalind Lewis served as the panel moderator. The panel addressed gender and racial diversity crisis amplified by Artificial Intelligence (AI). Panel members shared their outlook, concerns, recommendations, and the systems approaches role to address AI bias. The moderator (listed first) and panelists included:

Rosalind Lewis, acquisition analysis and planning subdivision principal director at The Aerospace Corporation. In this position, Lewis manages four departments supporting various activities in the acquisition decision analysis and support areas; cross program studies; modeling to include industrial base, cost, schedule, and risk analysis; and system engineering and program execution support. Additionally, she was an adjunct instructor at Loyola Marymount University for nine years in systems engineering. Lewis holds a B.S. degree from The University of Southern California (USC) in computer science, a M.S. degree from New York University in computer science, and a M.S. degree in systems architecture and engineering from USC.

Dr. Shamsnaz Virani Bhada; systems engineering assistant professor at Worcester Polytechnic Institute, earned her Ph.D.in Industrial and Systems Engineering from The University of Alabama at Huntsville. Dr. Bhada's research interests include policy content modeling and human diversity in engineering. She serves as Empowering Women as Leaders in Systems Engineering (EWLSE) lead for new faculty support for systems engineering faculty and PhD students. She dedicates her time to increasing women and minority population in engineering.

Cecilia Haskins entered academia after more than thirty years as a practicing systems engineer. Her career spans large and small firms, commercial and government projects, and employee and entrepreneur work. During the mid-1990's she actively participated in the tool creation community creating early model-based systems engineering products. Her educational background includes a B.S. in chemistry from Chestnut Hill College, and an MBA from Wharton, University of Pennsylvania. This combination contributed to her understanding issues with an insider's view of both the business environments and the technical solution domains. She has received recognition as a certified systems engineering professional since 2004. After earning her PhD in systems engineering from NTNU she developed and teaches an overview course with a novel lab. Her research interests include engineering education and innovative systems engineering applications to socio-technical problems, such as those encountered in software intensive systems, sustainable development, and global production systems.

Dr. Donna H. Rhodes is a principal research scientist in the Sociotechnical Systems Research Center (SSRC) at Massachusetts Institute of Technology. She is MIT's Systems Engineering Advancement Research Initiative (SEAri) director, leading a research group focused on advancing the theories, methods, and effective systems engineering practice applied to complex sociotechnical systems. She teaches systems architecting applied to enterprises,and model-based systems architecting and engineering graduate courses. She is the principal investigator for numerous sponsored research projects and advises graduate students in multiple MIT programs. Dr. Rhodes researches innovative approaches for architecting complex systems and enterprises, digital engineering transformation, human-model interaction, model curation, and social systems engineering.

Thomas A. McDermott Jr. is Systems Engineering Research Center's deputy director. Tom McDermott is a leader, educator, and innovator in multiple technology fields. He currently serves as the Systems Engineering Research Center's (SERC) deputy director at Stevens Institute of Technology in Hoboken, US-NJ, as well as a consultant specializing in strategic planning for uncertain environments. He studies systems engineering, systems thinking, organizational dynamics, and the complex human socio-technical systems nature. He teaches system architecture concepts, systems thinking and decision making, and the composite skills required at the leadership and engineering intersection. He has over 30 years' experience in technical and management disciplines, including 15 years at the Georgia Institute of Technology and 18 years with Lockheed Martin.

Dr. Mark L. McKelvin, Jr. is an engineering specialist in systems and software engineering at the Aerospace Corporation. In this role, Dr. McKelvin advises customers on model-based engineering techniques and develops solutions to architecture design challenges in cyber-physical and software-intensive systems. His interests comprise engineered system modeling, analysis, and design application, including cyber-physical, embedded, and software systems. He holds a PhD in electrical engineering and computer sciences from the University of California, Berkeley emphasizing in elecetronic design automation.

The panel focused on the gender and racial diversity crisis in most STEM disciplines. The Artificial Intelligence (AI) sector amplifies this crisis. Only 18% percent of authors at top conferences in the field are women and more than 80% of AI professors are men. 2.5% of Google's workforce is black, while Facebook and Microsoft hover at 4% (West et.al. 2019). These personnel disparities will likely yield systems replicating gender and racial bias, which will deepen historical inequality as more systems move toward AI. The discussion questions for the panel were:

- Will systems engineering face the similar issues as AI?
- Will MBSE and digitization amplify bias or does it serve as an equalizer in systems engineering?
- Can we define or measure MBSE bias?
- What strategies should serve as check and balances for gender bias?

