



# How Did I Get Involved with System of Systems Engineering: A History?

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# Preliminary Comments

- o Internet has connected people of the world since ~ 1995
- o **System of Systems** (or Cyber-physical systems) is a generalization of the Internet connectivity of systems or systems and people – or a cross-section of cyberspace and physical spaces!
- o **SoS** is getting into new application cases in a very persisting pace – from IT to smart cities, defense, energy, space, environment, healthcare, services, earth studies, etc.

# A Definition of SoS

One out of many definitions ...

A SoS is an integration of a finite number of constituent systems which are *independent* and *operatable*, and which are networked together for a period of time to achieve a certain higher goal.

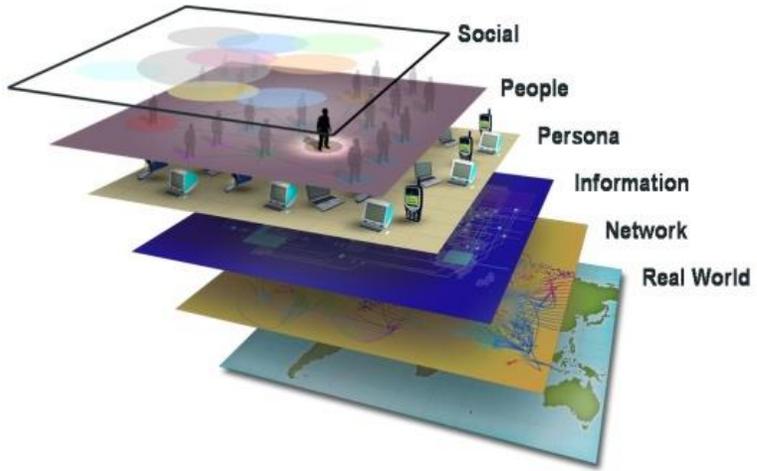
Goal: Security, lower cost, higher robustness, reliability, etc.

Applications: Environment, Energy, Defense, Automation, etc.

(Jamshidi, 2005, 2009)

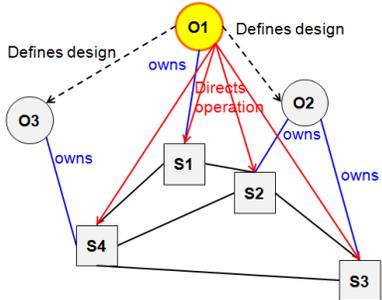
# Types of SoS

- **Operational independence of component systems**
- **Managerial independence of component systems**
- **Geographical distribution**
- **Emergent behaviour**
- **Evolutionary development processes**

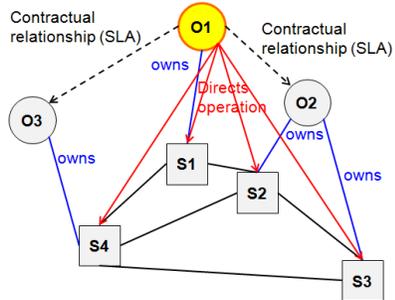


(Maier, 1998)

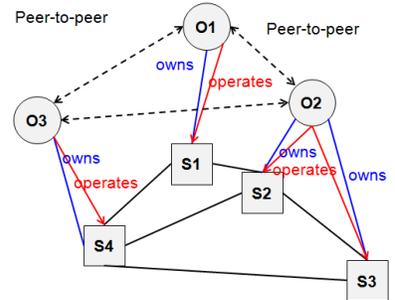
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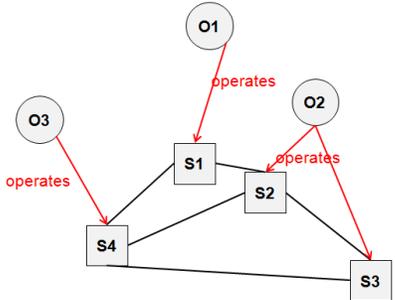
## Acknowledged



## Collaborative



## Virtual



Dahmann & Baldwin, 2008

# System vs. SoS



- **Distinction between a system and a System of Systems**
- An airplane is not a SoS, an airport is a SoS.
- **A robot is not a SoS, but a robotic colony (a swarm) is a SoS**
- **An isolated power plant is not a SoS, but a Smart Grid is a SoS**
- Significant challenges:
  - **What is the appropriate mix of independent systems ?**
  - **The operation of a SoS occurs in an uncertain environment**
  - **Interoperability**

- **History of 1<sup>st</sup> conference:**
- Initial exposure: In 2004 I became aware of a new paradigm at NASA JPL called System of Systems – SoS
- At the time I was IEEE SMC’s VP of Conferences for SMC and General Chair of the IEEE SMC 2005 conference on the Big Island of Hawaii.

