



**32<sup>nd</sup>** Annual **INCOSY**  
international symposium

hybrid event

Detroit, MI, USA  
June 25 - 30, 2022

A SaSIWG Initiative

# Illustrating the Business Value of Systems Engineering via Storytelling

[www.incose.org/symp2022](http://www.incose.org/symp2022)



# Acknowledgements

IS2022 Authors: Jeannine Sivi, Dorothy McKinney, Sarah Sheard, Lauren Stolzar

## Business Relevance Subteam:

- Jeannine Sivi
- Dorothy McKinney
- Sarah Sheard
- Lauren Stolzar
- Suzette Johnson
- Stephanie White

## Vignette & Story Authors:

- Jeannine Sivi: Healthcare
- Dorothy McKinney: Startups
- Sarah Sheard & Chandru Mirchandani: Aero
- Lauren Stolzar: eCommerce
- Suzette Johnson: Automotive
- Stephanie White & Yann Argotti: Automotive

And thank you to

- Mickael Bouyaud, Rita Creel, John Wood for reviews
- all active WG members for inspiration, brainstorming and support (active members listed in “About SaSIWG” attachment)



# Let's Start With A Story....

“Everything is Software”

“Everything is Data” (Data is Software)

SW, Agile, DevOps, MLOps, HCD/Design

Digital Transformation: All Sectors, Socio-Biz-Tech, C-Suite

“Tech” = software or IT

**SysE  
Centric**

**SysE +  
PM**

**Confront  
gaps**

**Wicked  
Problems**

**SysE as  
key-  
stone**

The Early Days

- ROI studies and papers

SaSIWG launches

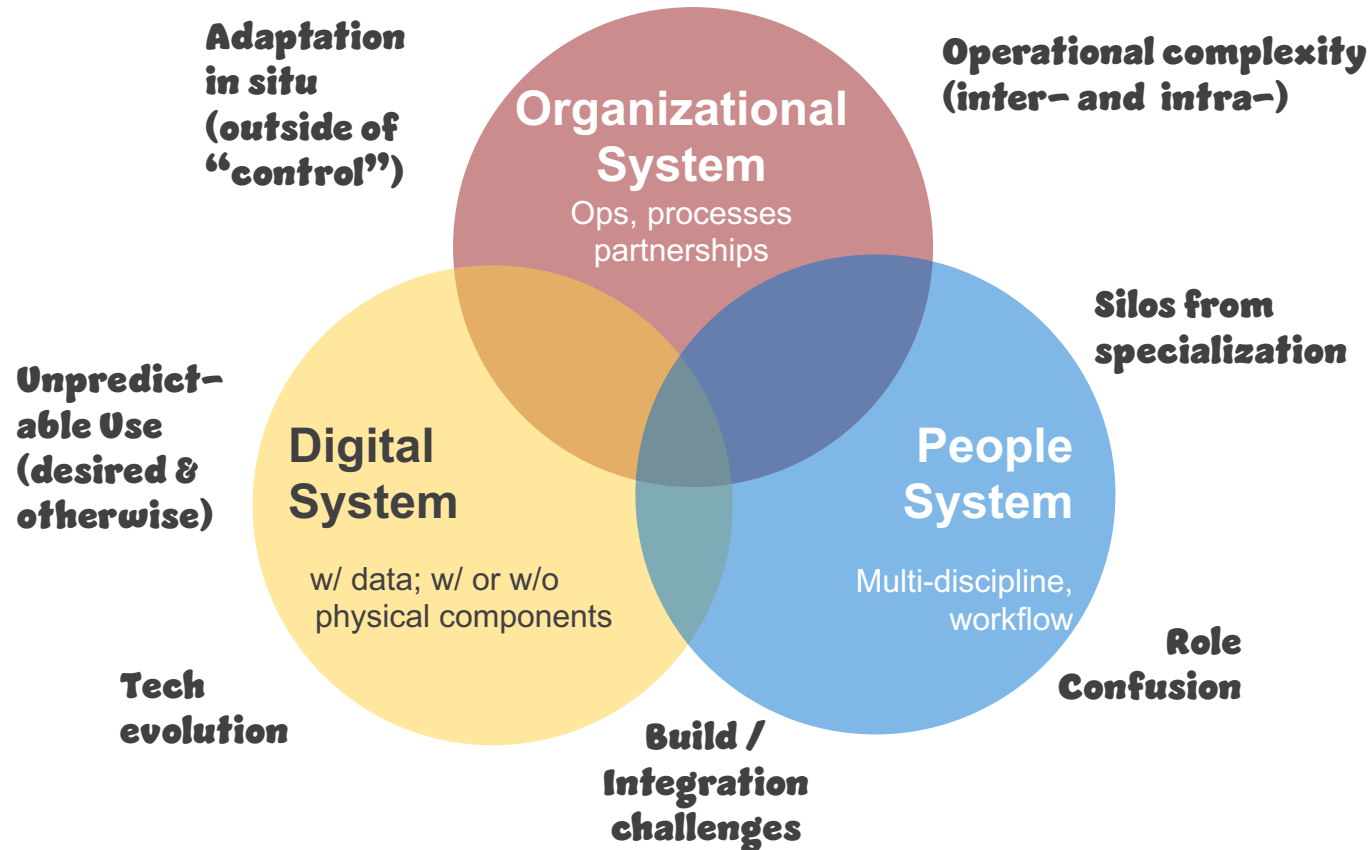
- Close interface gaps
- Find our way in “digital world”

