** **Pre-Symposium Tutorials**

*Tutorials are a separate fee from the Symposium. The fee to attend a
tutorial is $300 for one 4-hour tutorial, $500 for two 1/2 days.*

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**Tuesday, 5 Dec 8:00 a.m. – 12:00 p.m.**

**DoD Test and Evaluation Across the Acquisition Lifecycle***Dr. Michael Flynn, CTEP, CSEP, Defense Acquisition University*

An overview of the Adaptive Acquisition Frameworks guidance for Defense Acquisition System from a Test and Evaluation perspective with emphasis on the involvement in the Systems Acquisition Lifecycle and T&E's relationship to the Systems Engineering processes used throughout the lifecycle of major acquisition programs from requirements generation, through Post Milestone C. Coverage will include the latest policies and practices and the role of T&E with an overview of Agile Software practices, DevSecOps, Capabilities Based Test and Evaluation and the relationship between Developmental and Operational T&E. Focus will be on the major events that occur during each phase of acquisition, required documentation, and expected entrance and exit criteria for successfully achieving approval. The intended audiences are engineers, program managers, and industry for an understanding of DoD acquisition in relationship to T&E's involvement.

**End-to-End Automated AI/ML Test Case***Dr. Mitchell Sipus, Sr. Director of Product and Customer Strategy, CalypsoAI*

The rapid growth of Artificial Intelligence (AI) has led to its integration into many aspects of our daily life. AI is increasingly relied upon to make critical decisions, creating an urgent need for effective test and evaluation (T&E) tools to ensure AI-dependent systems are safe, reliable, and trustworthy.

Independent T&E processes can identify errors, flaws, and biases present in AI/machine learning (ML) systems or models, and are critical for assessing system or model performance, capabilities, and vulnerabilities during the development lifecycle, as well as in the deployment environment.

Yet high degrees of risk are established when T&E processes take place in isolation from an understanding of future conditions, user needs, or the user technology

environment.

The field of Human Computer Interaction (HCI) offers a range of applicable frameworks and methods to strategically inform the invention of new T&E processes, to mobilize T&E for maximum benefit of future technology users, and to better manage the systemic effects of ML within organizations and societies. Key questions involve understanding how a system or model responds to different operational environments, especially under unpredictable circumstances, is key to establishing trust that the system or model is fit for purpose. And how such processes can directly inform the decisions and actions of the technology users.

Within these processes, how a system or model responds to different operational environments, especially under unpredictable circumstances, is key to establishing trust that the system or model is fit for purpose. Depending on the business use, the

operational challenges could range from adverse weather conditions (e.g., fog, snow, rain, or smoke), poor indoor/ambient lighting (e.g., brightness,) equipment/software issues (e.g., camera movement causing blurriness or poor focus, lens flare, or electronic “noise” ), or a host of other situationally-specific circumstances that could affect the system’s accuracy, reliability, and robustness. T&E processes also play an important role in identifying and addressing increasingly concerning privacy and ethical issues.

We will run a tutorial automated testing and validation workflow where participants build or access a model library or model APIs with tools such as Google Colab and PyTorch, and then validate the model leveraging a PyTorch model and the VESPR Validate software product. We will go through many of the pitfalls common to testing AI models and talk about insights and learnings for the T&E community.

**Introduction to Test and Evaluation***Dr. Timothy Scully, Fellow of Test and Evaluation, Booz Allen Hamilton*

This 4-hour tutorial provides an introduction to the Test and Evaluation (T&E) process, organized around the four T&E Domains.

Domain I: Test and Evaluation Planning will cover Inspection / Analysis / Demonstration / Test (IADT); test criteria; attributes of a good test plan; planning considerations (training, ranges, safety, facilities, security, configuration mgt, ESOH); test plan documentation; DT, OT, and Integrated Testing; and best practices.

