34th Annual INCOSE international symposium

hybrid event

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INCOSE and IEEE SMC Society Alliance: 5 Years In

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Outline

- IEEE SMC Society (SMCS) overview
- SMCS – INCOSE Alliance history
- Mutual benefits
- Joint activities
- Summary and next steps

https://www.ieeesmc.org/

IEEE SMC Society

IEEE Systems, Man, and Cybernetics Society

Mission

Serve the interests of its members and the community at large by promoting the theory, practice, and interdisciplinary aspects of systems science and engineering, human-machine systems, and cybernetics. It is accomplished through conferences, publications, and other activities that contribute to the professional needs of its members.

Vision

Recognition as the world leading society for the advancement of theory and application in systems science and engineering, human-machine systems, and cybernetics.

Integrating research – Human-centered solutions

Systems engineering Issue formulation, analysis and modeling, decision making, and issue interpretation for systems engineering life-cycle phases related to definition, development, and deployment of systems.

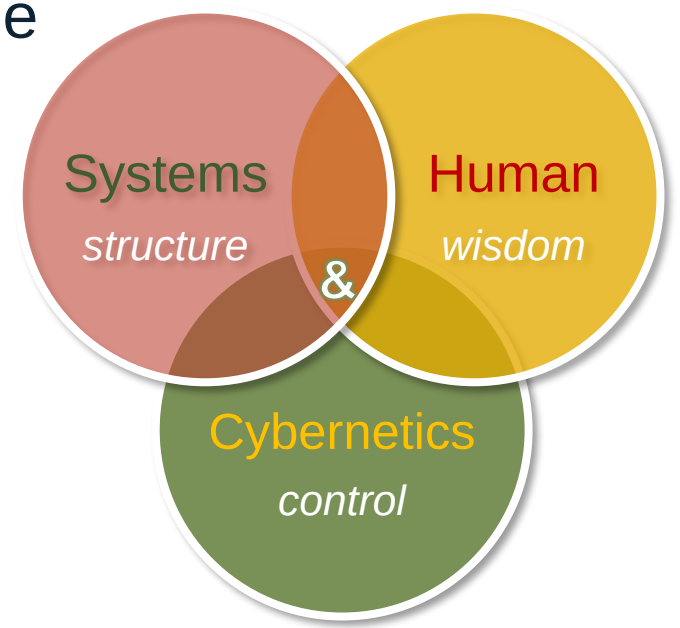
Human-Machine Systems Integrated human-machine systems at multiple scales, cognitive ergonomics and engineering; assistive or companion technologies; human-machine system measurement, modeling, and evaluation.

Cybernetics Computational intelligence, AI, computer vision, neural networks, genetic algorithms, machine learning, fuzzy systems, cognitive systems, decision making, robotics.

How SMCS Adds Value

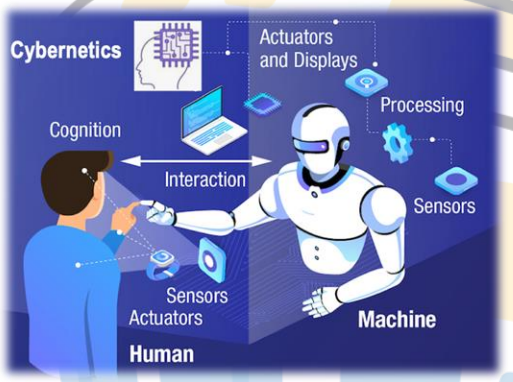
Unique as the only IEEE Society (of 39) to emphasize human-centered research and development, and *integrate* expertise in three areas:

- Systems Science and Engineering
- Human-Machine Systems
- Cybernetics



This combination influences & stimulates technical professional colleagues in ways that single disciplines, and employment alone, do not.

Technical Committees (TCs)



Systems Science and Engineering

- Autonomous Bionic Robotic Aircraft
- Bio-mechatronics and Bio-robotics Systems
- Blockchain
- Conflict Resolution
- Cyber-Physical Cloud Systems
- Cyber Humanities
- Cyber Systems and Engineering
- Discrete Event Systems
- Distributed Intelligent Systems
- Enterprise Architecture and Engineering
- Enterprise Information Systems
- Flexible Electronic Systems
- Grey Systems
- Homeland Security
- Intelligent Learning in Control Systems
- Intelligent Power and Energy Systems
- Intelligent Systems to Human-Aware Sustainability
- Intelligent Transportation Systems
- Logistics Informatics & Industrial Security Systems
- Medical Mechatronics
- ✓ **Model-Based Systems Engineering**
- Robotics and Intelligent Sensing
- Service Systems and Organization
- Systems Biology
- ✓ **System of Systems**

Human-Machine Systems

- Biometrics and Applications
- Brain-Machine Interface Systems
- Cognitive Computing
- Companion Technology
- Computer Supported Coop. Work in Design
- Cyber Humanities
- Cyber Systems and Engineering
- Env. Sensing, Networking & Decision-Making
- Human & Robotic Space Exploration Systems
- Human Centered Transportation Systems
- Humanized Crowd Computing
- Human-Machine Interaction for Connected and Automated Vehicles
- Human Perception in Multimedia Computing
- Information Systems for Design & Marketing
- Interactive & Wearable Computing & Devices
- Shared Control
- Visual Analytics and Communication