“Breakthrough” approach

- Multi-discipline partnerships
- Engage with more “why” less “what” and “how”

# Digital Business: Complex, Layered, Connected Ecosystems

This is hard, messy, and unpredictable. It is what we thrive on!



**"Digital": vast connectedness, flexibility**

- Org, people systems in concert with digital system

## Digital Challenges (all system types)

- Portfolio Mgmt: Strategy Implementation
- Interoperability: system, data, and process
- Composability: modular, fluid, pivotable

## Systems Principles & Risks still apply

- Breakage at interfaces
- Bottlenecks
- Leverage Points

## Significant impact if not well addressed

- Unexpected problems & Undesired results

**Systems Engineering is Key to Success.** *(We just need to convince people!)*



# Which Brings Us to Current Context

SaSIWG Mission: Increase the relevance of Systems Engineering in software- and data- intensive settings

- by focusing at interfaces (all types) where there are gaps, duplications, conflicts and missed opportunity to drive value
- by creating actionable work product for systems, software and related disciplines to collaborate and co-create
- Thereby ensuring systems that achieve mission, in a scalable, resilient, anti-fragile manner

Our Springboard into 2022:

- Key Questions: 8 categories of questions, published in 2021, inspired by “The Unicorn Project”
  - context, roles, processes & methods, people, synthesis, business case, business culture, business trends
- Better branding needed: “Everything is a System!”

Initiatives In Progress

- **Business Relevance: TODAY’S FOCUS!!**
- *Data & Architecture: Roadmap of “just do its” & small projects.*
  - *A story for another day....*