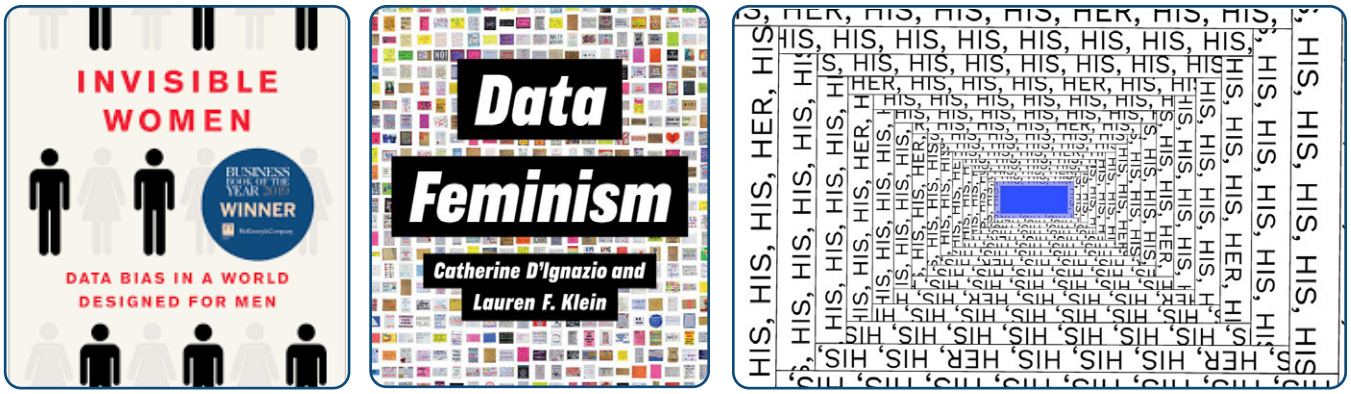


Figure 1: Popular Books Reviewed by Dr. Shamsnaz Virani Bhada

After Rosalind introduced the panelists, Dr Bhada established the problem with three popular books: Invisible Women by Caroline Criado Perez, Data Feminism by Catherine D'Ignazio and Lauren F. Klein, and the New York Times article "We teach AI everything including our biases" (see *Figure 1*); therefore, identifying AI bias amplification has multiple negative impacts and case studies showing populations not represented in the training data sets. The opportunistic companies such as Alegion exploit this issue with short term solution slogans such as "this blueprint to vaccinate yourself against bias in data." Long term solutions recommended by several universities and McKinsey involve diversifying the AI workforce by developing curriculums around the AI4ALL theme. Dr. Bhada, as a systems engineering educator, wants to inform her students about all human bias types appearing in the data used for digitization, especially in human systems integration area using AI in facial recognition systems to car safety systems. She also wants students to develop a skill to question the data provenance, validity, and neutrality along with universality. In the end, she urged the systems engineers to develop methods, approaches, and analysis for data