For descriptions + Cybernetics TCs, see:
https://www.ieeesmc.org/technical-activities/

INCOSE & IEEE SMC Society

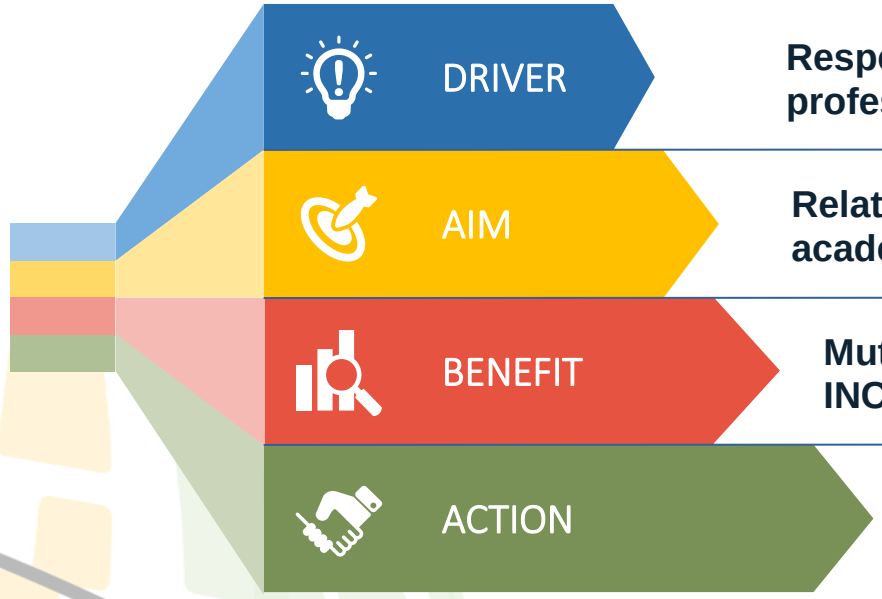
Shared SE strengths and interests:
***research** (SMCS) and **practice** (INCOSE)*

SMCS – Systems Science and Engineering (SSE)
Issue formulation, analysis and modeling, decision making, and issue interpretation for any of the systems engineering lifecycle phases associated with the definition, development, and deployment of large systems

INCOSE
Engineering discipline which integrates the system functions, system environment, and the engineering disciplines necessary to produce and/or operate an elegant system.

SMCS – INCOSE History

Relationship impetus & initial foci



Respective motivations to collaborate with other professional societies

Relationships in SE technical areas requiring academic foundation & focus in order to advance

Mutually attractive complementary nature of INCOSE industry- and SMCS academic-focus

Started deliberatively with MBSE focus; emerged organically amidst SoSE interests

Budding relationship…

2007

IEEE SMCS co-sponsors inaugural & later instances of **Intl. Conf on MBSE** involving INCOSE members

Andy Sage (Past SMCS President & INCOSE Fellow) serves as SMCS Liaison to INCOSE

Conference activities with INCOSE members

2010-11

Early Engagement

SMCS VP SSE (E. Tunstel) pursues INCOSE relationships

TC on SoS interacts with INCOSE Architecture WG

2011-13

VP SSE encourages TC on MBSE

INCOSE President (S. Brown), successors (J. Thomas, D. Wright) & ExCom endorse

D. Dori accepts MBSE tutorial invite to SMCS flagship conf.

Successful tutorial spawns new **TC on MBSE** (D. Dori, A. Madni)

MBSE-focused collaboration

2014

Conference Co-Sponsorship

INCOSE joins IEEE SMC & Reliability Societies as co-sponsor (persists in 2024) of the IEEE **SoSE** conference (main activity of the SMCS TC on SoS)