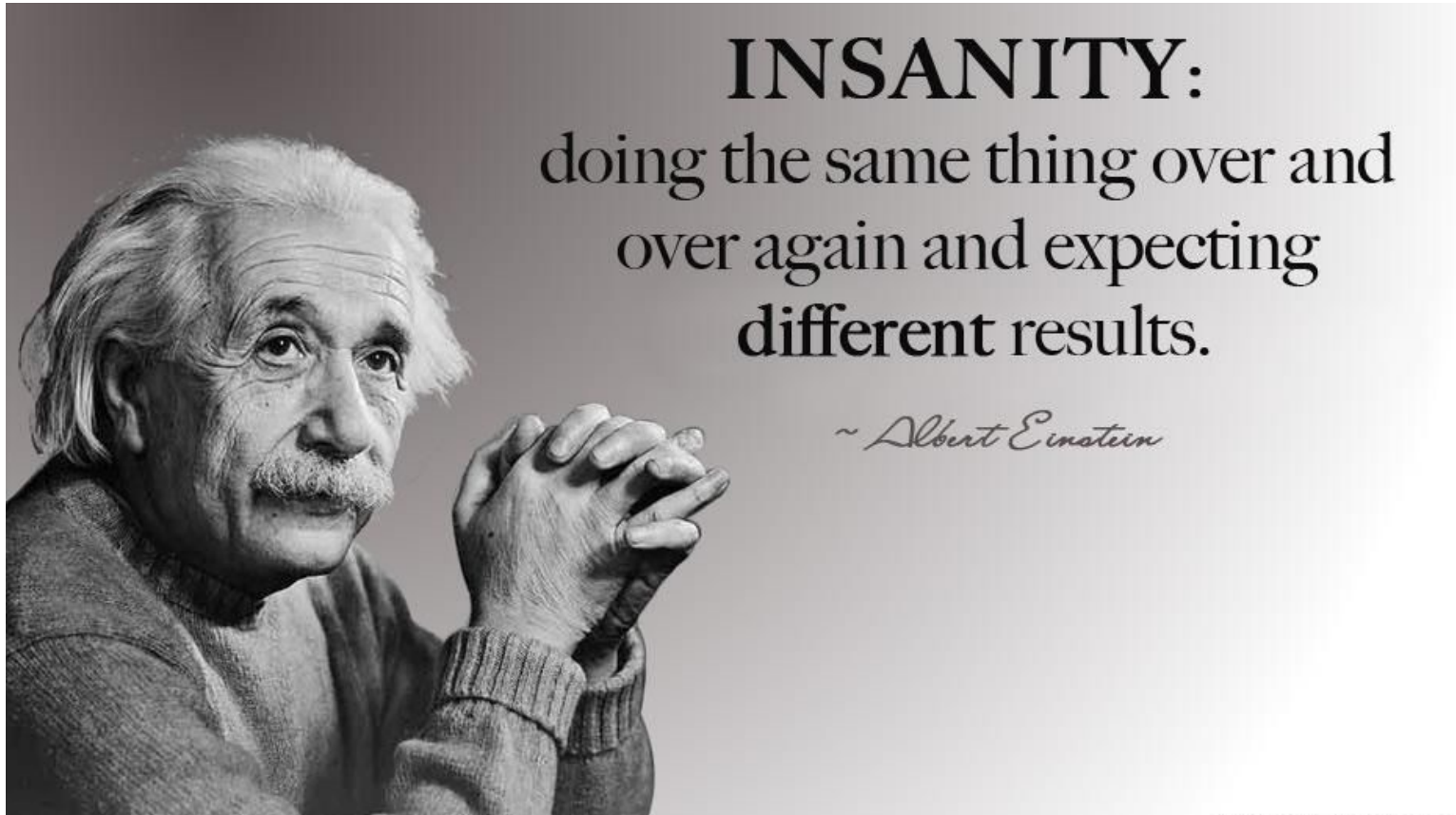
*“94% of problems in business  
are systems driven...”*

- *W. Edwards Deming*





# We decided to stop the insanity....



Historical efforts to bridge systems & software have had limited success.

*(We may feel like the “underdog” as software, data science & AI/ML, design, devops and agile prevail)*

So, instead of beating our usual drums.....

Benjamin~~X~~ Franklin, Mark~~X~~ Twain, Confucius~~X~~, Rita Mae Brown~~X~~, who knows who really said it first....



# We're trying something different

HOW WE ADD VALUE!

~~THIS IS WHAT WE DO!~~



- Business storytelling
- Showcasing OUR Business Relevance
- ***Unleashing Business Systems and Product Relevance***

Did you know?

- \$1Trillion (US) potential revenue is lost to competitors (in the US) because offerings weren't relevant enough (Accenture)

How did we get there? There was a Miro Board, lots of brainstorming, synthesis, a few diagrams (maybe). See the Paper for more!





# We wrote 6 vignettes (so far)



**Where we  
are often  
“incognito”**



## Healthcare

Aligning business & tech to  
compete with digitally  
disruptive startups



## eCommerce

Fast cycle time for app  
release, to scale in a  
competitive environment



## Startups

Remedying small team  
operational challenges that  
impede mission



## Aerospace

Overcoming “glue code”  
challenges of underbid  
software contract

## Automotive (Autonomous Vehicles)



Resolving overlooked  
ecoSYSTEM requirements for  
navigation software to work.

Resolving software disconnects  
and quality with SYSTEM digital  
threads for traceability

**Where we are  
underutilized  
in the “digital”  
playing field**





# We set out to master a new craft

- We like our vignettes (they got us to IS2022!)
- Yet we recognize that we often overwhelm others in ways that undermine engagement.
  - We are wired to see large systems and minute details simultaneously.
  - We love to share! (We are often not “less is more” people.)
  - And we often skip right past “why” (business) and dig into “how” (and “why it works”)

## innovation storytelling (n.)

the art and science of communicating strategic narratives and personal experiences around product developments, systems improvements, and ground-breaking thinking to drive innovation objectives.

