INCOSE ENCHANTMENT CHAPTER

The Enchanted View

Thinking about Systems

2021 Quarter #2

In This Edition

President's Letter

Arno Granados

As we roll into Spring, my day job has me collecting basis of estimate data (BOE) to support project planning and a trio of definitized cost estimates (DCE). On weekends you will find me building out the interior of my "adventure van" (I gutted the stock interior to add cabinets, bed, fridge, solar power). Both "jobs" have me thinking about the return on investment (ROI) of Systems Engineering (SE).

To a Systems Engineer, the BOE/DCE work is obvious, the ROI question comes about when the rest of the team sees the SE costs: Requirements? Interface Control Documents? Change Control? "*This is an experiment; we don't need (to pay for) that level of rigor.*"

My van is something of an experiment, too. I've taken to calling it Van 3.0.

Van 0.0 was a VW Syncro that my ex-wife got in the divorce. Van 1.0 was a GMC Safari AWD that got a lift kit and transfer case swap (low-range 4WD). Van 1.0 was great except for two things: A) it had independent front suspension (IFS); the lift kit put the front axles at an angle that wasn't good for the CV Joints. B) it had a tight driver side footwell that was uncomfortable on road trips. Van 1.0 didn't get "built out" (as the #vanlife community says). Whenever I went adventuring, I just pulled out the bench seats and loaded in a cooler and camping gear.

Van 1.0 was sold to finance Van 2.0, a '98 Ford Quigley conversion 4x4. Van 2.0 was bigger, had better parts availability, and started life as a cargo van. Van 2.0 got wood floors and a built-in bed, but otherwise not much modification. The only bad thing about Van 2.0 was that it had lived in Wisconsin before I bought it (it was significantly cheaper than a similar rig in California or NM), which meant it had a bit of rust. I spent a few weekends last year replacing almost everything on the front-end: u-joints, ball joints, shocks, springs, torque arms, tie-rod ends… The preponderance of Midwest rust convinced me that Van 2.0 wasn't worth the *low cost* I'd paid for it.

Enter Van 3.0, a 2010 Ford E350 that has lived all its life in Arizona or New Mexico (no rust!). It was 2WD from the factory, but the first thing I budgeted for was to convert it to 4WD (note here that the 'shift' keyboard symbol above the "4" is a "$"…$WD). After my DIY experience with the (albeit rusty) Van 2.0, I did some "trade studies" and opted to pay a shop in Colorado to do the 4WD conversion for me (it was

worth every penny). I'm now in the process of "building-out" the interior. A fridge powered off 12V, auxiliary battery and solar, storage cabinets, bumper mounted spare/fuel/water. The li$t goes on.

Which brings me back to ROI. My #vanlife journey could be construed as an exercise in systems engineering. Requirements? Cost? Schedule? Integration and Test? Risk? It's a *systems* problem. I'd like to say that my systems skills and experience have made a big difference…I think they *have* made a difference, however a significant factor in my #vanlife is an emotional component. I assert that there is an emotional component to *any* human designed/used systems that impacts perceived ROI. Whether we're talking cars, weapon systems, or climate change. *ROI is a value proposition.*

Thanks for thinking,
Arno

P.S. If any of the automotive terms had you scratching your head, think about your audience (and page count) the next time your day job has you writing something laced with domain specific jargon.

Virtual Spring Social Event!

Mary Compton

Last September we proved we can socialize, meet social distancing guidelines, and still have fun. The Enchantment Chapter will do that again on May 6, 202, 5:30 pm – 7:00 pm. You can participate in the Enchantment Chapters spring virtual social event via Zoom by signing up via Eventbrite. The Zoom link will be sent to registered participants after 12:00 noon on May 6th. Around 5:30 settle in with a cocktail and play Kahoot! led by Raymond Wolfgang. Kahoot! is a game-based learning platform used as educational technology in schools and other educational institutions. Its learning games, "kahoots", are user-generated multiple-choice quizzes that can be accessed via a web browser or the Kahoot app. Be prepared for a lot of fun!

Note that a smartphone, web browser or other device is needed to play along.

You can find details on our website. We hope you can join us!

Human Factors Ergonomics Guidelines for Home Offices

Cheryl Bolstad

Due to the global pandemic many of us have been working from home for all or most of the year. If you did not have a home office last year, you have now probably carved out a place in your home with which to do your daily work. Many companies are offering ergonomics assessments, but if you do not have access to such an assessment, here is a list of top human factors ergonomic concerns and related fixes. These come from my other professional society, the Human Factors and Ergonomics Society (Davis, Benden, Dennerlein, & Robertson, 2020). Having recently passed the one-year anniversary of working from home for many of us, I thought it would be a good time to share them.