2017-18

Article publication & attendance in respective magazines & meetings

INCOSE Pres. & P-Elect (A. Harding, G. Roedler) give SoSE 2017 keynotes

F. Sahin facilitates G. Roedler invite to SMC 2017 for SMCS ExCom dialog

Spreadsheet of potential collaboration areas drafted

Increased dialog and collaboration strategizing

Promising prospect since early engagement

Initial reactions…

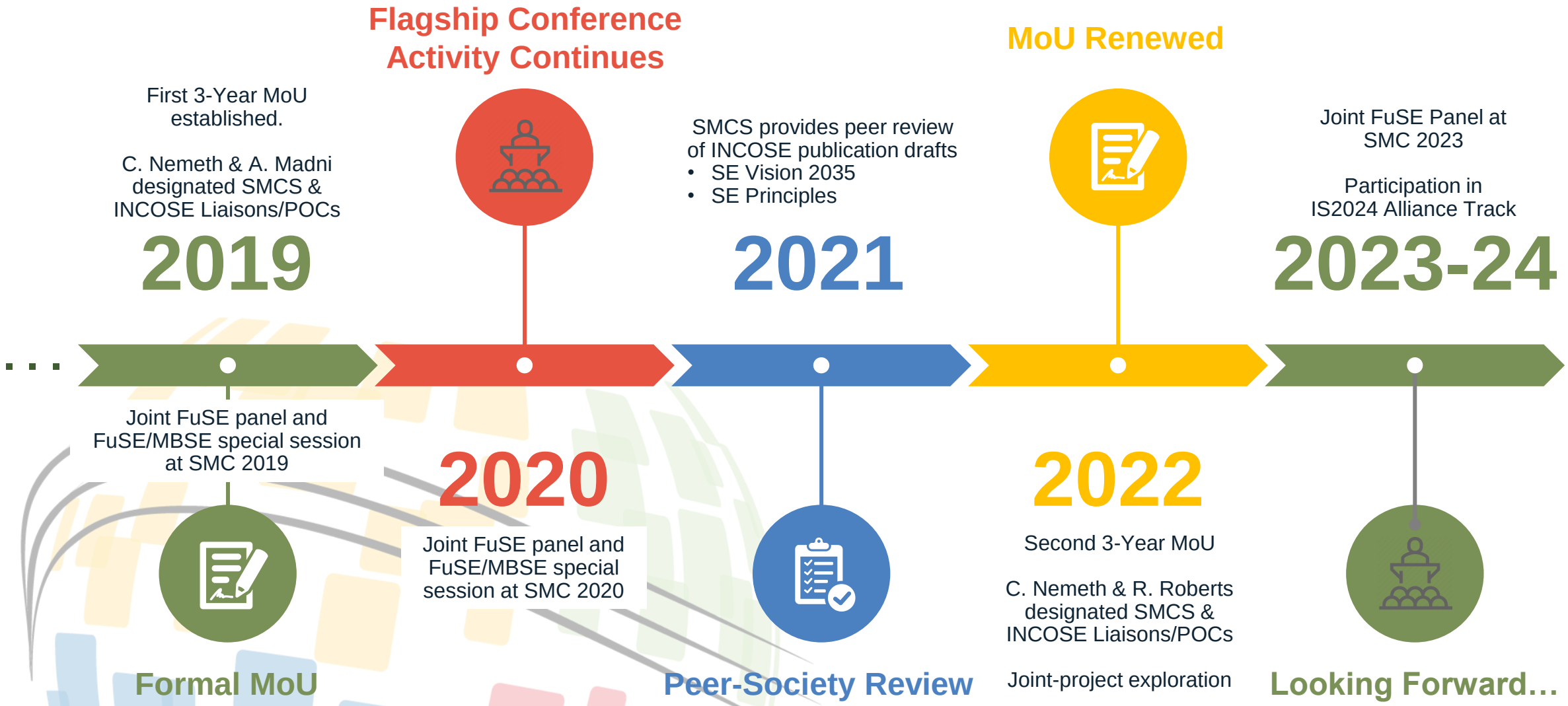
2011

"There is clearly scope to work together."
Samantha Brown, INCOSE President

"The fact that SMCS is largely an academic Society is probably one of key asset for a mutual benefits and complementarity with us."
Jean-Claude Roussel, INCOSE Technical Director

"A collaboration with the IEEE SMSC could be very beneficial to both organizations. As we go forward, there are many opportunities for academic involvement in research related to MBSE. A TC on MBSE with strong academic and industry participation could help advance an MBSE research agenda."
Sandy Friedenthal, Co-Chair, INCOSE MBSE Initiative

…Formal relationship



Memorandum of Understanding, est. 2019

- Outlines collaborative relationship & goals to:

  "develop and promote best practice processes and guidance, training, and supporting materials that can be used in projects and organizations, in the field of systems engineering throughout the world."

- Formalized the Alliance

Excerpt of press release

INCOSE Media Contact: Lisa Hoverman, marcom@incose.org

Institute of Electrical and Electronics Engineers on behalf of its and Systems, Man, and Cybernetics Society signs a MOU with the International Council of Systems Engineering

SAN DIEGO (April 24, 2019) – The International Council of Systems Engineering (INCOSE), the largest organization in the world dedicated to systems engineering, has signed a memorandum of understanding (MOU) with the Institute of Electrical and Electronics Engineers (IEEE) on behalf of its Systems, Man, and Cybernetics Society (SMCS), IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

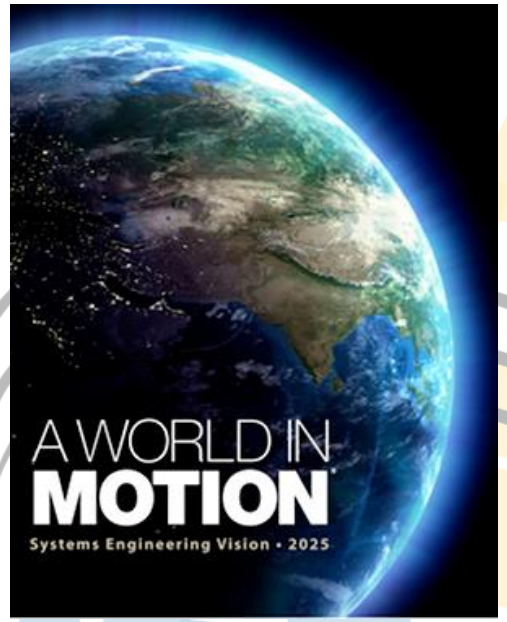
The purpose of the MOU is to jointly collaborate and participate within the global engineering community. The agreement formalizes the partnership between the two organizations to work on common projects and challenges, including the development and promotion of best practices and guidance, along with training and materials that can support projects and organizations in the field of systems engineering throughout the world.

