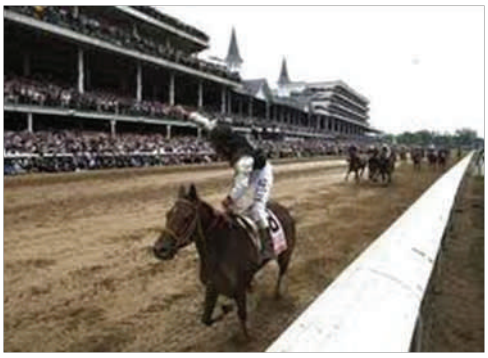
The Enchanted View
— Thinking About Systems —

Published quarterly and sent to all INCOSE Enchantment Chapter members. 2014 Q2
Visit our website at www.incose.org/enchantment

Measuring Performance

Ann Hodges, Chapter President, Sandia National Labs



I have always loved horses, and was delighted when the movie about Mine That Bird, New Mexico's own 2009 Kentucky Derby rock star, was recently released. The picture I've included from Google Images shows the huge lead that Mine That Bird had at the finish line. As I was watching the movie, I compared how Chip Woolley, the trainer, factored in Bird's past performance, characteristics that led him to "believe in" Bird's potential and "heart." Metrics such as speed in various conditions (wet, dry) are obvious, but other characteristics such as Bird's mischievous nature and "having a mind of his own" were what initially struck Chip. Chip also understood how Bird needed to feel challenged to perform at his top potential

One of the challenges that we as systems engineers face is measuring technical performance. Some of the more obvious measures come from the verification and validation activities: how many problems were found; what kinds of problems (e.g., requirements, architecture, interface); where they were found; how early/late they were found ("phase escapes"); and other such. With DOD customers, I have dealt with customer-level "measures of effectiveness" and system-level "measures of performance," but what really helped my understanding of the architecture of these measures was an INCOSE paper (Technical Measurement Guide, INCOSE-TP-2003-020-01) that I wanted to share with you, which is available at this location: www.incose.org/ProductsPubs/pdf/TechMeasurementGuide_2005-1227.pdf.

The paper has a wonderful discussion of the architecture of various types of measures and metrics (see Figure 1-1). What I found particularly helpful is the set of candidate technical measures (see page 50+) and suggestions for tracking the measures over time. During a conversation I had with Garry Roedler, one of the co-authors of the paper (an INCOSE Fellow and Lockheed Martin Fellow), he cautioned about going overboard on identifying measures, and said the goal should be to seek a manageable set of measures that provide enough insight into progress and technical risks. In my experience, it is particularly prudent to have crystal clarity on the key performance parameters (KPPs) and track the system's performance on those measures. These KPPs are typically go/no-go criteria for the system.

Like Chip, if we can better characterize the current anticipated performance during system development, we can adapt and adjust development as needed to mitigate problems and have better assurance of crossing the finish line successfully. ∞

March Double-Header Tutorial a Resounding Success

Ann Hodges, Chapter President, Sandia National Labs

The Enchantment Chapter offered a tutorial double feature in March, taught by Dr. Scott Workinger: Tutorial #1 Introduction to Systems Engineering on March 14 and Tutorial #2 Introduction to Transformational Systems Engineering the following day. I participated in both tutorials. Here is what the participants thought.

Tutorial	Intro to Systems Engineering	Intro to Transformational System Engineering
Participants	34	36
Overall Quality	4.3 / 4.0	4.3 / 4.0 (Mean/Median out of 5)
Aggregate Content	4.2 / 4.2	4.2 / 4.1 (Mean/Median out of 5)
Aggregate Instructor	4.6 / 4.7	4.7 / 5.0 (Mean/Median out of 5)

In the Intro to Systems Engineering, Scott presented fundamentals of classical SE and key issues that SEs face:

- A Concept of Operations outline – highlights included operational scenarios which should describe how the system will be operated within and at the edge; summary of impacts (the big "so what"), analysis (including tradeoffs, that can help determine potential architectures).
- Empathizing with your stakeholders is crucial to developing the set of needs and requirements.
- Key performance parameters (KPPs) are aspects your clients really care about. Scott presented a simple objective function that models the overall value of the set of KPPs, each of which are weighted with the sum of the weights adding to 1. This facilitates the discussion on ranking the KPPs.
- An R&D project has requirements that are focused on the goal of "gaining knowledge." Look for statements like "determine whether the technology can …" as potential requirements statements.
- Technical performance measures (see the "President's Message") e.g., customer-level measures of effectiveness or system-level measures of performance (including KPPs) can/should facilitate analyzing trade studies.