1) **Poor fit to chair including no lumbar support, non-adjustable, and no arm rests**

   FIX: Use a hard, small pillow between back and chair back, make sure you stand and/or walk around once every 30 minutes.

2) **Hard edge of table or counter where keyboard sits**
   FIX: Use a soft fabric cloth or pipe insulation on edge, position chair close to table edge so that arms can rest flat on table surface.

3) **Non-adjustable or seated only workstation**

FIX: Use objects around house to create a standing workstation like an ironing board, boxes or laundry basket on top of table or kitchen counter, make sure height of the top of the computer screen is slightly at or below eye level and between 20 - 40 inches away from you (e.g., eyes to screen about an arm's length).

4) **Glare from overhead lights or windows**
FIX: Position monitor away from window or at a right angle to window with sun glare to the back of the monitor, position monitor slightly behind the overhead light.

5) **Laptop on the lap results in head to be flexed forward**
FIX: Place a pillow or lap desk/tray under the laptop, (use a sturdy hard surface between the pillow and laptop to prevent monitor heat buildup and be sure cooling vent is not blocked by your solution).

6) **Long periods of inactivity, fixation and static postures causes discomfort and eye strain**
FIX: Move approximately every 30 minutes, varying seating posture, stand and walk–outside if available. Give eyes a break, focus on something 20 feet away for 20 seconds.

7) **Extended use of mouse will result in wrist and shoulder problems, especially if arm is extended away from body**
FIX: Use mouse in a position where arm is supported and not extended, take routine breaks (every 30 minutes), if long durations of mouse activity is required, use other hand.

8) **Small laptop keyboards and touch pads will result in poor wrist postures**

FIX: Purchase an ergonomic keyboard and mouse for the laptop and use the monitor on the laptop at a proper viewing height.

9) **Disruptions to managing a work/life balance**
FIX: Create boundaries for work and personal time, maintain a routine of work and non-work activities, and develop a time management schedule.

10) **Loss of connection and social isolation**
FIX: Create a sense of work and social community by connecting with co-workers for informal chats and sharing personal stories about working at home, connect daily with friends/family.

Davis, K., Benden, M., Dennerlein, J. & Robertson, M. (2020). Ergonomic Guidelines for Adult Home Offices. Human Factors and Ergonomics Society, Washington, D.C.

Agile and Systems Engineering

Ann Hodges

Are you on a project team using agile practices and struggle to figure out how to weave in systems engineering (SE) practices and artifacts in a short sprint? Are you told "*we don't have time for that <fill in the blank> in this sprint, let's write a user story for that in a later user story/program increment/epic*"? I'm most familiar with SAFe®, and there's SE types of roles hinted at in the training I received (version 4.0): System Architect/Engineer in the Program level (Agile Release Train [team of Agile teams] starts to emerge here), System Team in the Value Stream level, and Enterprise Architect in the Portfolio level. The Agile coach on the team I'm supporting recommended a relatively short video on agile and SE (Peter Lucky [321 Gang] *MBSE and SAFe® for Systems Engineers*). Some of the highlights I think are useful to consider in the journey to incorporate SE into agile include:

- An "architectural runway" should be defined before the first program increment and consists of an analysis model based on
- Stakeholder needs (e.g., SysML use case diagram, followed by behavioral flow [activity

- diagram, sequence diagram]). Use SE workshops to refine architecture and design along the way.
- Features in a program increment are verified minimally with respect to their acceptance criteria and acceptance criteria in user stories.
- SEs should be involved in program increment planning, based on the evolving architectural runway.
- Given a choice of embedding SEs (single SE team, embedded with each agile team, or hybrid/combination), Peter recommended the hybrid approach.

I think this is a topic ripe for further exploration so look for a Chapter talk on this subject.

Not for Women Only

Heidi Hahn

In a December 2020 article titled 'Factories and families' *The Economist* notes that from the 1600's until the mid-19th century most work was conducted in people's homes rather than in factories. Workers acted as independent contractors. They would gather raw materials from a central location, make the goods, return the finished products, and be paid for the pieces they had produced (hence the term "piece-work").