**Venue: Waikoloa Hilton Village on Big Island of Hawaii.**

- With some hesitation of the IEEE SMC Board, I managed to make SoS as the “theme” of IEEE SMC 2005.
- That conference was attended by 800+ individuals, including few friends from the newly established IEEE Systems Council such as Bob Rassa (Raytheon) the founding president of the IEEE System Council.
- IEEE SMC 2005 had a very successful Panel Session on SoS with panelists from major aerospace and defense industries, chaired by Bob Rassa.





# Birth of IEEE System of Systems Engineering Conference

**SOSE**

## IEEE SoSE 2006

- During the week of IEEE SMC 2005, I decided to launch a new conference to be called IEEE SoSE to be convened in June 2006, at the beginning of my move to Texas
- In June 2006, I convened the first SoSE in USC Hotel (then it was Radisson at LAX).
- To my huge surprise over 60 scientists and engineers and some students showed up. LCM, Boeing, Raytheon, General Dynamics, etc. attended. Seeing industry folks at any IEEE SMC conference was a rare occasion.
- Both SMC and SysC decided to be financial sponsors at that time.
- At the SMC 2005, I run into a persistent and enthusiastic young fellow by the name of Ferat Sahin. He said, “I want to work with you”. “I said I am moving to Texas”. He said, “it does not matter; I just want to be with you”.
- I invited Ferat to spend academic year (2006-2007) with me. That was the beginning of our 17-year relation.



# IEEE SoSE 2007

- The second SoSE Conference was brought to my new hometown in San Antonio, Texas in April 2007
- Venue was at the downtown San Antonio at the Holiday Inn Riverwalk.
- Conference attracted 120 submissions and resulted over 70 accepted papers .
- Among our keynote speakers were an Army General, former director of NSA, NASA, US Airforce, and many more industry participations.
- US economy was moving to a recession due to Wall Street mischieves.





# Monterrey Bay, California

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**IEEE SoSE 2008**



# IEEE SoSE 2008

Venue: Monterey Bay, California



- This conference fell short of expected attendance due to the ongoing recession.
- It was still had a good attendants from the industry
- Due to loss of income of SMC and SysC withdrew their financial support! A short-sighted decision.
- The banquet was convened in a nearby winery which was like a beautiful garden with exotic flowers and plants.

**IEEE SoSE 2009**

Albuquerque,  
New Mexico



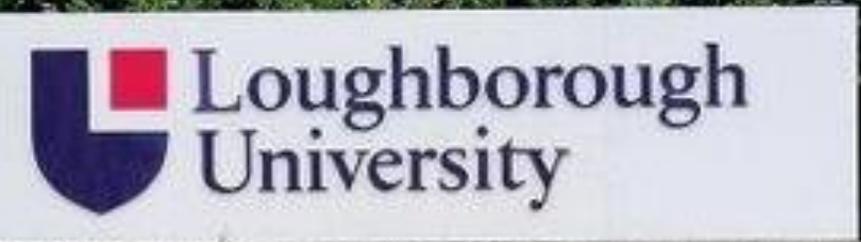
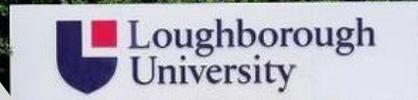
## IEEE SoSE 2009

Venue: Albuquerque, New Mexico



- This was the first conference that Dr Ferat Sahin joined me a co-General Chair
- The national economy was still in a recession
- The conference received less than 50 papers
- Conference did have keynote speakers from UK (Michael Henshaw), Lockheed-Martin Fellow (Reggie Cole), and myself as one.
- Hotel had to penalize us for shortage of room nights, but they said that they would waive it if the conference come back.