(continued bottom of page 2)

From the Conference on Systems Engineering Research

Mary Compton, Sandia National Labs

The 12th annual CSER conference, an international event, was held March 2**1-22,** 2014, jointly sponsored by the University of Southern California in collaboration with Stevens Institute of Technology and the International Council on Systems Engineering (INCOSE) LA Chapter. Attendance topped 225, a record for CSER.

CSER provides practitioners and researchers in academia, industry, and government a common platform to present, discuss, and influence systems engineering research, with access to forward-looking research. Systems Engineering is undergoing an exciting transformation to meet the challenges posed by complex systems in the 21st century. The development of affordable, adaptable and resilient systems is at the heart of this transformation. In keeping with this direction, the theme of CSER 2014 was "Engineered Resilient Systems: Challenges and Opportunities in the 21st Century."

The conference offered keynote addresses by four prominent speakers. My favorite was the first keynote given by Dr. Wanda Austin, President and CEO of the Aerospace Corporation. I thoroughly enjoyed Dr. Austin's address because it spoke directly to the conference theme. Dr. Austin's talked centered on the balance between resilience and affordability. Resilience and affordability is not a tradeoff; the challenge is to be resilient in an affordable way. She stressed that today's systems need to be designed for the unknown unknowns, thus adding a new dimension to creating requirements and specifications for these systems.

Over 100 participants presented original research papers on a variety of topics arranged into breakout sessions related to the conference theme, including: Systems Thinking, Model Based Systems Engineering, Resilient Systems Methods, Resilient Systems Applications, Cyber Security Systems Engineering, Lean and Agile Systems Engineering, Cognitive Engineering and Human-Systems Integration, Systems Architecting and Tradespace Analysis, Uncertainty and Complexity Management in Complex Systems, Next Generation Systems Engineering, Tradespace Optimization, Systems Engineering Applications, Advancing Systems Engineering Education, Systems Engineering Core Concepts, and Early Stage Design Concepts and Economic Value of Ilities.

I went to CSER hoping to get new ideas for a project I am to begin soon. I was not disappointed. I'll be visiting the CSER 2014 website (http://www.incose-la.org/events/conferences/cser-2014-welcome.html) to obtain copies of papers from the conference proceedings, which are open access, and the copies of presentations, which will soon be available for download. CSER 2015 will be hosted by the Stevens Institute of Technology in Hoboken, NJ.

∞

Bob Malins Helps Student Member Attend CSER

A UTEP student chapter member, Sergio Luna, had a presentation accepted for the March 2014 Conference on Systems Engineering Research (CSER), but attendance expenses were an issue. Bob Malins, from Sandia Labs, won a CSER registration door prize at IW14, and offered it to the Enchantment Chapter membership. Sergio and Bob connected on this to good ends, with Sergio saying afterwards: "Thanks to this gift, I was able to present my poster at CSER 2014. It was a great experience! I am [now] a PhD student in Systems Engineering at Stevens Institute of Technology." Bob smiles on the right. ∞

Tutorial a Resounding Success (continued from page 1)

In the Intro to Transformational Systems Engineering, highlights included:

- Although the classical approach to systems engineering has been successfully applied, the pace of change and growing complexity is forcing shifts in how systems engineering should be practiced. Scott presented some innovations and integrated them with classical systems engineering: agile systems engineering, model-based systems engineering, systems of systems engineering, "design thinking," and transformational thinking.
- Some basic principles of transformational systems engineering include 1) providing "enough" structure to empower innovators, avoiding significant constraints, and seeking agility (try to minimize cost of change); 2) embracing necessary change – design for emergence.
- Some useful pieces of the transformational systems engineering framework include agile systems engineering architectural patterns in 5 layers: 1) "platforms" for overall structure of projects which includes classical SE, design thinking, SoS engineering and agile development; 2) major SE practices that support level 1 platforms, and provide "plug ins" e.g., model based SE, human system interface, test engineering; 3) lower level SE patterns, e.g., use case analysis, requirements traceability/verification matrix; 4) discipline engineering practices that implement platform needs e.g., software engineering, mechanical engineering, Rational Unified Process; and 5) infrastructure that span the 5 facets of aggregates analysis (activity, form, values, discernment, consciousness) relevant for analyzing practices and environments.