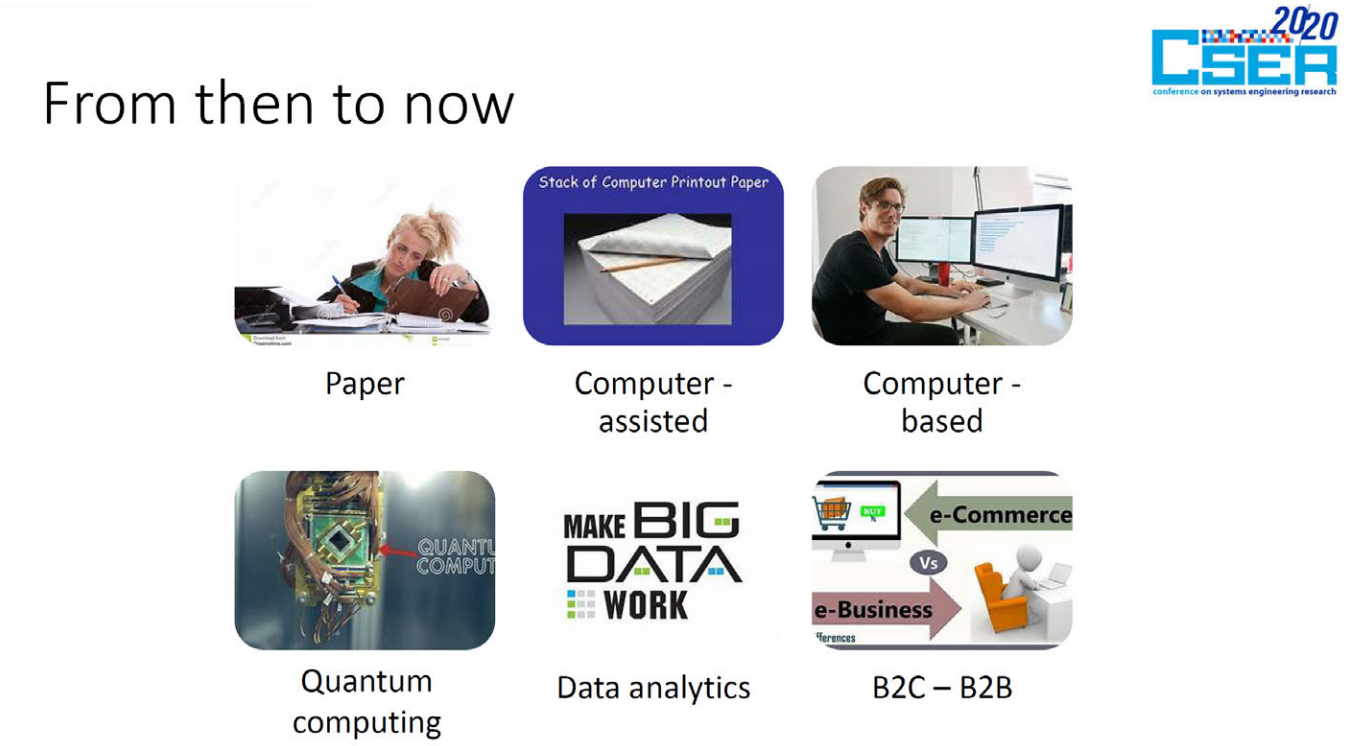


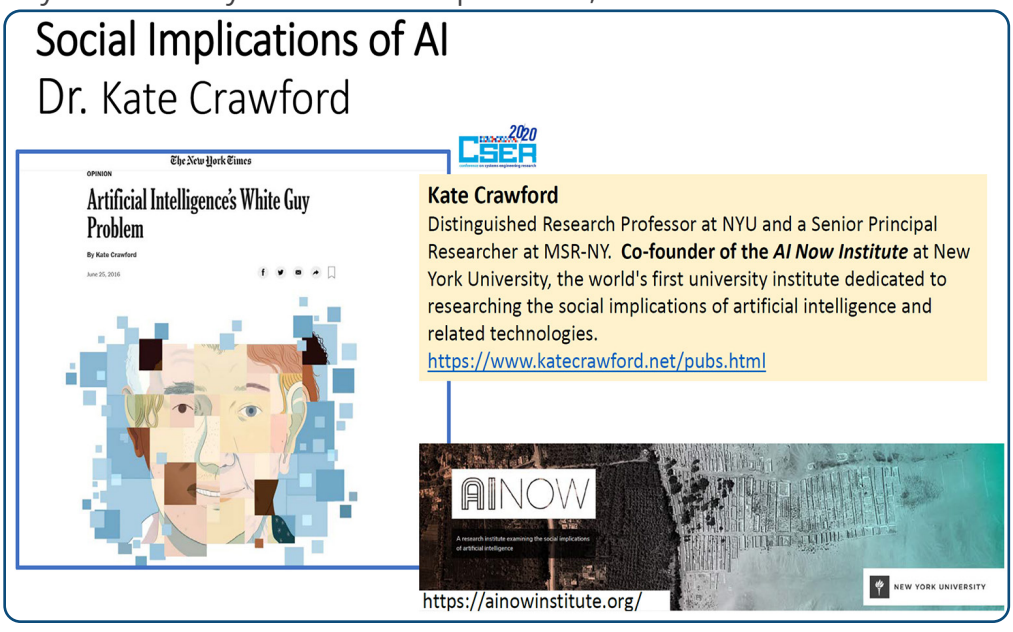
Figure 2: Dr. Haskins' Historical Perspective of Computers