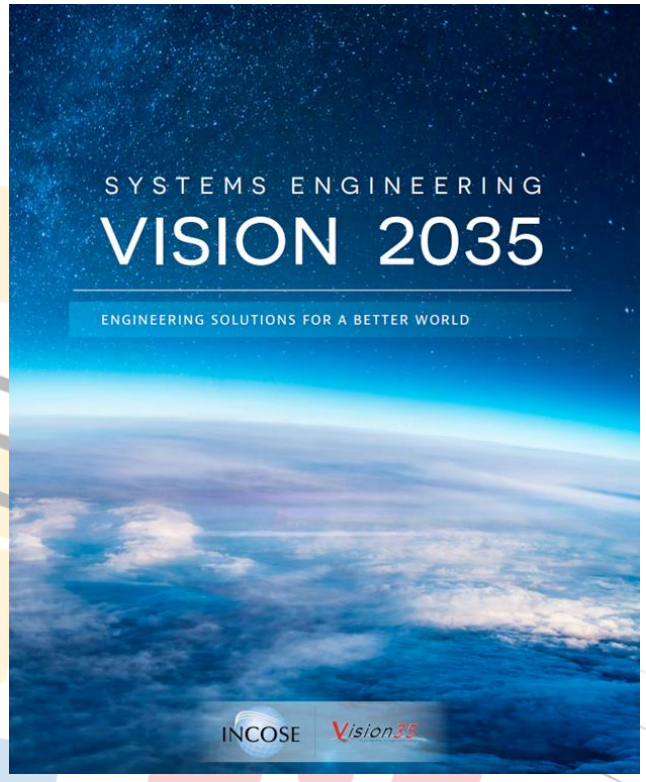
…

A Timely Collaboration…

INCOSE FuSE

Future of Systems Engineering





Systems Science and Engineering Research in the Context of Systems, Man, and Cybernetics: Recollection, Trends, and Future Directions

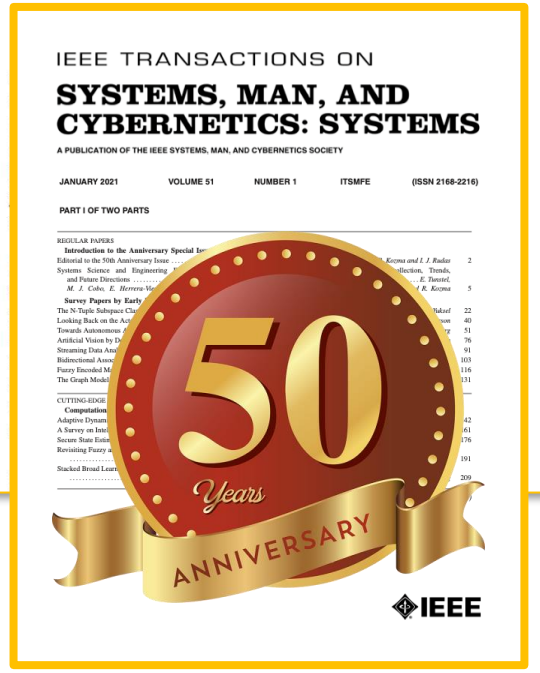
Edward Tunstel, *Fellow, IEEE*, Manuel J. Cobo, Enrique Herrera-Viedma, *Fellow, IEEE*, Imre J. Rudas, *Life Fellow, IEEE*, Dimitar Filev, *Fellow, IEEE*, Ljiljana Trajkovic, *Life Fellow, IEEE*, C. L. Philip Chen, *Fellow, IEEE*, Witold Pedrycz, *Life Fellow, IEEE*, Michael H. Smith, *Senior Member, IEEE*, and Robert Kozma, *Fellow, IEEE*

***Abstract*—To commemorate the 50th anniversary of the IEEE Transactions on Systems, Man, and Cybernetics: Systems, this article examines and reports on its past to current topical coverage of systems science and engineering toward exploring the evolving focus of the research community. Results of a systematic bibliometric analysis are presented with associated conclusions, implications, and summary of topical areas. In addition, respective views regarding the current state of the field and where it is headed are offered by recent leaders of the IEEE Systems, Man, and Cybernetics Society, including its continued relevance and role in the advancement of systems technology.**

***Index Terms*—Bibliometrics, co-word analysis, H-classics, H-index, research trends, science mapping analysis, SciMAT, systems engineering, systems science.**