A good turnout, 34 and 36 attendees, and great after-action reviews. Students said they liked the examples and particularly liked the opportunity to discuss issues and problems that had arisen in their work. Maybe we should do these again, in a two-day-each format with exercises, as Scott and students would have preferred? ∞

Recent Meetings

Jennifer Turgeon, Sandia National Labs

January 2014—Jack Ring, an INCOSE Fellow and Systemist for Educe LLC, provided us with a presentation on *Science and Engineering Cycles in Initializing Complex Adaptive Systems.* The generic challenges of understanding complex adaptive systems were demystified through a discussion on the interplay of science and engineering.

Then the distinctions of initializing system adaptivity were described through Jack's discussion on the stages of how we cope with complexity by using "rulesets" to qualify meaningful compositions of unrecognizable patterns. Slides and a full recording are posted on the Enchantment Chapter website.

February 2014—Chris Wood, Vice President for Administration at the Santa Fe Institute, shared a presentation on *What Kind of Computer is the Brain?* Chris's presentation addressed the questions "Does the brain compute?" and "If so, what and how?" He explained that the theory of computation is usually expressed as abstractions that are independent of any particular physical realization. However, once an abstract computation is actually implemented it becomes a physical phenomenon, and the physical substrate, silicon or brain tissue for example, matters tremendously. He focused in particular on the question of whether "computational primitives" exist for the brain that are analogous to binary arithmetic and Boolean algebra, in our computers. Slides are posted on the Enchantment Chapter website.

March 2014—Tyson Browning, Associate Professor of Operations Management at Texas Christian University, spoke on *Simulating Adaptive Project Management*. The landscape between the start and end of a project is often dynamic, uncertain, and ambiguous.

Tyson's talk explored a product development process modeled as a complex adaptive system. Rather than prespecifying which activities will be done and when, he set up a "primordial soup" of activities and simple rules through which the activities can self-organize. Instead of attempting to prescribe an optimal process, he explained that it is better to simulate thousands of adaptive cases and let the highest-value process emerge. Slides and a full recording are posted on the Enchantment Chapter website. ∞

Next Meetings

Jennifer Turgeon, Sandia National Labs

April 9: Evolving T&E in the FAA, John Frederick

John Frederick, Manager, V&V, FAA NextGen and Operations Planning Services.

Abstract: The movement to the next generation of aviation is being enabled by a shift to smarter, satellite-based and digital technologies and new procedures that combine to make air travel more convenient, predictable and environmentally friendly. NextGen enables the sharing of real-time data about weather, the location of aircraft and vehicles, and conditions throughout the National Airspace System. This briefing will discuss: 1) National Airspace System (NAS) operational views and evolving challenges, 2) improving T&E with people, process, and tools, 3) optimizing the T&E approach, and 4) where do we need to focus for V&V and T&E?

May 14: An Overview of Pattern-Based Systems Engineering (PBSE): Leveraging MBSE Techniques

Bill Schindel, president of ICTT System Sciences, and Troy Peterson, Booz Allen Fellow.

Abstract: This tutorial is a practitioner's brief overview of Pattern-Based Systems Engineering (PBSE), including some specific system domain illustrations. INCOSE thought leaders have discussed the need to address 10:1 more complex systems with 10:1 reduction in effort, using people from a 10:1 larger community than the "systems expert" group INCOSE currently reaches. Through the PBSE Challenge Team of the INCOSE/OMG MBSE Initiative, the team aims to enable INCOSE membership, and the larger systems community beyond INCOSE, to achieve such order-of-magnitude improvements. PBSE leverages the power of Model-Based Systems Engineering (MBSE) to rapidly deliver benefits to a larger community. Projects using PBSE get a "learning curve jumpstart" from an existing Pattern, gaining the advantages of its content, and improve that pattern with what they learn, for future users. The major aspects of PBSE have been defined and practiced some years across a number of enterprises and domains, but with only limited INCOSE community awareness, through IS tutorials, followed by start-up of the PBSE Challenge Team at the IW2014 LA meeting in January.

June 11: Secure Engineering Assurance Model™

Dawn Beyer, Ph.D and Lockheed Fellow, and Perri Najib, Lockheed Sr. Fellow.