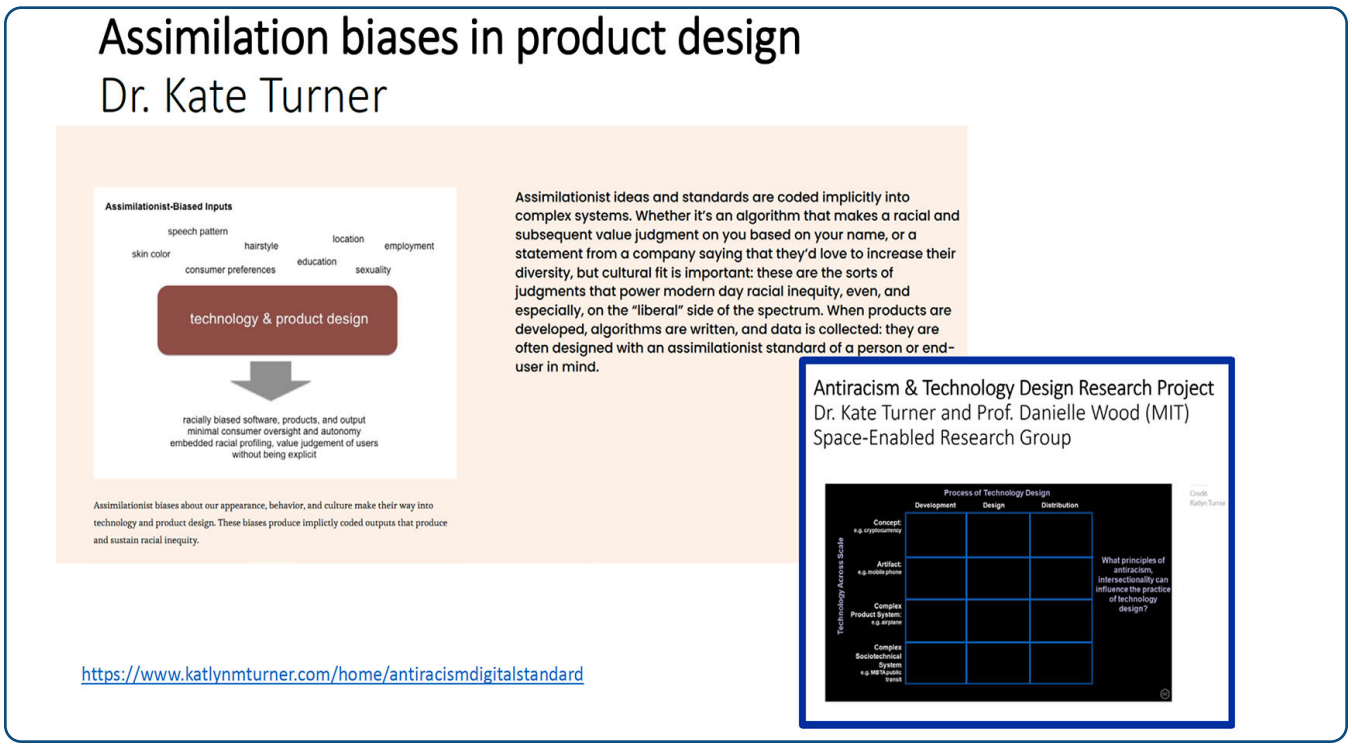
bias and its impact on system design. Perhaps we too need an AI4SE4ALL.

Dr. Haskins presented a historical computer and their influence on design decisions perspective based on her long systems engineering career and 15 academia years. She had many different experiences with this topic. Being a "dinosaur" in systems engineering, she has worked in digitization since 1968 when the workplace introduced computers. At this time, the machines doing work faster and with fewer errors than people idea gained popularity among her colleagues especially as a potential assistance to do their jobs better. For clerical type tasks, accounting or preparing reports, a computer-assisted approach became standard workplace process. Then Dr. Haskins described moving to computer-based data processing. But machines still determined how we designed our systems and what 'allowances' we had. Then machines became faster, with more memory; and people started talking about new business methods. Computing had arrived. Relying on websites, businesses could work with others through computing, and data processing through different storage devices became the new normal. The attention now moved to capitalizing on all this data and calling it data analytics. Now there is more and more human influence where biases occur, and we might not even notice them. Quantum computing helps people analyze medicines, develop anti-bacterial treatments, and nitrogen cycles, beyond what anyone could have perceived, but these are subject to human bias introduction. However, they are also more computation focused and closer to the science but may fall into other pitfalls.

Dr. Haskins focused her bias perspective on human beings, skills can help us become better—imagination and critical thinking, creativity and empathy, adaptability and sustainability—factor out bias, but schools do not teach them. She called for action to examine "how we educate people for the future. If they do not receive the true baseline skills they need, we will continue to see biases introduced in application development. Our computer-based community is aware of a need for developing unbiased applications and development. Perhaps a good starting place would be treating these needed skills as hard skills. The training data mirrors how people think—bias is introduced there. We must look beyond the technology for bias sources—so people can reach their potential."