**|Un|told**

<https://untoldcontent.com/>

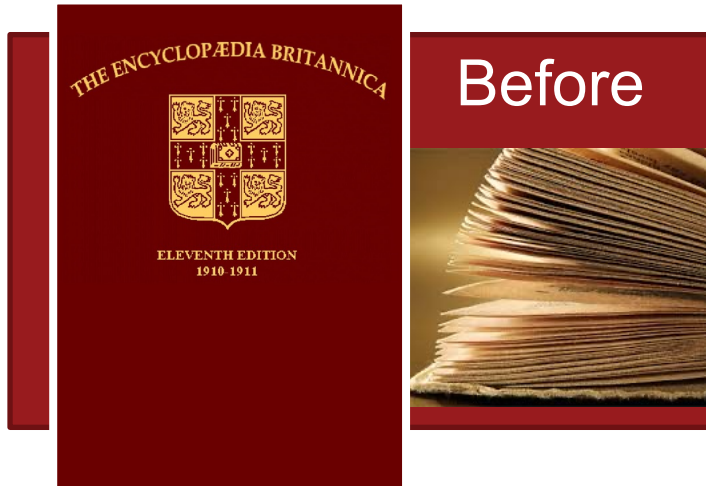
Thank you INCOSE & Chris Hoffman  
for sponsoring our Storytelling Cohort!



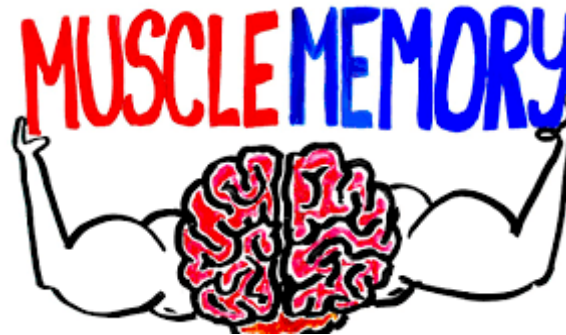
# We learned that

## This kind of storytelling is HARD!

We had to let go of details



*Build new muscles  
(still workin' on it!)*



And find crucial threads

**After**

- There was an org/system/product...
- One day... (something happened)
- Because of that....
- Until finally....
- And ever since....

*Good news: There are patterns, frameworks and tools!*



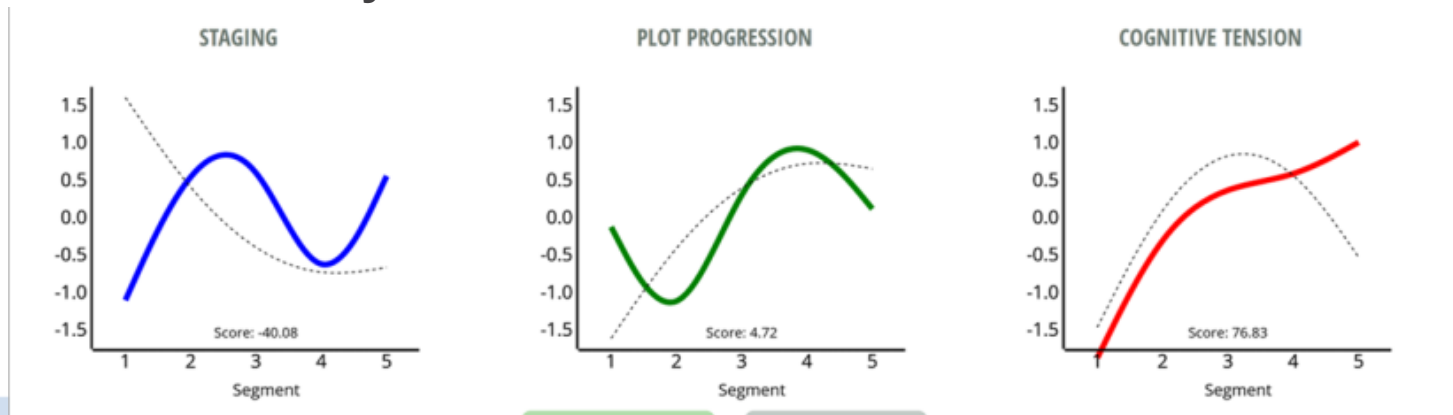
# Toolkit Faves



## Pixar Story Arc

- Once upon a time, there was (a business situation)
- One day, something happened....
- Because of that....
- Until finally....
- And ever since....