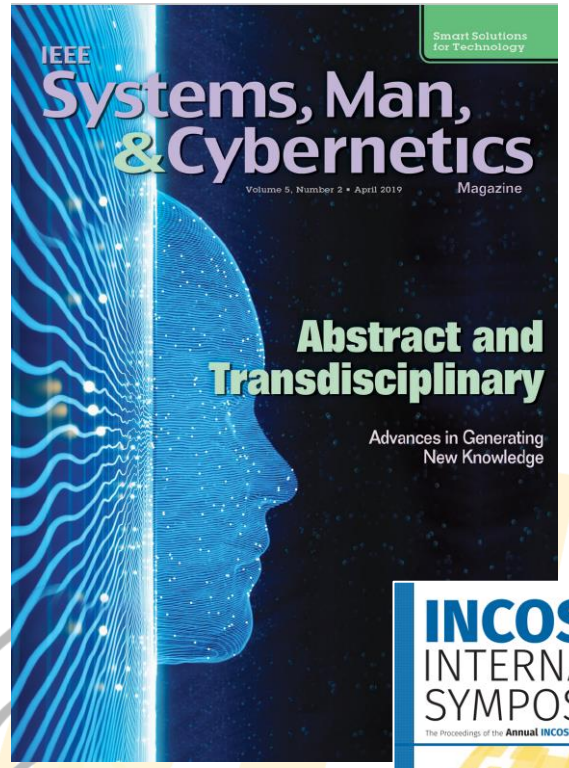
I. Introduction

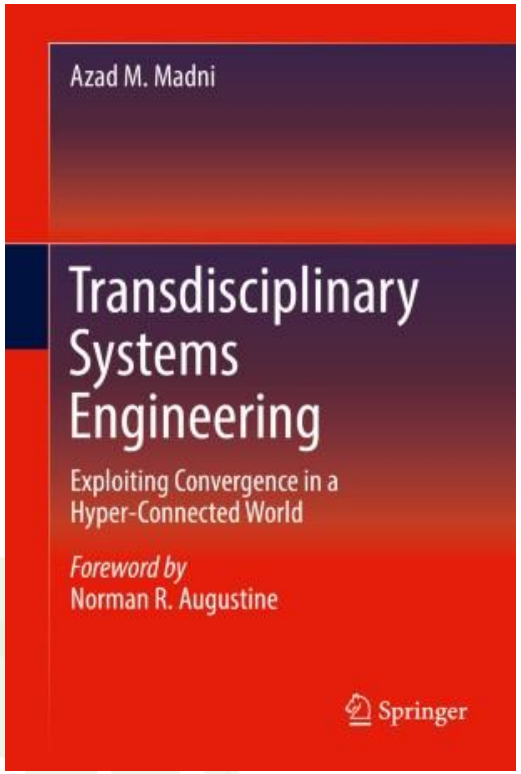
FOR THE past half-century, this journal has served as a conduit for dissemination of new research findings and for

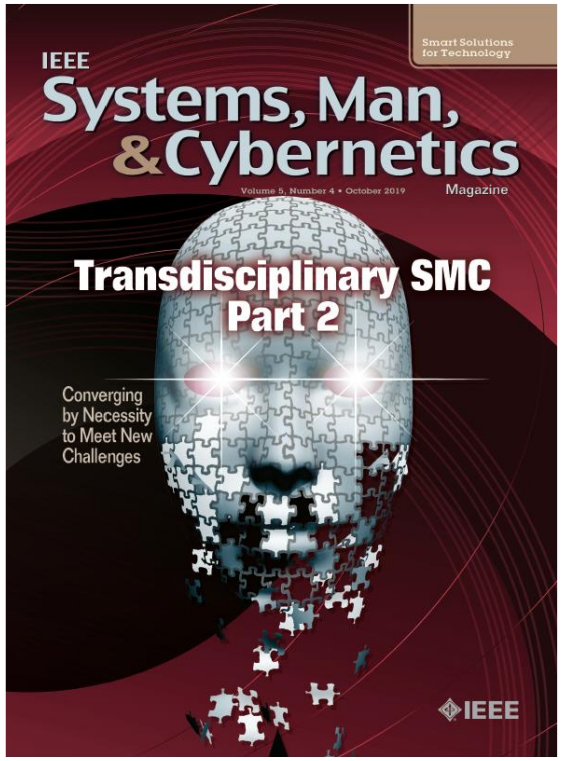


IEEE SMC Systems, Man, and Cybernetics Society

Emphases on transdisciplinarity







Publications since 2018
+ panels at IS 20xx

H. Sillitto, R. Griego, E. Arnold, D. Dori,, et al, "**Envisioning Systems Engineering as a Transdisciplinary Venture**," 2018 INCOSE IS.

M. Watson, A. Madni, B. Mesmer, D. McKinney, "**Envisioning Future Systems Engineering Principles Through a Transdisciplinary Lens**," 2020 INCOSE IS.