Abstract: This presentation discusses the Lockheed Martin Security Engineering Assurance Model™ (SEAM™), created to "seam" together people, process, tools, threat intelligence, communication and collaboration throughout an engineering lifecycle to reduce cyber security risk. It is in response to the agile nature of the growing cyber threat, which demands cyber security engineering with core agility-enabling concepts, such as learning loops, be in place. The concept of constant learning through identification and exploitation of feedback loops across a systems lifecycle is key for success when dealing with the rapidly changing and complex cyber environment. The unique focus of SEAM™ is to ensure that engineers, developers, program and capture managers, and operations personnel can understand their role, responsibilities, and contributions to the logical, physical, and administrative security posture of their proposal, development, operations, and retirement efforts. SEAM™ provides the roadmap for leveraging Lockheed Martin's best practices, tools, and subject matter experts for users to effectively and efficiently integrate security engineering into system engineering solutions. At Lockheed Martin this assurance model is underway and being implemented. A further discussion needs to continue within the system engineering community on addressing security challenges we all currently face on programs, and how agile system engineering must also incorporate and take ownership of agile system security engineering. ∞

Student Chapter at Work

Eric Smith, University of Texas El Paso

Here is an update on three student projects in process.

Miner Recycling System: Juan Carlos Armenta, Pedro Diaz, and EE Senior Design Team: Michael Armendariz, Joshua Mendoza, Ricardo Messina.

The primary objective of this project is to design a dependable recycling system using the systems engineering approach, which will go in hand with an environmental educational campaign for students, maintenance staff and facilities services.

Based on current surveys, a smart solid waste management system will provide for a more sustainable campus, increase Green Recovery education, act as a potential revenue stream and deliver significant savings to UTEP's current operating costs. Current expected goals are to increase UTEP's recycling rate to 30% and reduce current waste operating costs.

By incorporating a three-step process consisting of Collaboration, Sustainability and Growth, along with the development of a sustainable system, the preliminary project will provide the tools for the implementation of a self-sustainable Miner Recycling System and solid waste management throughout the campus.

Bike Share System: Edmundo Casas, Lidia Zamarron, Ramya Peri and EE Senior Design Team: Ricardo Barreto, Jose Gaspar, Mario Renteria, and Mario Rojas.

The primary objective is to implement a bike share system for UTEP that has many bikes in strategically located places for the UTEP community to use efficiently. This system will also help in the reduction of carbon emissions.

The Bike Share System shall be implemented and managed by UTEP to satisfy and tailor the system toward the UTEP community needs. After implementation, the bulk of the system management shall be through a student-driven business entity within campus.

Busing for Miners: David Herrera and Luis Hernandez.

The primary objective for this study will be to develop an efficient busing system for the UTEP student community. This system will meet the requirements of the UTEP student community, City of El Paso, Sun Metro, SGA, UTEP Engineering, and the Green Fund Committee, in order to attain high user satisfaction and usage. A wide-area dedicated bus system will be beneficial in the reduction of emissions gases from student-driven vehicles, will prove to be cost effective to students when compared to the cost of commuting and individual vehicle ownership, and will result in furthering the exposure of UTEP growing its infrastructure toward Tier 1 status.

∞

Group Picture: Biking - Recycling - Busing Team Members

IMSE Day at UTEP April 24

On April 24th, the Industrial, Manufacturing & Systems Engineering (IMSE) Department at the University of Texas at El Paso will hold its 6th annual "IMSE Day"—newly renamed (from "SE Day") to reflect the integrated nature of the three research fields of the department. The organizational effort is being provided by the student members of the Student Division of the Enchantment Chapter of INCOSE and by the members of the Institute of Industrial Engineering (IIE) student chapter.

The preliminary agenda includes speakers from General Dynamics, Engility, Army Research Labs, and Ajou University in South Korea.

This 2014 conference is coincident with the Centennial Celebration of UTEP, and so the conference name is "Engineering the Future: The Next 100 Years." UTEP opened in 1914 as the State School of Mines and Metallurgy, but has since become a full-spectrum university.

In addition, the symposium is combined with a Department of Education sponsored Green Energy Manufacturing Leadership Workshop, which occurs on April 24th and 25th, and will feature teachers from Arizona State University, Drexel University, the NIST-sponsored Texas Manufacturing Assistance Center, and UTEP. Topics will include: Innovation, Ethics, and Leadership.

The impetus for gatherings is to increase awareness of the wonders of engineering, and to promote the study and application of systems engineering, industrial engineering and manufacturing engineering in shaping the world of the future.