## Narrative Arc Analyzer



## Storytelling Drivers

Impact, Empathy, Alignment,  
Evidence, Engagement

## Patterns we tried

Pixar Story Arc  
And, But, Therefore  
Happy Accidents  
Reinventing the Future  
Aligning the Ecosystem

## Tools we tried

Narrative Arc  
Narrative Transport

*More in the Untold Content Toolkit!*

# An Aerospace Story

*(for organizations who have heard of Systems Engineering)*



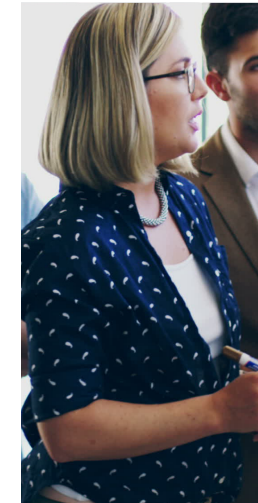
The Story: Small Aerospace Organization Optimistically Bids COTS integration Contract Without Systems Engineering and Realizes Kind of Late Why That Was a Mistake



Big Win, No SysE



Interface Problems



Use SysE Practices and Work Together

*The Big Idea: “Glue Code” means “Systems Engineering Is Required,” not Unnecessary*

# A Healthcare Story

(for orgs who say “Systems what????”)



The Story: Joining Business/Clinical & Technical voices to overcome digital disruption in market



Large Payer/  
Provider org,  
dominant in market



Digital Startup  
Erodes Business



“Let’s integrate their data”  
AND THEN  
“Let’s build our own”



Business-Technical Tension  
Org, Ops, Product Alignment  
Solution Launch (Prod/Svc/Workflow)  
Business-Technical Partners

*The Big Idea: Holistically engineered and aligned org, process, product systems accelerate interoperability, New Digital Ventures and an “IT with the Business” culture*



# A Story for Startups

*(for orgs who have no time for anything but mission and getting funding)*



## The Story:



***They had an idea  
for a new app***



An angel investor,  
gave them funding  
and a tight deadline  
for a working prototype



**Progress was too  
slow, and failure  
loomed**



**A Systems Engr  
helped them see a  
balanced systems  
view & manage risks**



**They completed  
the prototype on  
schedule and went  
on to success**

*The Big Idea: A balanced systems view enables effective use of scarce resources*

# An eCommerce Story

(for orgs who say “Systems what????”)



The Story: Innovative idea for a restaurant reservation system tests organizational silos and allows Systems Thinking to shine.



Innovative Idea



Organizational  
Silo Prevents  
Collaboration



Systems Thinking  
Brings Together  
Best Ideas



Feature  
Launch!



Systems Thinking  
Fully Incorporated

*The Big Idea: Looking across an organization for the best features to support a new and innovative idea allows faster time to market with fewer bugs.*



# An Automotive Story

*(another story for organizations who have heard of Systems Engineering)*

The Story: NewAir, an aircraft company, wins its first government contract to build navigation software for a semi-autonomous ground vehicle.



NewAir has an idea and wins a software contract.



They discover that requirements related to the environment weren't defined.



This puts the project behind schedule. They fear they will lose the contract.



A systems engineer joins the team, defines operational scenarios and environmental constraints, specifies requirements, and this saves the project.

The big idea: Systems engineers understand the big picture and are needed to define requirements, even for software projects (especially when ecosystems involved!)



# Our eBook

Audience\*: Digital Transformation Execs

- Those who make decisions and have “buying power”

Desired Action: Acquire, Hire, Leverage SysE

- Or at least ask us for more info....

Content

- Business Systems problems in today’s software- and data-centric world
- Intro to our stories: purpose and call to action
- Stories
- Your Next Step: Where to get more info
- Quick Refs and Resources



What do we mean by eBook?

- Book-like reading experience
- Embed video, audio
- Track usage, interaction
- (future) multi-path navigation\*
- (future) embedded surveys\*

*\*this is platform dependent. We will start simple*

\*A secondary audience is others like us who can influence others with stories, i.e., arm others with tools

# Our Ask



We are looking for

- “Early adopter” readers (who aren’t “us,” i.e., SysE)
- Contributors to our story library
- Executive CAB advocates

And Remember: Everything is a System!

- Systems Engineers and Thinkers hold keys to unlock persistent, scalable business and ecosystem value



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# References

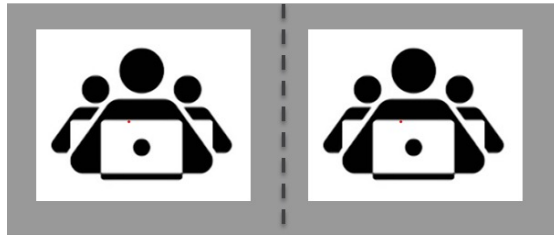
# A 2<sup>nd</sup> Automotive Story

*(another story for organizations who have heard of Systems Engineering)*

Story: Autonomous Vehicles Corp is experiencing increasing market demand for autonomous vehicles while experiencing mounting safety and cyber-security threats. Rapid software releases are paramount to meet the growing demand.