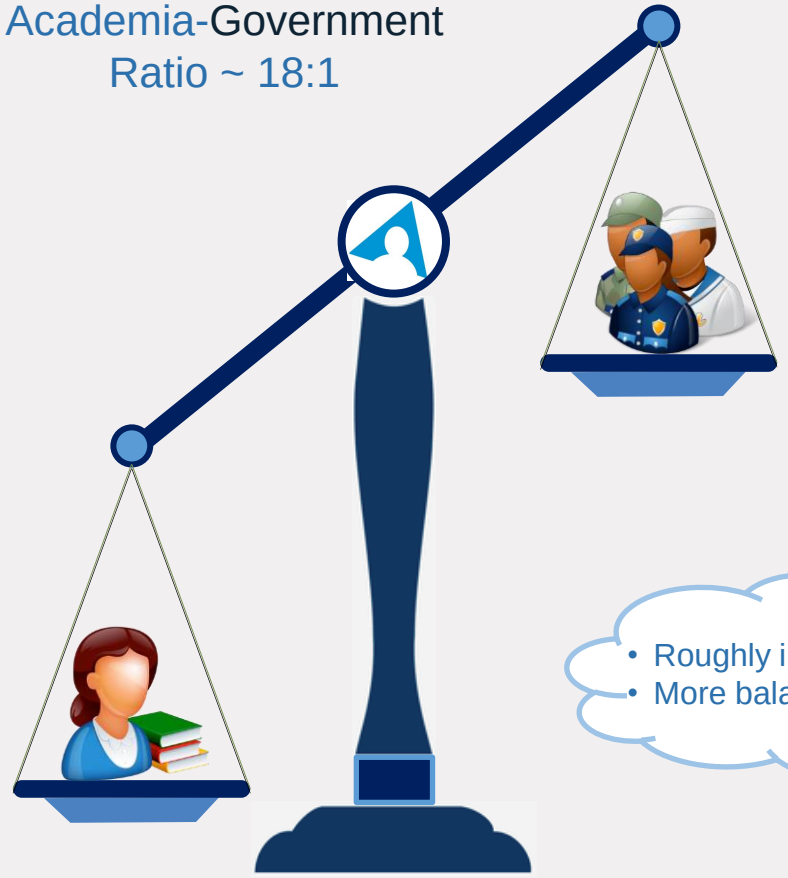
Mutual Benefits

Complementary membership demographic

Largely Academic, SMCS could be considered a "research arm" of the INCOSE-SMCS Alliance

Academia-Industry
Ratio ~ 5:1

Academia-Government
Ratio ~ 18:1



- Roughly inverse for INCOSE
- More balanced for Alliance

Mutual Benefits

Technical complementarity, fostering reciprocal value

Mutual Benefits

Promotion & joint or reciprocal activities

Mutual Promotion

of respective, common-interest events, announcements, etc.

Joint Publications

Technical/position paper co-authorship.
Contributions to respective pubs.

Joint Conference Activity

Co-organized conferences/workshops.
Co-organized panels/special sessions.

Joint Webinars/Tutorials

Educational and training offerings.
Joint or mutual dissemination.

Potential 2nd-order Benefits

Dual Membership

Mutual membership promotion & growth.
Industry-academia membership balance.

Training / Education

Sharper member training/education focus.
Breadth & depth on theory & application.

Technical Collaboration

Broadened WG/TC views & knowledge.
Constructive projects; potential products.

Joint Publications

Allows drawing from both communities
to develop new publications

Conferences / Events

Combined theory-applications focus.
Higher attendance; Alliance exhibits.
Member discounts; SE Cert. Exam offers.

Joint Activity

Initial activity brainstorm @ SMC 2017

Potential Opportunity Area	Priority	Item Title	Item Description	INCOSE Perspective / Focus	SMCS Perspective / Focus	Benefits	Notes	Actions

- Garry Roedler (then P-Elect) attended, met, and brainstormed with SMCS leadership (D. Filev, E. Tunstel, C. Nemeth)
- Drafted list of 13 potential opportunities in multiple areas:
  - Conferences/Events
  - WG-TC Collaboration / Research
  - Professional Development / Training
  - Publications
  - Membership
- Action taken on several opportunities to date; additional scope remains