Next, Dr. Donna Rhodes introduced the current research state in human bias impacting engineering systems area. Her position was that this is a critically important topic for the systems community. That is, human bias in engineered systems is a multi-faceted challenge we have the means (and responsibility) to help address. She argued systems engineers lack the deep knowledge to do bias research but it is our responsibility as individuals and as a community to educate ourselves on this topic and work together to raise awareness and promote strategies designing engineered systems, supporting models, and tools without bias. She highlighted several main researchers: Dr. Kate Crawford, Artificial Intelligence's White Guy Problem, Dr. Kate Turner, Prof. Danielle Wood, and Dr. Emily Wall (see *Figure 3*). These researchers impact the digital bias future in their





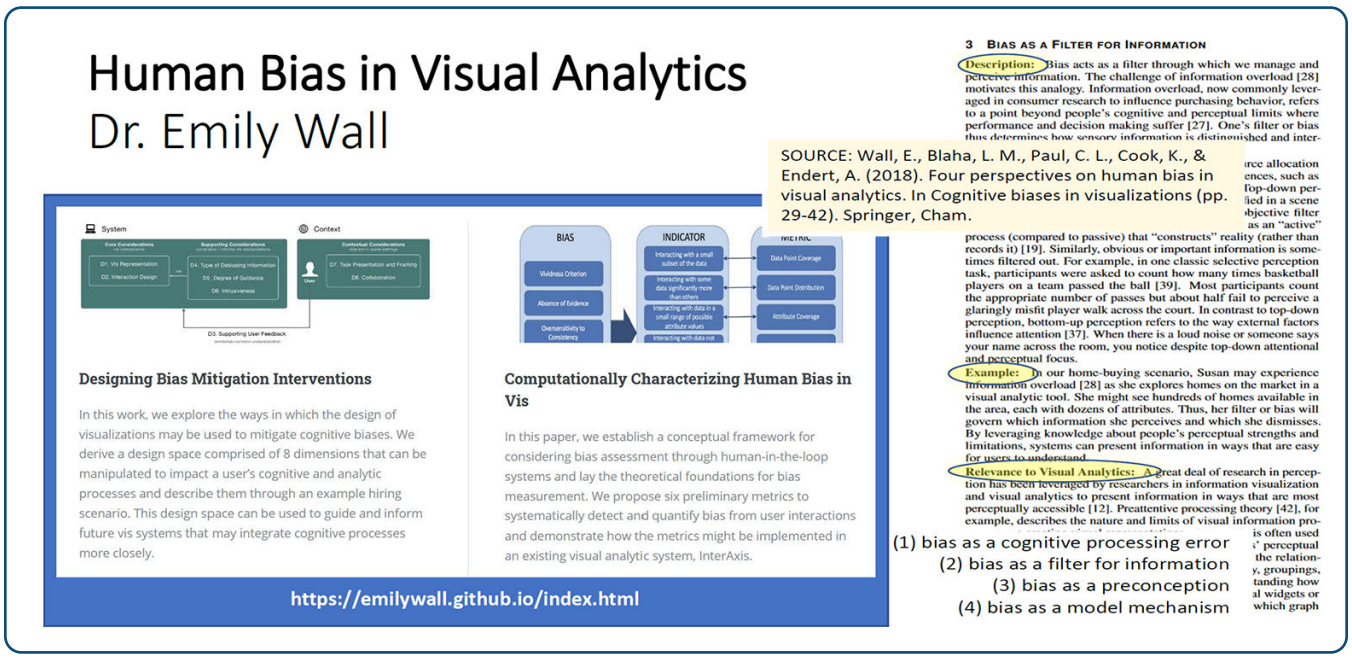


Figure 3: Researchers Reviewed by Dr. Donna Rhodes

disciplines. Dr. Turner researches AI's social implications by introducing mechanisms for evaluating data provenance along with machine learning model specificities. Dr Turner has developed evaluations to catch product design assimilation biases. Dr. Wall designs bias mitigation interventions by adopting visualization to catch cognitive bias.

Dr. Rhodes concluded her position stating "It is our responsibility as individuals and as a community to educate ourselves on this topic and work together to raise awareness, and promote strategies designing engineered systems, models, and tools without bias."