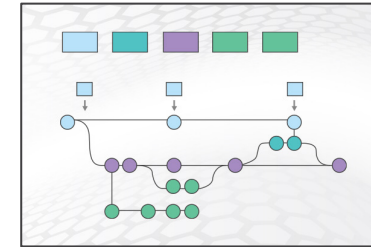
Increasing demand  
Increasing cyber-  
security threats



Systems Teams and  
Software Teams  
working in siloed  
environments



Major quality  
and safety  
failure



Digital thread with  
accurate, up-to-  
date system  
visibility



Built-in  
quality/safety  
Accelerate  
innovation

*The Big Idea: Digital threads providing visibility of current and accurate data enables agility and improves time to market*



# About the Authors



**Jeannine Sivi** is a business and technology strategist who recognizes undiscovered possibilities and spearheads paths of practical innovation, cutting through complexity and ambiguity to deliver value at speed, at scale. She is PointClickCare's Senior Director of Decision Analytics, serving seniors and healthcare organizations via point-of-care and business insights. She held prior leadership, product, and technical roles at SDLC Partners (Highmark), UPMC, Carnegie Mellon's Software Engineering Institute, and Kodak. She earned engineering degrees from Purdue and RIT, and Caltech's Technology & Innovation Management certificate. A Pittsburgh native, she enjoys its cultural diversity and has a longstanding passion for nature and animals.



**Dorothy McKinney**, an INCOSE Fellow, has over 45 years of aerospace and research experience, 34 of those at Lockheed Martin and heritage companies (including over 15 years as an adjunct professor at two universities during that time). Since retiring as Fellow Emeritus, she has started and closed a dot com start-up (ConsideredThoughtfully) and a systems engineering consulting firm (Advanced Systems Thinking). Earlier she worked at Stanford Research Institute and at ArgoSystems/Boeing. Her undergraduate degree is from Prescott College in English and Systems Sciences. She also has an MS in Computer Engineering from Stanford University and an MBA from Pepperdine University.



# About the Authors



**Sarah Sheard** is an INCOSE Fellow, CSEP, and Founder's Award winner. An INCOSE member since 1992, she chaired INCOSE's SaSIWG from 2017-2021 and has been a Journal Associate Editor for over 15 years. Her systems engineering publications include 4 INCOSE "Best Papers" and an INCOSE "Product of the Year." She retired in 2019 as a systems and software engineering researcher and consultant at CMU's Software Engineering Institute. She earned her 2012 Ph.D., which examined system development complexity, at the Stevens Institute of Technology. During the pandemic she added acrylic painting and piano playing hobbies to 50 years of folk dancing.



**Lauren Stolzar** has over 15 years' experience in systems engineering, software engineering, program management, proposal management, and technical leadership on software systems for a wide variety of organizations, ranging from ecommerce to defense. She specializes in leading geographically distributed, multi-organization teams in bringing complex systems to life. Lauren has led teams from early research experimentation, flight test, and deployment, in addition to working directly with the user community to understand existing needs. She holds a BS and M.S. in Computer Science from Worcester Polytechnic Institute and was initiated into INCOSE's Institute for Technical Leadership in 2020 as part of Cohort 4.



# About SaSIWG

The Systems and Software Interfaces Working Group





# SaSIWG Purpose and Mission

Increase the relevance of systems engineering in software- and data- intensive organizations and programs by

- improving mutual understanding of what each discipline does, and the value provided
- developing work products to address additional knowledge or capabilities for each discipline, how they work together, what they jointly design and build, and how to honor respective accountabilities
- focusing at the interfaces of systems and software engineering and related disciplines, where there are gaps, duplications, conflicts and missed opportunities (missed leverage and synergy) to drive value

**Charter Purpose Statement:** Understand, clarify and resolve issues with systems-software interfaces that challenge our ability to engineer today's and tomorrow's systems.

- These interfaces include physical, logical, data, and human aspects.

The Working Group (WG) was formed in response to the systems-software interface challenge identified as one of the top six needs of INCOSE's Corporate Advisory Board (CAB) members. A primary goal of the WG is to generate practical artifacts to be made available to INCOSE's Corporate Advisory Board (CAB) members.