Domain II: Test and Evaluation Design will include Traditional T&E vs Modern Assessment and Evaluation; schedule-driven vs event-driven testing; verification cross-reference matrices; two-level full factorial vs fractional factorial, orthogonality, factor interaction and average value effects, with a case study; automated testing; subjective assessment; and modeling and simulation in T&E.

Domain III: Test and Evaluation Execution will present test readiness reviews; prerequisites for test execution; test execution step-by-step; information to record; anomaly management; general considerations; sources of data errors; post-test activities; and best practices.

Domain IV: Test Data Analysis, Evaluation and Reporting will discuss confidence and the binomial nomograph, with an exercise; data reduction; data evaluation strategy; and test reports.

The tutorial will conclude with a presentation of T&E Tenets.

**RF Fundamentals**

*Darren McCarthy, Rohde & Schwarz*

Join us for a four-part series where our technology expert covers everything RF. We will start with a refresh on the basics of RF and will work our way through transmission characteristics, communications systems models, thermal noise, and phase noise. We review the basics of digital modulation, including IQ representation and constellation diagrams. We show how to measure the quality of digitally modulated signals.

**T&E as a Part of Agile Development***Robin Poston, Dean of the Moody School of Graduate and Advanced Studies, Southern Methodist University and Research Fellow with the Systems Testing Excellence Program FedEx Institute of Technology, The University of Memphis Wayne Dumais - Deputy T&E, Department of Homeland Security (DHS)*

To discuss T&E in support of agile development, we need to explore the sequence of the evolution of the agile methods, rationale for the application of different methods, compare traditional and agile software development approaches, discuss research conclusions regarding the agile method’s impact on software performance, review benefits and challenges of agile, and appreciate the fit of agile methods with Systems Acquisition Life Cycle. Furthermore, in this tutorial we will also discuss when to use agile, the role of the tester on agile projects, and various kinds of testing applicable to agile software developments.

**T&E in a Digital Engineering Environment***Jean Petty, Cyber Resilience T&E Manager, Department of Homeland Security (DHS)*

This tutorial will review digital engineering concepts in general and then deep dive into specifics for test and evaluation (T&E) in a digital engineering environment. The course will review concepts, methods, tools, and best practices for five Digital Engineering topic areas including models, an authoritative source of truth, technological innovation, innovative infrastructure, and workforce. Each topic area will be addressed in general, followed by discussion of specific issues and challenges for T&E. Discussion areas will include:

* How planning and the evaluation components of T&E need to evolve in the DE environment, given Model Based Systems Engineering, Mission Engineering, and automated testing.
* The characteristics of T&E tools within the DE environment and considerations and methods for automated tools selection.
* Data access, data sharing, and hurdles for building an authoritative source of truth.
* Special concerns for Cyber T&E in a Digital Engineering environment.
* Digital Engineering infrastructure and infrastructure providers.
* T&E workforce within a Digital Engineering ecosystem.
* Gaps in current infrastructure, capabilities, workforce, etc.

This course is intended for T&E professionals who are new to Digital Engineering or are beginning to implement Digital Engineering in their T&E practices. The course will include lecture, discussion, and interactive exercises.

**Tuesday, 5 Dec 1:00 p.m. – 5:00 p.m.**

**Cognitive EW: An AI Approach***Dr. Karen Haigh, Consultant for Cognitive Electronic Warfare and Embedded AI/ML*

This tutorial will present an overview of how AI can be used in EW. They will describe opportunities for using AI in situation assessment and electronic support (ES), and decision-making techniques for electronic protect (EP), electronic attack (EA), and electronic battle management (EBM). We will present AI techniques from Situation Assessment, Decision Making, and Machine Learning, and discuss tradeoffs.

We will describe approaches to the important issue of real-time in-mission machine learning, and evaluation approaches that demonstrate that a cognitive system that learns how to handle novel environments. The tutorial is intended to be a voice track to the 2021 book Cognitive Electronic Warfare: An Artificial Intelligence Approach (Artech US and Artech UK). Our intended audience is RF people--experts in EW, cognitive radio, and/or cognitive radar--who want to learn more about how and where to use AI. Our goal is to help triage and guide EW system designers in choosing and evaluating AI solutions. Cognitive EW is one of these critical advances that will determine the outcomes of future battles.