IEEE SoSE 2010



Loughborough  
University, England

# IEEE SoSE 2010

Venue: Loughborough University, England

- Michael Henshaw came to the rescue, and the recession was practically gone.
- For first time SoSE went to Europe.
- Dr. Henshaw did an excellent management and promoted the conference through UK's industries.
- IBM- UK sponsored our banquet.
- We had over 100 papers again and keynotes by the likes of Judith Dahmann, and representatives of British industries among other keynote speakers.
- During the breaks, I saw an expert bicycle rider on the campus and when I watched closely it was Judith, she enjoyed the meeting.



# IEEE SoSE 2011

## Albuquerque, New Mexico, Again !



- Second visit of Albuquerque, NM was almost like a charm
- Garry Roedler, a Fellow of LMC was our Industrial Liaison and opened a lot of opportunities for SoSE Conference
- Via Garry's effort, Liz Porter, a LMC Vice President came and gave a very good keynote
- Again, with help from Garry INCOSE began supporting the conference
- Nearly 90 accepted papers were presented
- Hotel was happy and we were happy and conference got off the hook for financial penalty.

# GENOVA, ITALY



Genova, Italy

**IEEE SoSE 2012**

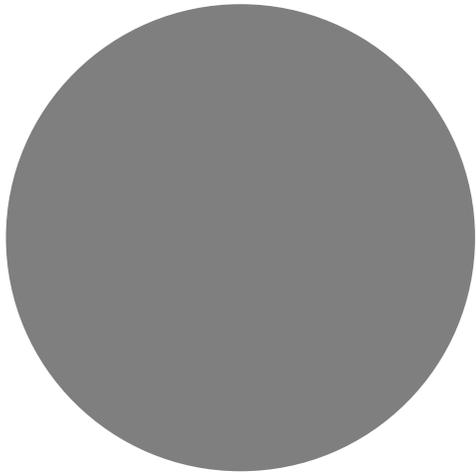
## Venue: Genoa, Italy

- SoSE 2012 was held in Genoa, Italy from July 16-19, 2012
- Week before that in Rome, we attended INCOSE Symposium
- Conference took care of lunch, while the hotel took care of the breakfast
- Our friend Paul Hershey (Raytheon) came to SoSE 2012 for the first the time and we had a wonderful time together.
- Michael Henshaw arranged and chaired a panel session with attendees from European Commission
- Gala banquet was convened at a nearby Genoa Aquarium with sharks looking at us.
- General Chair, Roberto Sacile put most of us on a boat and we went to **Portofino**

IEEE SoSE 2012

# GENOA, ITALY





**Venue: Maui Prince Hotel, Makena, Maui**

**IEEE SoSE 2013**

# IEEE SoSE 2013

- SoSE 2013 was a smash success with 3 parallel sessions for 3 days in June
- Welcome reception was at the sunset on the beach of the hotel.
- A former President of INCOSE was among our keynote speakers
- Two co-General Chairs Sahin and Jamshidi convened a reception for the key organizers and attendees.
- Many students attended the meeting





Stamford Grand,  
Adelaide, Australia

**IEEE SoSE 2014**

# IEEE SoSE 2014

Venue: Stamford Grand, Adelaide, Australia



- Professor Steven Cook, who had attended many SoSE's, took the conference to Adelaide, Australia
- Conference, I was told, was a big success.
- I was not able to go to that meeting due to an illness.



# IEEE SoSE 2015



**Venue: Hilton Palacio Hotel Riverwalk, San Antonio, Texas, USA**

- SoSE 2015 had 3 parallel sessions for 2.5 days
- Many industry participants such as Judith Dahmann, Garry Roedler, et al. attended and had 2 panel sessions
- The banquet took place on the roof of the hotel in open air



# IEEE SoSE 2016

**Venue: Campus of Kingsburg College, Norway**



- Professor Gerrit Muller of Norway, in cooperation with Prof. Martin (Delft University, the Netherlands)
- SoSE 2016 was jointly took place with an annual workshop of Kingsburg College
- There were 4 parallel sessions, and the conference provided a remarkable buffet lunch every day
- As usual, we had a strong participation of industries from US and welcome a few Scandinavian industries.