Tom McDermott based his position on how the data and engineered system decisions introduce bias (see Figure 4). He describes the

excitement around AI as bringing customers in by "if you nail two things together—someone will buy it from you." His deep learning and neural networks interpretation was that it is the statistical algorithms and learning software combination; machine learning is not new but is combining and not necessarily producing the correct value. Industry has framed and called it AI—creating a buzz but they fail to have insight into where it all comes from. He then explained rules-based systems distinguish between a tank and a truck. Machine learning gives us more accuracy, but these algorithms already build in bias. We want accuracy for tanks and to not blow up trucks, resulting in a probability-based recommendation. The challenge is they might not always give you the real probability, but the probability based on biased data. The bottom line is AI augments do not replace human intelligence or expertise. Mr. McDermott cautioned us about our AI over-dependence. Bias is always present in human produced rules, human programmed metadata, or the data itself. In his closing remarks he stated "We need to understand the data is probabilistic and we need to program the data accordingly." He suggested we need a second opinion comparing two to three alternatives. We depend on labeled (biased by hired people) and unlabeled data (biased by data you give it—Twitter images). We must consider systems data engineering and the requirements. He encourages the following questions: Who labels the data? Where does the data come from? He summarizes by stating AI, machine learning, and deep learning rest on many different approaches and there are not many experts in this space, rather, there is a huge knowledge and skills gap. Systems engineers may understand trades and use cases, but they do not always understand the underlying technology.

Dr. Mark McKelvin presented the harsh historic data reality which, although accurate, may not represent present workforce and culture. As technology becomes more pervasive in systems intended to improve human living, the systems engineering community will face racial and gender bias issues manifesting in the produced systems unless we take systemic actions to increase diversity and inclusion reflecting the users of the systems we build. To do so, the systems engineering community must identify biases and adopt strategies to correct biases when identified throughout an organization at all levels. He concludes "Systems disproportionately affect women and people of color."

There are people behind code development, there are people behind algorithm training, but people are the bias source and also the complexity in our systems.

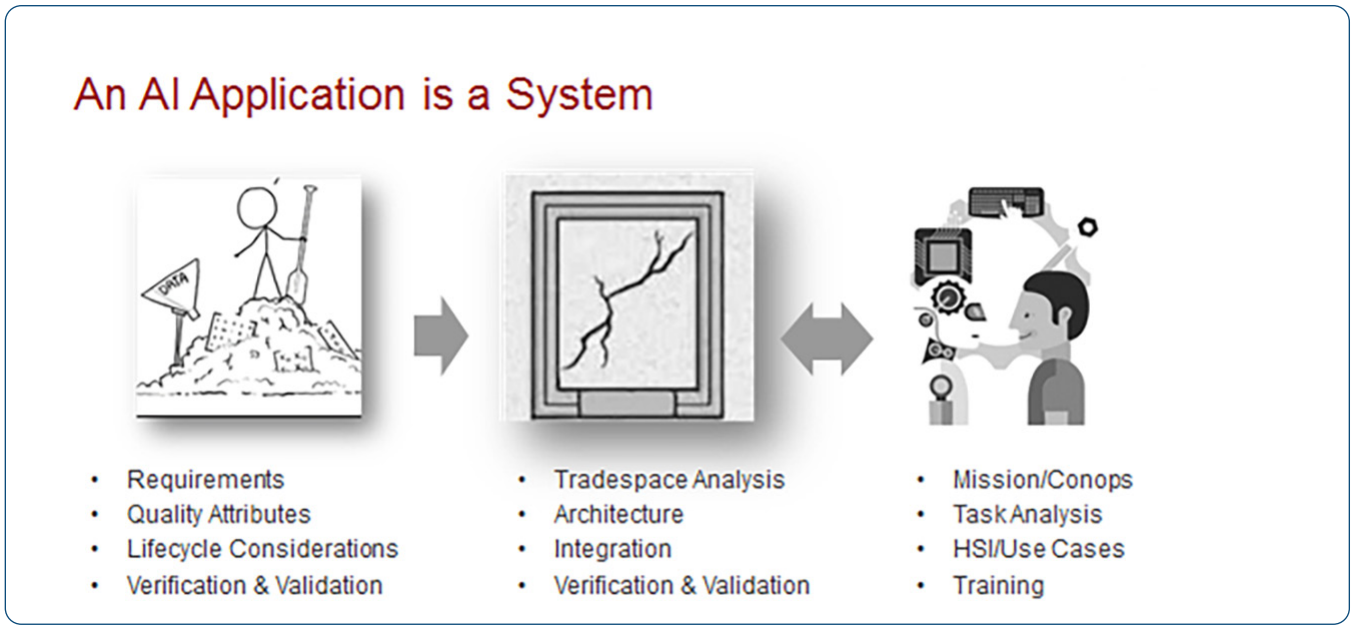


Figure 4: Tom McDermott Overview of an AI Application as a System

We can improve a lot.

- Increase diversity in decision making. Decision makers consider how decisions affect others. Economic, racial, and cultural.
- Day to day, be an advocate. See something say something. Hear something say something. Stamp it out. Be an advocate.
- Race, religion, politics—stay away because they create conflict but these are who we are. These come out in the bias our products portray.