In the piece-work system, those who owned the raw materials and equipment had enormous power over the workers. This resulted in lower pay and the use of other exploitative practices that would not be present in the factory system that came about with the Industrial Revolution in the late 17- and early 1800s.

In the factory system, workers had more leverage to demand higher pay, especially as unionization grew from the 1850s on. But, the piece-work system had advantages not enjoyed by factory workers. Home-workers were not limited to working for only one employer; they could earn income from multiple tasks, depending on where money was to be made. Because employers expected goods to be produced to a certain standard and to be delivered on time, but did not control when or how the work was done, these workers also had more control over their time and could set their own balance of work and leisure. This system was particularly beneficial to women, who could combine household duties, including those related to child-rearing, with contributing to the family income.

The article's authors cite German sociologist Max Weber who claimed that the shift from home-based work to factories had far-reaching consequences in that workers had less control over their lives. They argue that the pandemic-caused shift to home-based telework could have similarly far-reaching effects. This article makes me wonder if allowing professional women to telework far earlier than at the outset of COVID-19 would have helped ease the salary inequities attributable to disparate responsibilities for household chores and taking care of children between men and women with similar educational backgrounds performing similar jobs. It also makes me wonder whether, if telework persists into the post-pandemic future as the norm, there will be a gradual but salutary effect on salary equity. That would make a fascinating study!

INCOSE Technical Leadership Institute (TLI)

Raymond Wolfgang

Ever want to go more in depth – with how leadership and systems engineering interact? As your representative in the INCOSE Technical Leadership Institute (TLI) Cohort 6, I'm finding out – and quickly! We as a cohort, using Zoom and MS Teams – first created a shared model of leadership development. After presenting this to the

coaches, the content moved to the theory of constraints and emergence. Future themes on how disruption and change affect how we lead are in the works, as is work around how we *learn* to lead.

Our current assignment (one major one per quarter) involves merging how constraints on our lives (professional and personal) drive emergence in programs and our own abilities. With the first of two years of the TLI entering its fourth quarter, we have delved into not just leadership, but the theory of leadership from a systems perspective. Even the pandemic, with the drive to remote work acting as a constraint, has birthed a new way to do business for most of us; this itself is a type of emergence. This led to cohort-sponsored seminars such as "Technical Leadership in Disruptive Times" and "Technical Leadership of Virtual and Remotely Distributed Teams."

One of the best parts of the program, is not only the networking within Cohort 6, but also the interaction between all the cohorts from the beginning – over 80 engineers in all. Finally, we are blending in current events into our recent work – addressing diversity and inclusion from a systems perspective of constraints (i.e. my own personal thinking) and emergence – broadening my own understanding from hearing other members' stories. While perhaps not engineering per se, issues of workplace inclusion and fairness come into play in our organizations and affect not only the quality of our work, but quality of life. It has overall, been an intense experience – and a learning journey. I can't wait for year two!

Recent Chapter Meetings

Ann Hodges

January 2021

David Long, founder and president of Vitech, INCOSE Fellow and Expert Systems Engineering Professional (ESEP), and 2014/2015 INCOSE president, presented "Schema and Metamodels and Ontologies – Oh My!". Over the last five years, there has been a growing fascination with conceptual data models, metamodels, and ontologies in systems engineering. What began as a murmur – something living largely at the fringes of systems engineering and MBSE – has grown as many projects and practitioners delve into these topics. So what are these concepts? What differentiates them, and more importantly, why should I care? How do I properly leverage these ideas to advance my projects and my enterprise? As organizations apply model-based systems engineering, managing information in a computer model requires a defined data structure. Combined with the ease of modern ontology editors such as OWL or capabilities embedded in many tools, practitioners have begun to develop their own conceptual data models and ontologies. As systems engineers experiment and leverage these capabilities, they cross into the area of language design, often developing custom languages for their projects without the greater depth or consideration necessary to connect enterprise practices. There is a fundamental information model that underpins systems engineering. This information model characterizes the knowledge we must elicit, develop, analyze, and manage to successfully engineer systems. It lives implicitly in the process standards that guide our practice, the data item descriptions that define our artifacts, and the representations we use.