∞

43 Working Groups For Your Interests

All Working Groups (WG) to the right have linked Charters. WGs with web sites have a web-site link as well. The Point of Contact is someone from the chapter familiar with WG activities, and will discuss the WG and connect you with the appropriate people should you wish to be an observer or a participant. Or you can make contact directly through the WG's web site.

Working Groups generally have a workshop during the January International Workshop (IW). Many WG's have Global-Meet presentation events throughout the year, and most have project activity that goes on among project teams with teleconferences and web-enabled remote collaboration during the year.

Most WGs accept passive members, those not ready to participate actively but interested in following WG activities.

The Complex Systems WG, for instance, has a series of recorded webinars on their web site, as do many other WGs. The Natural Systems WG has a monthly webinar open to anyone interested.

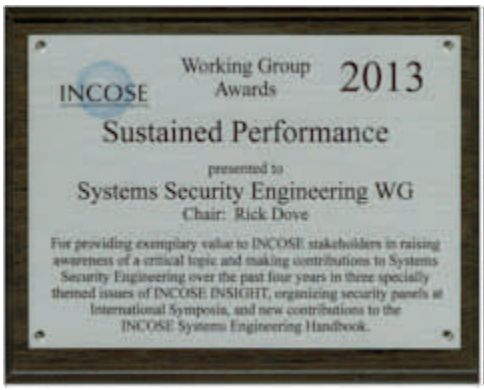
If you haven't attended any WG meetings at one of the IWs, you should feel comfortable in doing so. Workshops activities vary, with mixtures of round-the-room discussion, presentations, break-out sessions, project planning and work, project updates, symposia on topics, and more.

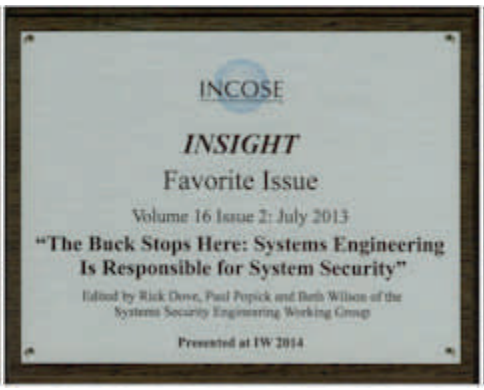
The INCOSE page for Working Group direct contact is at:
www.incose.org/about/organization/ti.aspx

∞

Working Group	Chapter Point Of Contact
Affordability - Charter - Website	
Agile Systems and Systems Engineering - Charter	Rick Dove, dove@parshift.com
Anti-terrorism International - Charter	
Architecture - Charter	
Autonomous Systems Test & Evaluation - Charter	
Biomedical - Charter	
Competency - Charter	Heidi Hahn, goldhahn@concentric.net
Complex Systems - Charter	
Cost Engineering - Charter	
Decision Analysis - Charter	Jeni Turgeon, jturgeo@sandia.gov
Defense Systems - Charter	
Global Earth Observation Sys of Sys - Charter	
Human Systems Integration - Charter	
Infrastructure - Charter	
In-Service Systems - Charter	
Intelligent Enterprises - Charter	
Knowledge Management - Charter	
Lean Systems Engineering - Charter	
Life Cycle Management - Charter	
Measurement - Charter	
Model-based Conceptual Design - Charter	
Motor Sports (education) - Charter	
Natural Systems - Charter	
Net-centric Operations - Charter	
Object-Oriented SE Method - Charter	
Power & Energy Systems - Charter	
Process Improvement - Charter	Ann Hodges, alhodge@sandia.gov
Reliability Engineering - Charter	
Requirements - Charter	
Resilient Systems - Charter	
Risk Management - Charter	Jeni Turgeon, jturgeo@sandia.gov
Space Systems - Charter	
Systems Engineering Effectiveness - Charter	Ann Hodges, alhodge@sandia.gov
System Engineering in VSME - Charter - Website	
System of Systems - Charter	
System Safety Integration - Charter	
Systems Science - Charter	
Systems Security Engineering - Charter	Rick Dove, dove@parshift.com
Tools Database - Charter	
Tools Integration & Interoperability - Charter	
Transportation - Charter	
Training - Charter	
Verification & Validation - Charter	

IW14 Awards For Security WG Projects





Resources

From TEDx – Is there an equation for intelligence? Alex Wissner-Gross Says yes: F = T ∇ Sτ, intelligence is a force, F, that acts so as to maximize future freedom of action, or keep options open, with some strength T, with the diversity of possible accessible futures, S, up to some future time horizon, tau. In short, intelligence doesn't like to get trapped. He shows a video that demonstrates some of the amazing applications of just this single equation. He explains intelligence in terms of causal entropic forces. Don't scoff. Watch: www.ted.com/talks/alex_wissner_gross_a_new_equation_for_intelligence.