**Incorporating T&E into Acquisition Contracts "Shift All the Way to the Left"**

*Terry Murphy, Deputy Director, Office of Test & Evaluation, Department of Homeland Security (DHS) & Adam Martin, DHS*

So you’re a Test and Evaluation Manager (or Key Leader) of a program and you and your T&E working group have just finalized the programs T&E Master Plan. Looks like you’ve accomplished all the pertinent tasks for T&E and ready for execution. Right? Not so fast, have you ever heard the term if it’s not written into the contract it probably won’t happen? To many of our T&E professionals are steeped in technical expertise and key on development of sound well defined T&E plans, but all too often they lack program management broness to understand they’ve missed critical steps. That being said, has the T&E manager coordinated with their programs contracting officer, contract specialist and or contracting officer’s representative? Probably not.

This tutorial will provide the T&E professional an overview and process for inclusion of T&E equites into the acquisition contracting artifacts. The goal of this tutorial is not to make T&E professionals contract experts, but rather provide them a keen understanding of their “Key” role, responsibilities, processes, and as key players within this process ensure T&E equities are included within acquisition contracts.

The main focus will leverage the initial procurement notice released to industry per Federal Acquisition Regulation (FAR) Part 15, the Request for Proposal (RFP). Topics will include:

* Request for Proposal background and content
* Detailed overview of each RFP Part and Section with discussion on inclusion of T&E equites based on lessons with examples
* Discussion on the Statement of Work (SOW) and or Statement of Objectives (SOO) - Differences, purposes, and how the T&E professionals assist in the development

It is critical that our T&E professionals have a full understanding of their “Key” role within the program contract development process. Without the T&E professional working side-by-side the contracting Team there are NO guarantees that T&E equities will be clearly articulated and communicated within the contracting documents. The T&E professional is the key to ensuring that T&E is accurately, effectively, and with clarity included within the program contract actions, thereby reducing:

* Confusion
* Misinterpretations
* Unclear requirements

There is a gap for our T&E professionals within this area of knowledge, and it’s for that reason, this tutorial is recommended.

**Laser System Test & Evaluation Challenges**

*Douglas H. Nelson, Senior Combat Systems Engineer, Teknicare, Inc. and Mark Stevens, Systems Engineering Department, Naval Postgraduate School*

An introduction to the challenges of testing and evaluating Laser Systems. An overview of the basic physics and terminology of these systems is included. The unique effects of Laser Systems are also discussed to provide a foundation for test objectives. Test and evaluation needs for Laser Systems including required diagnostic beam propagation and atmospheric measurements are briefly examined.

**Lethal Autonomy is the New Reality – Are we Ready to Dominate the Needed Doctrine and Testing Imperatives***Dr. Malcolm Tutty, Research Fellow, RAAF Air and Space Power Centre and ITEA BoD*

Over the last few decades, defence communication and information systems have been increasing the complexity and interconnectedness of systems that has pervaded society more broadly throughout the Information Age. Even more than society in the broad, Western Departments of Defence (DoDs) have sought to attain information dominance at the same time as it struggles with lethal autonomy. The result has been a large number of complex systems, system-of-systems and families-of-system-of-systems in both the physical, human and information domains. How should we address fully Lethal Autonomous Weapon Systems (LAWS) as Network-Enabled Weapons (NEW), directed energy and cyber warfare become more attractive and where does human control of LAWS sit with responsible use of artificial intelligence and ensuring information assurance?