The CAB has over 100 members, spanning 38+ nations with representation from industry, govt and academia. CAB members employ >200K systems engineers. See <https://www.incose.org/incose-member-resources/corporate-advisory-board>



# Operating Principles

*Current Prioritized Topics: (as of 10/14/21)  
Business Relevance, Data, Architecture*



- Enjoy the camaraderie and the work *(at the intersection of the Venn!)*
- We are volunteers. We set expectations accordingly.
  - Make steady progress at acceptable pace.
- Think big, bite off realistic pieces, make steady progress
  - Alignment to our vision is a strength of this working group
  - We explore new areas, and balance breadth & depth
- Identify top 1-3 priorities, for near-term time window
  - Get them done with high quality, move to next priorities
  - Gladly conduct as many addl activities in parallel, as group capacity permits
- Form follows function. Be Iterative. Flex as needed.
  - Content development may lead us to change format, channel or even type of work product or activity
- We are both a contributory and a learning community
  - Share expertise and collaborate for the greater good
  - Be self-challenging. Ok to think out loud (be raggedy). Ok to think offline.





# Overarching Goals

*Current Prioritized Topics: (as of 10/14/21)  
Business Relevance, Data, Architecture*

- Priorities selected
  - ✓ 3Q2022 and forward: Business Relevance, Data, Architecture
- Outcomes, Impact tbd
- Work Products & Activities
  - ✓ Publications: 2+ per year *(IS, other INCOSE channels; at least one non-INCOSE channel)*
  - BoK or other standards, references contributions: 1+ in the coming year
  - Cross-discipline collaborations: 1+ in the coming year
  - Community engagement, activation: # tbd *(webinars, meetups, non-INCOSE events, and other non-publication, non-BoK channels)*
- Learning
  - ✓ Book Clubs: 2 per year
  - Learning Session: monthly, starting when?
- Operations & Engagement
  - ✓ Continued active engagement: 7-10 active members per month; # delegate\* SMEs from other domains
    - Active members commit to 1+ activities/year (typ. ~4-6 hrs/month)
    - Multiple ways to participate: Monthly discussions, book club, publications, reviews, tech support, etc.
  - ✓ INCOSE events: IW, IS
  - Non-INCOSE events tbd
  - CAB Sponsor and Advocate

\*"Delegate" status is how INCOSE recognizes participation of SMEs from other disciplines who are not INCOSE members



# Ways to Engage

- Active workstreams and projects as of March 2022
  - Business Relevance: Vignettes & ebook - opportunities to assist with outreach, and to contribute additional stories
  - Data & Architecture: Roadmap of Just Do It and Other projects - ongoing opportunity to contribute, lead subteams, facilitate, and document
  - Book Club #4 (just started) - “Transdisciplinary Systems Engineering.” Participants welcome!
- WG Roles
  - Chair - Jeannine, Would like to have a co-chair
  - Tech Support - Bill
  - Learning & Enrichment - Sarah
  - Book Club #4 – Macaulay is facilitating
    - Facilitator role: Prep deck template, divide book into sections, line up presenters, remind them
    - Open opportunity to prepare a slideshare summary of past book clubs, as an outreach activity
  - Community Engagement (proposed role, open)
    - Help us stay on top of INCOSE events and Non-INCOSE events relevant to our mission and prioritized topics
  - Archivist (open role)



# Accomplishments List

## Current Priorities

- Business Relevance (3Q2021, WiP)
- Data + Architecture (3Q2021, WiP)

## Impact tbd

- Derivative Pubs, citations
  - Right to Left and Outside-In: Systems Engineer's Role in Software-Dominant Organizations of the 21st Century – Special Emphasis on Cyber Security and DoD" Ken Nidiffer, NDIA Systems and Mission Engineering Conf, 2021

## Work products & Activities

- Publications:
  - IS2018: INCOSE Working Group Addresses System & Software Interfaces (list of interfaces, types)
  - IS2019: What are Cyberphysical systems and What needs to change?
  - IS2020: Key Problems and Needs Survey Findings
  - IS2021: A Guide for Systems Engineers to Finding Your Role in 21st -Century Software-Dominant Organizations \*\*\*Best Paper\*\*\*
  - Insight July 2021 Theme Issue: 7 papers
  - IS2022: Business Relevance Vignettes
  - (WiP) Vignettes ebook, and addl pub channel tbd
- BoK contributions [future]
- Cross discipline collaboration
  - IEEE technical committee (WiP)
- Community Engagement, Activation
  - IW2021 Video

## Learning Sessions

- Book Clubs:
  - Systems Engineering of Software Enabled Systems,
  - The Unicorn Project,
  - Thinking Fast & Slow
  - (starts 4/21/22) Transdisciplinary Systems Engineering
- Speaker Series: Learn & Discuss (details tbd)

