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# INCOSE

## Autonomous Systems Test and Evaluation Working Group, ASTEWG, Charter

### 1 PURPOSE

The Autonomous Systems Test and Evaluation Working Group, ASTEWG, intends to develop, vet and promote principles, practices and metrics for the T&E of autonomous systems in both deterministic and non-deterministic situations.

Initial experiences with autonomous systems, especially within the Department of Defense (DoD), have demonstrated that test and evaluation practices and tools must become more responsive to development cycle times, produce actionable knowledge needed by end users and enable timely readiness assessment after system resiliency or maintenance events during operational usage [c.f., items 1-4 in Section 6 below]. Further, the cost and cycle time of standing up a T&E capability for each autonomous system must be reduced considerably.

### 2 GOALS

- a) Clarify the meaning and implications of deterministic and non-deterministic contexts
- b) Clarify the meaning and implications of the kinds and degrees of autonomy, autonomous systems and systems of autonomous systems.
- c) Clarify the challenges involved in independent and objective estimation of the expected operational effects and availability of an autonomous system and system of systems with respect to anticipated missions, environments and engagements.
- d) Identify ways of producing an abstract model of an autonomous system interacting with its context.
- e) Identify the implications on systems praxis of creating testable autonomous systems.
- f) Identify the implications on systems praxis of creating mission effectiveness estimation and test systems effectiveness estimation.
- g) Compile vignettes, cases and tutorials that exemplify useful T&E and inadequate T&E.
- h) Determine criteria and method for measuring the competency of INCOSE members re: T&E of Autonomous Systems.
- i) Perform trial measurements of intended and actual users re: T&E of Autonomous Systems.

### 3 SCOPE

#### *Principles*

- a) Degrees of non-determinism
- b) Degrees of autonomy
- c) System dynamic and integrity limits
- d) Requisite variety
- e) Requisite saliency
- f) Test characteristics
- g) Evaluation characteristics
- h) Effectiveness
- i) Operational Availability
- j) Readiness

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## ***Practices***

- j) System Management by model, e.g., Live, Virtual and Constructive
- k) Spans problem system identification, as well as problem suppression system design/architecting, engineering, activation and learning.
- l) Results in necessary, sufficient, and efficient T&E.
- m) Produces not only a model of an intended system but also a set of criteria for evaluating the efficacy of such model then of the system, once realized and throughout its operational usage.
- n) Discovers and conveys actionable knowledge that Users need in order to configure and apply both single node and multi-node autonomous systems.
- o) Continuously evolving workforce competency
- p) Context Situations: DoD, DHS, Enterprise, sociotechnical, social, industrial, medical, transportation (rail, air, road, etc.), communication, etc.

## ***Metrics***

- a) Measures of Effectiveness; system and T&E
- b) Standards of Acceptance (mission specific)
- c) Probability of latent faults.
- d) User trust
- e) Probable error

## **4 SKILLS AND EXPERTISE REQUIRED**

The ASTEWG seeks members with:

- a) Expertise in SE of implicit (context sensitive, self-adapting, self-evolving) systems
- b) Experience in using or relying on autonomous systems. Military, supply chain, automotive, etc.
- c) Similar interests in other professional societies and industry associations.
- d) Motivation to participate in action research
- e) Bias toward prototyping and second opinions.
- f) Discovery and adoption of tools for knowledge acquisition, interpretation, production, conveyance, and utilization.

## **5 MEMBERS, ROLES AND RESPONSIBILITIES**

The ASTEWG leadership, members and a brief description of their responsibilities are as follows:

### ***Co-Lead: Don Greenlee***

Responsibilities: Liaison with Board Sponsor(s)/Champion(s). Foresight and Motivation of participants.

### ***Co-Lead(s): Thomas Tenorio***

Responsibilities: Timely status reporting to Tech Ops. Timely communication across WG. Act in the absence of the lead.

### ***Co-Lead(s): Jack Ring***

Responsibilities: Quality of WG products and communications. Assistant Director, Technology Enablers. Act in the absence of the lead.

### ***- Members:***

All those interested in mutual knowledge discovery, sharing, and vetting then formulation and promulgation as knowledge claims.

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## 6 OUTCOMES (PRODUCTS/SERVICES)

### *To date:*

1. Tutorials at 4 ITEA Conferences in 2009 and 2010
2. Paper at NIST System of Systems Conference, 2009
3. Paper at INCOSE-LA Mini-Conference, 2010
4. Paper at NIST PerMIS Workshop, 2010
5. Presentation to Enchantment Chapter, 2010
6. Demonstration of selected tools, e.g. CMap 2010
7. Participation in PATFrame reviews, 2010, c.f., [web.mit.edu/patframe/](http://web.mit.edu/patframe/)
8. Systems of the Third Kind, INCOSE INSIGHT, July, 2012
9. Trip Report AIAA Workshop Complex Aerospace Systems Exchange, CASE 2013
10. The Fuzzy Front End of System Conceptual Design. INCOSE Southern Arizona Chapter, 2014
11. Helping Supply Chains Learn --- De-conflicting Invention and Innovation. Design and Sustainability Session, Congress on the Future of Engineering Software, 2015
12. Fit For Purpose? A system value perspective. INCOSE San Diego Chapter mini-conference, 2015

### *Intended*

- a) Autonomous system characteristics, common / domain specific.
- b) Autonomous system descriptive modeling challenges, concepts and practices.
- c) Autonomous system engineering prescriptive modeling challenges and practices.
- d) Autonomous system interoperation, maintenance and simplification challenges and practices.
- e) Example (abstract) actual Autonomous Systems models/frameworks.

## 7 APPROACH

- a) Monthly teleconference, quarterly progress webinars, meetings at IW and IS
- b) Enable participation by members who are not yet INCOSE members
- c) Facilitate a dialog regarding tenets applicable to i) autonomy, ii) estimation of operational effects and iii) preferred ways of making the WG autonomous.
- d) Working papers, WG position papers, INCOSE influence papers
- e) INCOSE-approved papers, panels and tutorials at INCOSE, ITES, IEEE, ISSS, IIE and others
- f) Poll INCOSE members to discern trends in their awareness and appreciation of and preference for recommended principles and practices.

## 8 MEASURES OF SUCCESS

- a) Achieve Requisite Variety (at least 12 key participants).
- b) Utility of knowledge claims produced as measured by INCOSE member survey.
- c) Impact of WG on INCOSE member performance, motivation and innovation by INCOSE member survey.

## 9 RESOURCE REQUIREMENTS

- a) Infrastructure for monthly telemeetings
- b) Ability to poll INCOSE members twice yearly
- c) \$4,000 annually for stipends, two each \$2,000 stipends for key users as speakers at IW and IS sessions

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**10 DURATION**

Complete by 12/2018.

**SIGNATURES**

Enter the signature block of the submitter *Jack Ring #582* Date 12/22/2015

**1<sup>st</sup> Level of Approval**

Paul Schreinemakers

Technical Director, INCOSE

Date 12/23/2015

**Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description</b>	<b>Author</b>
12/22/2015	1.0	Approval Draft	Jack Ring