Dr McKelvin points out bias comes from the historical information, if you even collected such data. Take as an example reports where law enforcement responds to communities. If you report something in a certain area, your report reflects in the data. But what if you do not report? This is a hard problem to deal with. As systems engineers it is necessary to be more aware of the social and cognitive biases. He cites Kahneman's Thinking Fast and Slow identifying more biases such as confirmation, sampling (relevant), and attribution biases. As technology becomes more pervasive, systems engineering will face challenges with racial and gender bias unless we take systemic action. Dr. McKelvin, along with several other panelists, requests systems education to identify, address, and correct these biases.

The panel generated a dynamic and engaging discussion on how systems engineering is at the cusp of recognizing bias digitization and one key outcomes Alice Squires stated was "Listening to this panel was energizing. I sense a multi-pronged approach led by the systems engineering community, for proactively identifying and systematically eliminating negative unintended biases from our digitized systems models and designs, and beyond."

In closing, the panelists and audience agreed to continue the conversation in their institutions and INCOSE. The unanimous recommendation was not only bias education but also its presence in current machines, along with introducing political and social sciences and soft skills in the systems engineering curriculums. Needing conscious technical leadership in the murky "bias digitization" water, seems to be a new frontier for systems engineering and INCOSE at large.

The Future of Work: EWLSE at the Japan Symposium 2020

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The two-day Japan Symposium, held 2-3 September 2020, theme was "Beyond Traditional Systems Engineering Domains and Regions." Stueti Gupta, EWLSE lead for Asia Oceania, organized a 90-minute workshop on "Systems Leadership and Diversity, Equity and Inclusion for Future of Work." The current industrial revolution era—also known as 'Industry 4.0' which has brought disruption with digitalization technologies, a global operating landscape, and the gig economy's emergence—motivated the workshop theme. As Industry 4.0 progresses, Japan leads the way in architecting a human centered society also referred to as imagination society, Society 5.0. With this as the backdrop, Stueti talked about systems leadership and why diversity, equity, and inclusion (DEI) matters as designers conceptualize Society 5.0. During the workshop, two breakout sessions allowed participants to interact and experience diverse discussion perspectives. These breakout sessions proved very insightful for the participants and the discussion facilitators. Stueti also walked through several scenarios often seen in teams or workplaces and what leaders can do to boost DEI. Several research reports in this area show organizations are more profitable and efficient; this organizational performance level cannot happen with just a few initiatives but requires a systems lens. The session ended with a brief INCOSE overview, including a Systems Café summary as a great forum to participate in diverse topics, and the EWLSE working group focus and initiatives. Around forty participants attended the workshop.

#IamRemarkable Workshops in India, Japan, Mongolia

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#IamRemarkable is a Google initiative empowering women and other underrepresented groups to celebrate their workplace achievements and beyond. This workshop aims to improve women and

underrepresented groups' self-promotion motivation and skills, and challenges the participants self-promotion social perception. This is a 90 minute workshop where participants learn self-promotion importance in personal and professional life and equip tools to develop this skill. The participants grown through engaging exercises and peer interactions. Stueti Gupta, EWLSE Asia Oceania Sector lead, is a silver tier facilitator with the program and has facilitated seven workshops so far. Four workshops are for EWLSE participants in the Asia Oceania sector. Keep a look out for #IamRemarkable sessions at upcoming INCOSE events!