## Engagement

- Current member engagement: ~19 overall
  - WG monthly meetings: ~10
  - Book Club: ~5
  - Other activities (subteams, reviews, tech support): ~6
  - Delegate SMEs: 3
  - *Note: subteam counts are not mutually exclusive*
- INCOSE events
  - IS: 2018, ?2019 & 2020?, 2021
  - IW: 2020, 2021, 2022
- Other events [future]
- CAB Sponsor and Advocate [future]

## Awards

- Best Paper Award, IS2021
- Achieving the Systems Engineering Vision, 2021





# Vignettes: eBook Objectives, Audience, etc

Extracts from approved Technical Project Plan (TPP)

Our Business Relevance ebook is a collection of vignettes that demonstrate - through storytelling - the use of systems engineering principles and practices in a range of traditional and non-traditional systems settings, to address real business problems experienced by executives, technologists, designers, users and others.

It is in the context of

- SaSIWG mission
- Challenge areas\*\* of organizational context, business case, proactive business leadership and business adaptation.
- Years of attempts to engage our non-Systems counterparts not leading to desired engagement and close collaboration.
  - We have not sufficiently "engaged hearts"; We likely have not come across as walking in their shoes and understanding their journey

Our target readership:

- Digital transformation leadership (cross-discipline) in multiple sectors, who have decision authority to include SysEngr
- Systems Engineers needing new ways to communicate, engage and inspire others to engage and achieve value
  - by incorporating systems engineering in strategy, problem definition, and systems definition through retirement.

\*\*8 sets of challenge questions were posited in the July 2021 Theme Issue and have been used as a springboard for both this work product and our data+architecture work



# Data+Architecture Journey

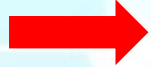
- Journey recap
  - Stemming from Book Club 3, IS2021 and Theme issue: key challenge questions, many ideas
  - Sept-Oct 2021: Data & Architecture prioritized from shortlisted topics, to supplement biz relevance
  - Nov-Dec 2021: presentations on ontology, roles
  - Jan 2022: deep dive workshops on 2 emergent themes, noted below
    - Objective: generate prioritized list of ideas, aligned to interface problems & value
    - Approach: *digital whiteboard collab sessions, "brainwriting / idea elaboration," reverse engineering the problem, affinity grouping*
    - Teams generated ~100 ideas & elaborations, distilled as shown on following slides
  - Feb 2022: short list (by elimination); simple eval and multivoting to create ver1 game plan
- Themes for Deep Dive Workshops (*aligned to 3 challenge question categories: Roles, Methods, Contexts*)
  - Architecture Ontology Matrix (or alternative) to synch systems and software architecture and activities, and to enable comprehensive tradeoff analysis by any role
  - Adaptive roles, their accountabilities and architecture/engineering principles
    - For data-intensive systems in particular
- Overall goal: create guidance that
  - Specifies, clarifies the interface issues within these themes and relative to these big challenges
  - Characterizes their changing nature (dynamic, like quicksand....)
  - Offers adaptable approaches, navigation, solutions (accelerators) for a range of scenarios
  - *Where said guidance is disseminated via multiple, consumable channels*



# Data+Architecture Priorities

where several selections are organizational in nature (not data or arch, per se)

We are  
here



## Just Do Its\*

- Org & Roles: Roles  
Relationship model
- Org & Roles: Cross training  
Gamification – buzzwords
- Org & Roles: Roles  
Title neutral roles/functions, incl new “consistency” role
- Org & Roles: Communications *(might go with process)*  
Venus/Mars communications booklet

## Projects\*

- Bridging Mechanisms: Tools  
Arch ontology pattern library
- Org & Roles: Org as system  
Beer Game alternative (simulation, incl Conway's)
- Bridging Mechanisms: Process  
Kickstart workshop
- Bridging Mechanisms: Architectures  
Case study for harmonized (sys/sw) architectures
- Data as Keystone: Awareness, training (maybe tools?)  
Patterns of data/arch for orgs



# Current Active Members (2021-22)

- Jeannine Sivi, Chair
- Sarah Sheard, Founding Chair
- Yann Argotti
- Mickael Bouyaud
- Leung Chim
- Rita Creel
- Todd Harless
- Patricia Lucey
- Dorothy McKinney
- Chandru Mirchandani
- Ken Nidiffer
- Macaulay Osaisai, Book Club Sherpa
- Bill Scheible
- Lauren Stolzar
- Suzette Johnson
- Rich Turner
- Stephanie White
- John Wood