# IEEE SoSE 2017

**Venue: Hilton Waikoloa Village Big island, Hawaii**



- This SoSE conference returned to the same venue where IEEE SMC 2005 took place. Recall: Idea of this conference began at the 2005 meeting.
- Again 3 parallel sessions in 3 days took place with well over 100 papers
- Among keynote speakers were Alan Harding (former INCOSE President), Judith Dahmann and Garry Roedler (INCOSE President). Other keynotes, among others, were Michael Henshaw and Imre Rudas.
- Industry was again well represented from US and Europe.
- General chair of SoSE 2018 in Paris Prof. Thierry Denoux attended the event.

# IEEE SoSE 2018

**Venue: Sorbonne, Paris, France**

- Three parallel sessions in 3 days
- Several SoSE keynotes and panel sessions. French industries showed up at the meeting.
- Active participation of INCOSE
- Gala banquet was on the River Seine



**Venue:**  
**Sheraton Hotel,**  
**Anchorage,**  
**Alaska**

**IEEE SoSE 2019**





## **IEEE SoSE 2019**

**One of the largest attendance and submissions in SoSE history**

**Alaska was a desired location for many people**

**Three parallel sessions for every day**

**General chairs of SoSE 2020 (Budapest, Imre Rudas) and SoSE 2021 (Stockholm, Jakob Akelsson) were present**

**Many side trips were made after the conference**



# IEEE SoSE 2020 - Virtual

Venue: Obuda University, Budapest, Hungary

- Completely virtual
- Over 150 papers submitted



# IEEE SoSE 2021



Venue: **Västerås, Sweden**  
**June 14-18, 2021**

- conference theme: “Autonomous Cyber-Physical Systems of Systems”.
- 5 keynote speakers from USA, UK, France and Sweden
- 40 final accepted papers
- Conference was convened in a hybrid mode: Virtual and Live
- General Chair, Jakob Axelsson offered a very organized meeting



# IEEE SoSE 2022



**Venue: Campus of RIT, Rochester, New York**

# IEEE SoSE 2022

**Venue: Campus of RIT, Rochester, New York**



# SoSE 2022

## SoSE 2022 Statistics:

1) No. of papers submitted?

**114**

2) No. of papers accepted?