Society of Women Engineers Conference 2020: EWLSE Update

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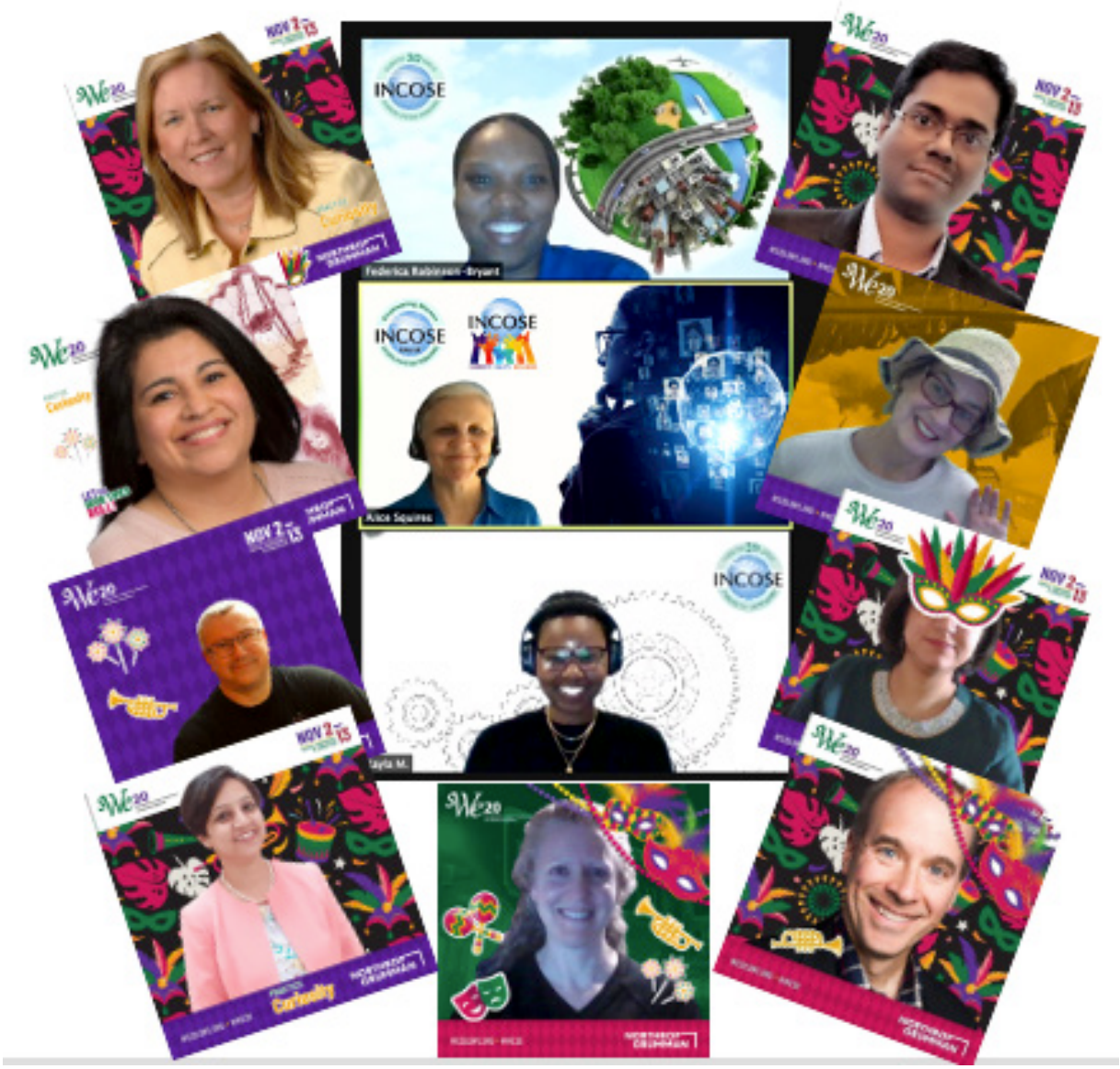
For the last three years, Empowering Women Leaders in Systems Engineering (EWLSE) has sponsored an INCOSE EWLSE booth at the Society of Women Engineer's conference, although this year was quite different! As the conference went virtual, the EWLSE team expanded from 4 to 12 supporters as SWE expanded the free registration number for booth supporters and modified a two-day event to span a two-week long event from 2-13 November. For many EWLSE team attendees, this was a first-time experience at SWE and



doubly the first time for all attendees as a virtual experience. As those who attended virtual conferences can attest, there has also been quite a challenge in how to engage participants in a virtual fair! As an additional challenge, for SWE, participants often look for work (paid) opportunities. EWLSE members from around the world came together to answer questions about 'what is systems engineering', 'how does systems engineering relate to my field', 'what opportunities are available to me in INCOSE', 'why should I consider certifying in systems engineering', and many more, with guest visits from many INCOSE members otherwise attending the SWE event.

Marilee Wheaton led the overall SWE booth activity, and Lisa Hoverman led the amazing booth setup (see Figure 5) with links to INCOSE, EWLSE, the System Cafés, INCOSE *INSIGHT* Diversity issue, INCOSE SEP certification, and videos celebrating INCOSE's 30th anniversary, about INCOSE, and how to network with INCOSE. The twelve EWLSE booth supporters (see Figure 6) included: Marilee Wheaton, Federica Robinson-Bryant, Shamsnaz Virani Bhada, Erika Palmer, Stephanie Chiesi, Lauren

Stolzer, Kerry Lunney, Ramki Raman, Kayla Marshall, Stueti Gupta, Alan Harding, and Alice Squires. We also had a special guest appearance from Enanga Daisy Fale from the Minnesota North Star chapter.

See you next year at SWE 2021!