Scope of INCOSE-SMCS Alliance activity

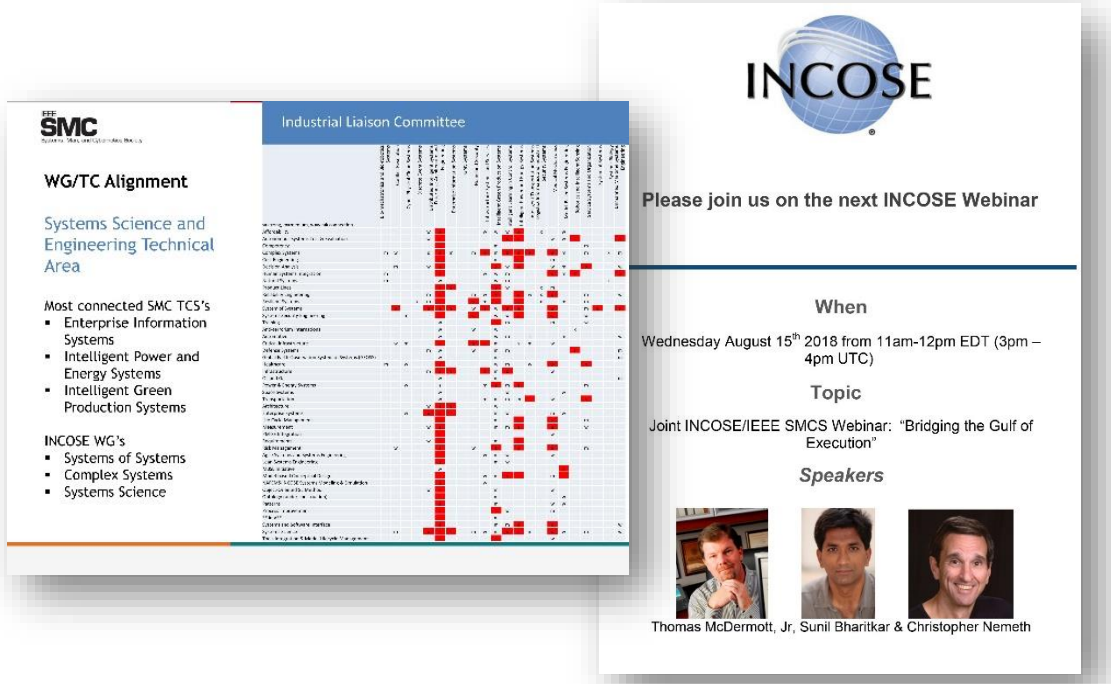
- The scope is both broad and evolving…
- Includes mutual promotion, INCOSE WG and SMCS TC technical collaboration, publications, conference panels & sessions, webinars, etc.
- The scope encompasses activities related to each of the 4 FuSE streams

Activity summary to date

- 4 **Joint Panels** at SMCS flagship conferences, IEEE SMC 2018-2023
- 3 **Planning/strategy meetings** participation at IW2018 & IW2019
- 2 **Joint Special Sessions** at IEEE SMC 2019 and 2020
- 2 **Peer Reviews** of INCOSE vision & principles publications, 2021
- 2 Preliminary **Joint-Project exploration** and definition activities, 2022
- 1 **Joint Webinar** on "Bridging the Gulf of Execution," 2018

2018 Activities

- Participation in monthly INCOSE Future of Systems Engineering (FuSE) Initiative planning meetings
- Participation in the “SE of the Future” track at IW2018
- Joint webinar: “Bridging the Gulf of Execution”
- Assessed & documented WG-TC scope-based alignment
- FuSE listening session at IEEE SMC 2018 (led by Bill Miller, FuSE Lead)



2019 Activities

- Monthly participation in FuSE planning meetings
- Participation in INCOSE Strategy Session at IW2019
- Joint FuSE/MBSE Special Session at IEEE SMC 2019
- Joint FuSE Panel at IEEE SMC 2019 (included Pres. Garry Roedler and FuSE Lead Bill Miller)

2020 & 2021 Activities

2020:

- Joint FuSE/MBSE Special Session at IEEE SMC 2020
- Joint FuSE Panel at IEEE SMC 2020 (included Pres. Kerry Lunney and FuSE Lead Bill Miller)

2021:

- Monthly participation in FuSE planning meetings
- Peer-reviewed and provided SMCS perspective on
  - INCOSE “SE Vision 2035” draft
  - INCOSE “Systems Engineering Principles” draft

2022 Activities

- Drafted joint-project concepts:
  1. “System Context” in response to INCOSE request for project contribution related to influence of context on system performance and PESTEL factors – an identified gap (thus potentially impacting the FuSE *Foundations* and *Methodologies* streams)
  2. Demonstration of how MBSE can exploit Digital Twin Technology in improving system models and contribute to model-based V&V including demo addressing human/societal need

  ❖ These project concepts are aligned with SE Vision 2035 top-level roadmap for **Research** and **Applications** (thus potentially impacting the FuSE *Vision & Roadmaps* and *Application Extensions* streams)

2023 Activity

- Joint FuSE panel at IEEE SMC 2023 (included Pres. Marilee Wheaton and FuSE Lead Bill Miller):
  - Described how INCOSE plans for the future
  - Identified development needs that INCOSE can inform, and potential needs
  - Identified new SE challenges and opportunities from the SMCS perspective
  - Suggested opportunities for joint collaboration

(l-r) INCOSE President Marilee Wheaton, SMCS Sr. Past President Eddie Tunstel, FuSE Lead Bill Miller, SMCS VP System Science and Engineering Haibin Zhu.