**74**

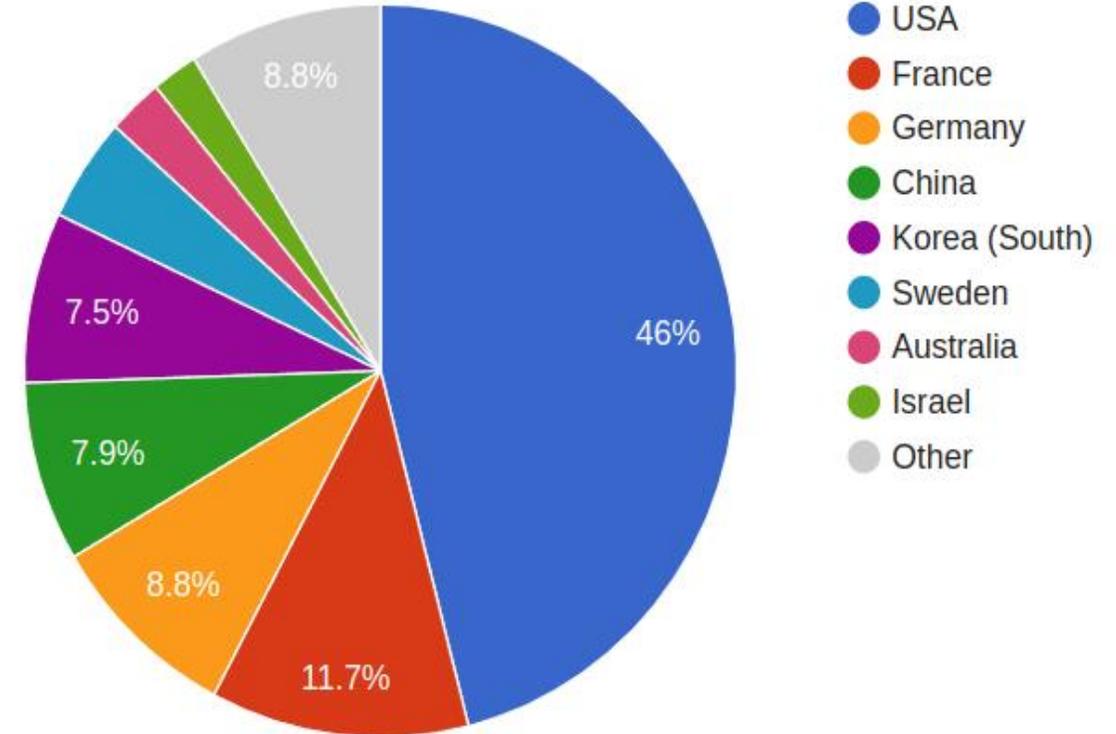
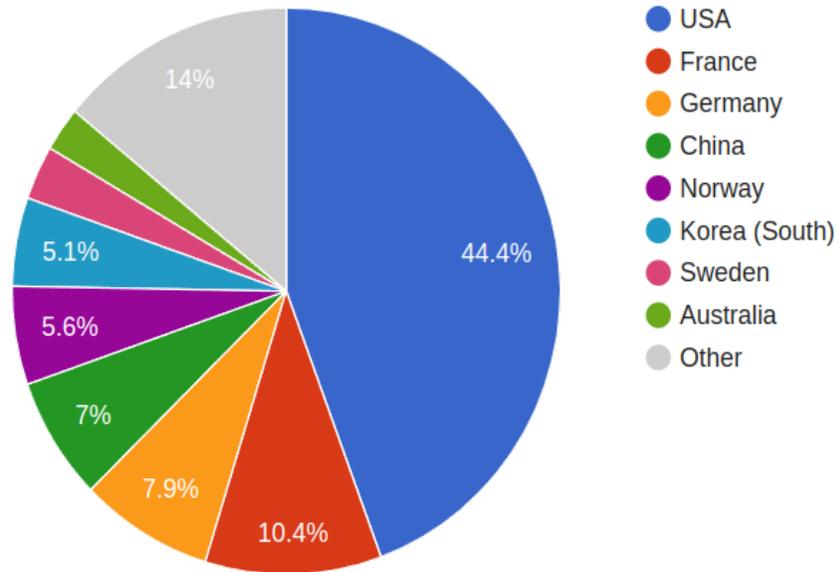
3) Which countries have submitted?

**ALL Papers submitted:**

## ACCEPTED PAPERS

Author distribution by country

Author distribution by country



Courtesy of Celal Savur

# SoSE 2022

## Authors by Country and Region (All Papers)

All authors of submitted papers are counted. Authors are counted once for each paper.

Country	Authors	%	Papers (1st author)	%
USA	158	44.4	52	46.0
France	37	10.4	8	7.1
Germany	28	7.9	6	5.3
China	25	7.0	7	6.2
Norway	20	5.6	7	6.2
Korea (South)	18	5.1	5	4.4
Sweden	11	3.1	5	4.4
Australia	9	2.5	3	2.7
Brazil	7	2.0	2	1.8
Israel	5	1.4	2	1.8
The Netherlands	4	1.1	2	1.8
Estonia	4	1.1	1	0.9
Italy	4	1.1	1	0.9
Pakistan	3	0.8	1	0.9
Peru	3	0.8	3	2.7
India	3	0.8	1	0.9
Spain	3	0.8	0	0.0
Iran	3	0.8	1	0.9
Lebanon	3	0.8	1	0.9
Bangladesh	2	0.6	1	0.9
Turkey	2	0.6	1	0.9
Philippines	1	0.3	1	0.9
Japan	1	0.3	0	0.0
Qatar	1	0.3	1	0.9
Hungary	1	0.3	1	0.9
<b>Total</b>	<b>356</b>			

SoSE 2022 Statistics:  
 There are 356 authors from 26 nations. USA provided 46% of the submissions from 158 authors.

Author counts for Europe, Middle East, Africa are shown both combined and separated into Europe and MEA. 