From way out there – A pair of Swedish women have developed a remarkable solution to head protection when riding a bike: the invisible bike helmet. Tired of strapping ugly, uncomfortable turtle shells to their heads, the pair came up with a revolutionary solution that does manage to give you full head protection without wearing anything on your head. Once you see how it works it all makes sense, and is a very clever solution that draws from a number of technologies that are well-established and familiar. Watch: http://autos.yahoo.com/news/swedes-develop-invisible-bike-helmet-184635653.htm.

From TEDx – Animal behavior isn't complicated, but it is complex. Nicolas Perony studies how individual animals — be they Scottish Terriers, bats or meerkats — follow simple rules that, collectively, create larger patterns of behavior. It shows how this complexity born of simplicity can help them adapt to new circumstances, as they arise. Perony studies spacial data to see patterns. He then tries to ascertain the simple rules that individuals seem to be following that result in the larger flow. Watch: www.ted.com/talks/nicolas_perony_puppies_now_that_i_ve_got_your_attention_complexity_theory. ∞

New Chapter Members

Francis Peter, Management Sciences

Enchantment Chapter now has 93 active members including 4 Senior Members. We would like to welcome the following new INCOSE members to Enchantment Chapter :

Paul Adamson	USAF
Albert Eras	Sandia National Labs
Cindi Reyes	Sandia National Labs

The Enchantment sponsored Student Chapter of the University of Texas at El Paso currently has 10 active members. No new members were added in the first quarter. ∞

Connect to Your Community of Practice

Chapter meetings with a focus on systems engineering are held monthly on the second Wednesday, except in December. The December meeting is an annual social event, with mingling, dinner, and a speaker chosen for enjoyment by systems engineers and guests alike.

Monthly meetings feature speakers from out-of-town as well as local (more or less) subject matter experts on topics of relevance.

On occasion special facility tours are arranged, sometimes as the monthly meeting, and other times on a separate schedule.

Chapter meetings begin at 4:45 pm. After chapter news, announcements and introductions, the presentation and discussion generally lasts until 6:00 pm, carried on GlobalMeet for anybody to access who can't attend in person.

Tutorials with coverage on topics of interest are arranged approximately twice a year. Delivered by experts in the field, tutorials range from 1/2 day to day+ durations, and generally involve a tuition.

Mix with people who have the same professional interests as you do, but with a diversity of perspective beyond daily workmates. It comes in handy when you need help or answers to questions outside your accumulated experience, need a connection at another organization, or simply want some mind stretching thought.

Meeting announcements, event notices, and GlobalMeet links routinely go to all INCOSE members within the Chapter's geographic territory; as well as to names on a special *information* list open to one and all. Sign up for the *information* list with a request to the Chapter secretary listed below.

∞

Chapter Board

Ann Hodges	President	505-844-6284	alhodge@sandia.gov
Rick Dove	President Elect	575-586-1536	dove@parshift.com
Ricardo Pineda	Past President	915-747-7871	rpinedas2002@yahoo.com
Mary Compton	Treasurer	505-845-9268	mlcompt@sandia.gov
Jeni Turgeon	Secretary	505-553-4554	jturgeo@sandia.gov
Regina Griego	Director	505-844-7238	griegor@sandia.gov
Mike Gruer	Director	505-828-5656	mike.gruer@honeywell.com
Heidi Hahn	Director	505-665-4606	goldhahn@concentric.net
Ron Lyells	Director	505-828-5625	ron.lyells@honeywell.com
Francis Peter	Director	505-255-8611	fepeter@outlook.com
Bob Pierson	Director	505-767-1210	pierson@aptec.com
Eric Smith	Director	915-747-5205	esmith2@UTEP.edu
Tom Tenorio	Director	575-322-4123	tenoriot@gmail.com

Published quarterly by

INCOSE Enchantment Chapter,
New Mexico.
Published material
does not necessarily reflect the views and
opinions of the Board of Directors,
or the Editor of the publication.

Call, email, or fax
your news, reviews, announcements, contributions, or suggestions to:

Rick Dove, Newsletter Editor
Phone: 575-586-1536
Fax: 575-586-2430
dove@parshift.com