Summary & next steps

Summary

- Covered history leading to the formal INCOSE-SMCS Alliance + activities pre- and post-MoU
- Described mutual benefits and joint activities to date
- 5-Years in, the Alliance remains effective and has high remaining potential for growth
- Through this Alliance, we expect that various SE challenges will be addressed over time

Plans & prospects going forward

Plans / upcoming work:

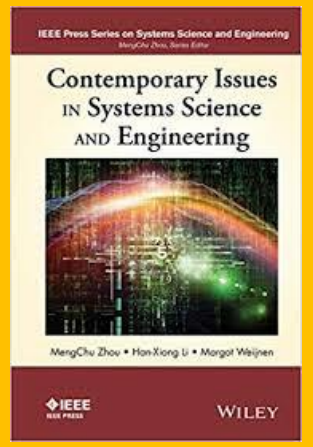
- ❑ Complete identification of participants to carry joint project(s) forward
- ❑ Extend WG-TC interactions to INCOSE Human Systems Integration WG for “mind meld” on that topic area
- ❑ Consider participation in INCOSE Academic Council sponsored Workshop for SE Research

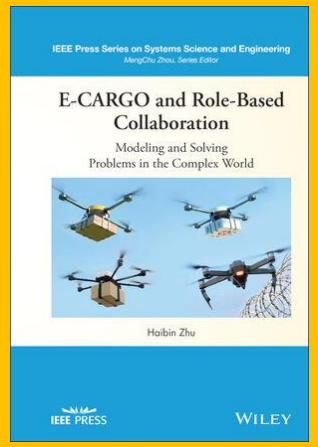
Prospects & upcoming activity opportunities (next 6-12 months):

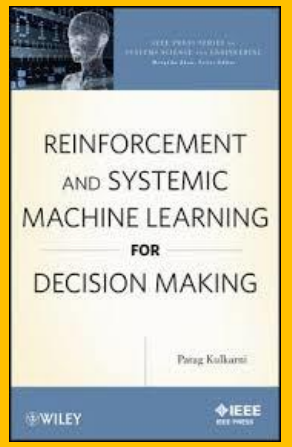
- ➢ Contribute to or support joint-project definition and execution
- ➢ Develop the next joint webinar(s)
- ➢ Propose new books to SMCS-led, IEEE Press Series…

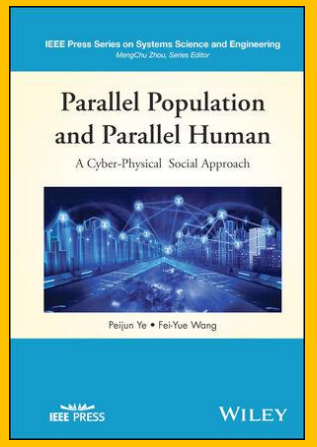
Book opportunities in IEEE Press Series

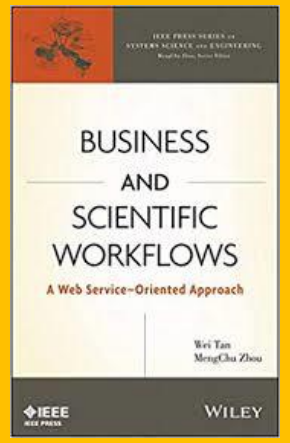
Systems Science and Engineering

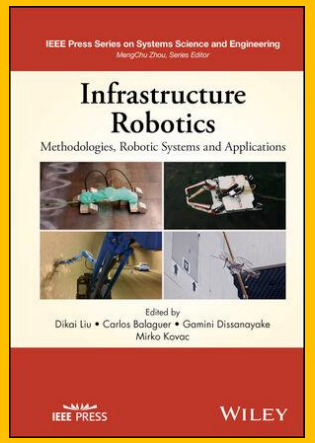


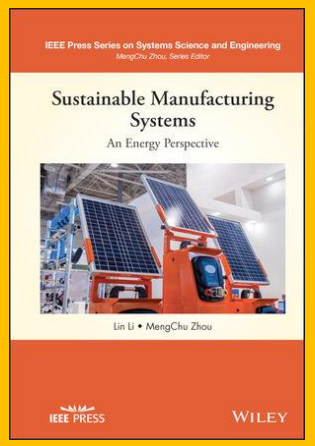






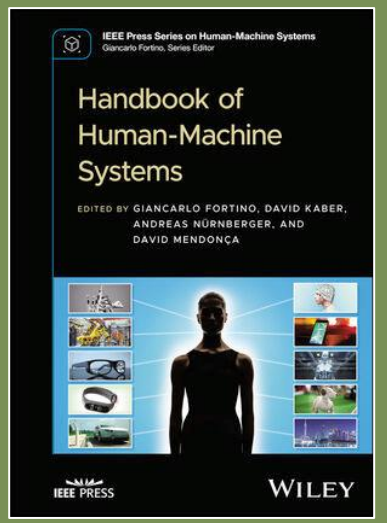


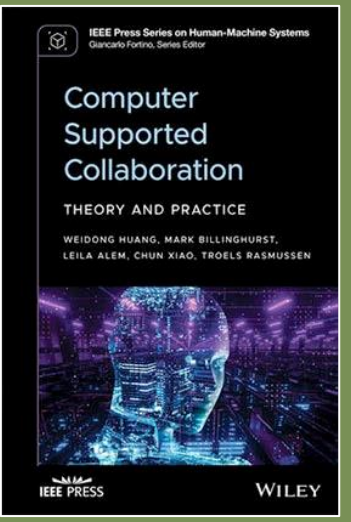




+ 17 more titles

Human-Machine Systems





YOUR BOOK ?

https://ieee-press.ieee.org/book-series/systems-science-and-engineering/

https://ieee-press.ieee.org/book-series/human-machine-systems/

Thank you for your attention!

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34th Annual INCOSE international symposium

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