February 2021

Dr. Gan Wang, an INCOSE Fellow, ESEP, a Global Engineering Fellow at BAE Systems and the Chief Engineer for its Integrated Defense Solutions, presented "Implementing a Model-Based, Digital

Engineering Enterprise for a Defense Systems Integrator – An Ongoing Journey". As the aerospace and defense industry strives to embrace digital engineering transformation, organizations quickly realize that this transformation is much more than just tools or infrastructure. It requires comprehensive change that involves people, process, and technology, and that calls for organizational strategy and stakeholder commitment. This paper provides an overview of an on-going corporate initiative to develop an enterprise-wide, model-based systems engineering (MBSE) and model-based engineering (MBE) capabilities and to instantiate a transformation of legacy workforce and culture. Our vision is to apply digital engineering (DE) as an enabler to transform legacy, document-based development stovepipes into a product-centric, integrated, digital engineering enterprise. At the implementation level, however, it involves a multipronged investment strategy in technology, infrastructure, process, and people, as well as an incremental process of learning and experiments. This presentation laid out the architectural vision, implementation approach, and the business rationales. It also reflected on the journey to date, discussing some of the early successes, hurdles and challenges in implementing the digital engineering initiative for a diverse defense services business.

March 2021

Dr. Ron Carson, an Adjunct Professor of Engineering at Seattle Pacific University, an Affiliate Assistant Professor in Industrial and Systems Engineering at the University of Washington, an INCOSE Fellow and ESEP, and retired Technical Fellow in Systems Engineering from The Boeing Company, presented "Perspectives on the Boeing 737MAX Maneuvering Characteristics Augmentation System (MCAS)". Using publicly available news articles and reports he examined the system design and characteristics of the Boeing 737MAX MCAS (Maneuvering Characteristics Augmentation System) in the context of two fatal crashes in 2018 and 2019. The rationale for the system was explained. The system architecture and operational characteristics were described. Hazard severity classification is examined, along with the required reliability per the regulations. The role of the pilots in compensating for failure was highlighted. The regulatory and business environments were also discussed as contributors. He described how assumptions regarding pilot responses were apparently not validated, and contributed to the fatal crashes of the two airplanes. The human factors implications for automation, training, simulators and manuals were described. Ongoing modifications to the 737MAX, organizational design, and regulations were described. The attendees received an overview of the MCAS including rationale, architecture, and operations during normal and failure conditions, and some consequences of the program and system design assumptions and implementation. Specific implications for the role of systems engineering were discussed.

April 2021

Raymond Wolfgang currently works as a Systems Engineer on several programs at Sandia National Laboratories and is also a member of the INCOSE Requirements Working Group (RWG), among many other accomplishments. He introduced the community to the INCOSE Guide to Verification and Validation, a work-in-progress of the INCOSE RWG. The context of the Guide with respect to the other RWG documents under development was shared. These other documents are the forthcoming Guide to Managing Requirements (GMR), and the Needs and Requirements Lifecycle Manual (NRLM). A very top-level table of contents of the Guide to V&V was presented, along with a timeframe for completion and release. The attendees left with an understanding of what documents are in-process from the RWG, how they will eventually all fit together, and an approximate timeline for their release to the INCOSE community.

Upcoming Events

Ann Hodges

May 12, 2021: Dr. Cheryl Bolstad, Principal Systems Research and Analysis Engineer for the Applied Cognitive Science department at Sandia National Laboratories, will present "Human Systems Integration and Its Role in Systems Engineering".

June 9, 2021: Paul Davies, with a total of over 40 years in systems engineering in defense and aerospace, nuclear, and rail industries, will present "Interface Management, The Neglected Orphan of Systems Engineering".

July 14, 2021: Dave Peercy will present Education as a System of Systems.

August 11, 2021: Pat Foley is a highly experienced project controls data specialist who has built and supervised the deployment of complex project data management platforms. His business and technical qualifications span more than 30 years. He will present WBS Integration with an Effective Schedule.

Membership

Robin Reynolds

Please welcome the following new members to our Chapter! The Enchantment Chapter currently has 104 members. INCOSE has over 18,000 members in 70 countries worldwide.

Chase Burgett
John Fritts
Brandon Klein
Gerald Carmody

PMIRGC Partnership

Our Chapter partners with the Project Management Institute Rio Grande Chapter (PMIRGC). As an INCOSE Enchantment Chapter member, you may attend PMIRGC events for their member price. Visit the **PMIRGC website** for event information.

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The Enchanted View
is published quarterly by the INCOSE Enchantment Chapter (New Mexico & El Paso). Published material does not necessarily reflect the views or opinions of INCOSE, the Enchantment Chapter Board of Directors, or the Editor, Robin Reynolds.

Call or email your news, reviews, announcements, or other contributions and suggestions to the chapter Secretary: Ann Hodges, alhodge@sandia.gov .