This Tutorial and Workshop examines the UN and Australian perspective and the System of Controls and Advanced Control Directives being proposed to address the implications of LAWS and NEWs for human decision making in their employment. Given the complex systems and key assurance initiatives being pursued systematically by the US, UK and Australian DoD initiatives to effect these more integrated, interoperable and information-assured (I3A) capabilities, while also ensuring these capabilities remain resilient to the new cyber threats using ethically-aligned approaches to experimentation, test & evaluation and employment.

The Workshop participants will be challenged as to their thinking and will directly contribute to the discourse on what Five Eyes doctrine and testing approaches should be and how best to articulate that.

**Overcoming Distributed T&E Challenges with TRMC Solutions***Gene Hudgins, TRMC JMETC/TENA*

The Test and Training Enabling Architecture (TENA) was developed as a DoD CTEIP project to enable interoperability among ranges, facilities, and simulations in a timely and cost-efficient manner, as well as to foster reuse of range assets and future software systems. TENA provides for real-time software system interoperability, as well as interfaces to existing range assets, C4ISR systems, and simulations. TENA, selected for use in JMETC events, is well designed for its role in prototyping demonstrations and distributed testing.

Established in 2006 under the TRMC, JMETC provides readily-available connectivity to the Services’ distributed test capabilities and simulations. JMETC also provides connectivity for testing resources in the Defense industry and incorporation of distributed testing and leveraging of JMETC-provided capabilities by programs and users has repeatedly proven to reduce risk, cost, and schedule. JMETC is a distributed LVC testing capability developed to support the acquisition community during program development, developmental testing, operational testing, and interoperability certification, and to demonstrate Net-Ready Key Performance Parameters (KPP) requirements in a customer-specific Joint Mission Environment.

 JMETC is the T&E enterprise network solution for secret testing, and uses a hybrid network architecture – the JMETC Secret Network (JSN), based on the SDREN. The JMETC MILS Network (JMN) is the T&E enterprise network solution for all classifications and cyber testing. JMETC provides readily available connectivity to the Services' distributed test capabilities and simulations, as well as industry test resources. JMETC is also aligned with JNTC integration solutions to foster test, training, and experimental collaboration.

TRMC Enterprise Big Data Analytics (BDA) and Knowledge Management (BDKM) has the capacity to improve acquisition efficiency, keep up with the rapid pace of acquisition technological advancement, ensure that effective weapon systems are delivered to warfighters at the speed of relevance, and enable T&E analysts across the acquisition lifecycle to make better and faster decisions using data that was previously inaccessible, or unusable. BDA is the application of advanced tools and techniques to help quickly process, visualize, understand, and report on data. JMETC has demonstrated that applying enterprise-distributed BDA tools and techniques to T&E leads to faster and more informed decision-making that reduces overall program cost and risk.

This tutorial addresses using the well-established TENA and JMETC tools and capabilities combined with BDA tools and techniques to reduce risk in an often-uncertain environment; regularly saving ranges time and money in the process.

**Verification, Validation, and Accreditation of Modeling and Simulation for T&E***Jean Petty, Cyber Resilience T&E Manager, Department of Homeland Security (DHS)*

This tutorial provides information on Verification, Validation, & Accreditation (VV&A) processes for modeling and simulation (M&S) supporting acquisition programs, focusing on VV&A for M&S supporting test and evaluation (T&E). The course includes a review of the methodologies and documentation used by acquisition, systems engineering, and T&E disciplines for determining whether a model or simulation should be used and the credibility of the model or simulation for that use.

M&S supports developers and decision makers throughout acquisition, engineering, and T&E. M&S supports requirements development, performing trade-off studies, understanding and demonstrating system capabilities and performance, and T&E. VV&A helps to assure that models and simulations are correct and appropriate for the purpose. Topis

* Methods for planning and performing VV&A
* VV&A for M&S supporting T&E
* VV&A challenges
* Gaps in current infrastructure, capabilities, workforce, etc.

This course is intended for T&E professionals who are considering using M&S to support test and evaluation and who would like to ensure VV&A is performed.  The course will include lecture, discussion, and interactive exercises.