Region	Authors	%
United States	158	44.4
Europe, Middle East, Africa	126	35.4
Europe	112	31.5
Asia/Pacific	62	17.4
Middle East and Africa	14	3.9
Latin America	10	2.8
Canada	0	0.0
unknown	0	0.0

Courtesy of Celal Savur



Venue: Polytechnic of  
Lille, Lille, France

**SoSE 2023**

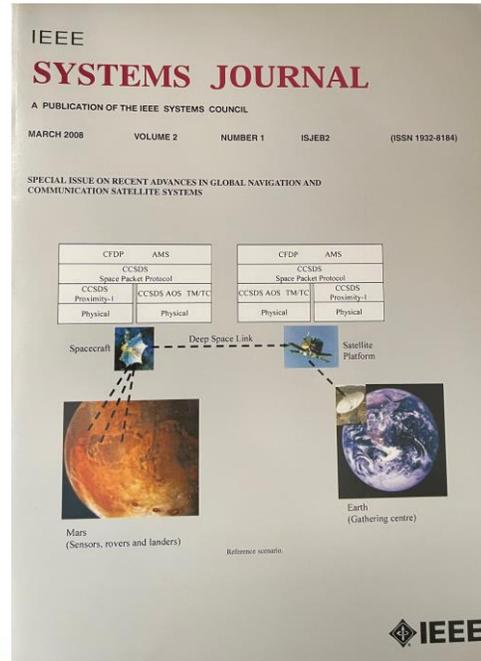
General chair: Rochdi Merzouki



# HISTORY OF IEEE SoSE CONFERENCES

SoSE	Location	General Chair(s)
2006	Los Angeles, CA, USA	Mo Jamshidi
2007	San Antonio, TX , USA	Mo Jamshidi
2008	Monterrey Bay, CA, USA	Mo Jamshidi
2009	Albuquerque, NM, USA	Mo Jamshidi and Ferat Sahin
2010	Loughbrough, UK	Michael Henshaw
2011	Albuquerque, NM, USA	Mo Jamshidi and Ferat Sahin
2012	Genoa, Italy	Roberto Sachile
2013	Maui, HI, USA	Mo Jamshidi and Ferat Sahin
2014	Adelaide, Australia	Steven Cook
2015	San Antonio, TX, USA	Mo Jamshidi and Ferat Sahin
2016	Kingsburg, Norway	Gerrit Muller and A. Martin
2017	Big Island, HI, USA	Mo Jamshidi and Ferat Sahin
2018	Paris, France	Thierry Denoux
2019	Anchorage, Alaska, USA	Mo Jamshidi and Ferat Sahin
2020	Budapest, Hungary?	Imre Rudas
2021	Stockholm, Sweden	Jakob Axelsson
2022	Rochester, NY,USA	Mo Jamshidi and Ferat Sahin
2023	Lille, France	Rochdi Merzouki

# IEEE'S Lone SoSE Journal



**12.029**

Impact  
Factor

**0.02316**

Eigenfactor

**2.34**

Article  
Influence  
Score

**18.3**

CiteScore  
Powered by Scopus

# Conclusions

- SoSE conference is the only IEEE-affiliated meeting of its kind
- SoSE is one of the few IEEE and INCOSE events
- Three of the European General Chairs were previously in industry and had come to academia. This fact was very helpful.
- Thanks to all general chairs: Ferat Sahin, Michael Henshaw (UK), Roberto Sacile (Italy), Steven Cook (Australia), Gerrit Muller (Norway), P. Mar (The Netherlands), Thierry Denoux (France), Imre Rudas (Hungary), Jakob Axelsson (Sweden), and Rochdi Merzouki (France)
- Thanks to our supportive individuals from Industry: Gary Roedler, Paul Hershey, Reggie Cole, Judith Dahmann, Liz Porter, Alan Harding, and finally last, but not least to INCOSE and IEEE.

The logo consists of three concentric circles. The innermost circle is a dark blue color and contains the text 'SOSE' in white. The middle circle is a medium blue color, and the outermost circle is a lighter blue color.

SOSE

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SOSE

**Thank you**  
**Grazie**  
**Merci**  
**Köszönöm**  
**Tack**

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