Autonomous Systems Test and Evaluation "Get Well" Program

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Abstract:
Warfighters are not getting the information they need to ensure suitability, safety, effectiveness and survivability of autonomous systems. The DOD is simply not prepared or equipped to perform independent, objective T&E on autonomous systems. Those few who have figured it out tell us that qualifying autonomous systems for deployment is a new and different paradigm from past T&E. Meanwhile the UAS roadmap calls for a ten-fold proliferation of kinds of systems. These range from 40,000 pound logistics behemoths to 2.4 gram urban warfare inspectors. Degrees of autonomy range from simple adaptation to simultaneous adaptations by multiple autonomous components that comprise an autonomous system. Clearly, a vigorous and innovative "get well" program is urgent. A get well program will entail three thrusts.

First thrust: Develop 60 DOD personnel to expert level at producing and conveying knowledge regarding suitability, effectiveness, safety and survivability of autonomous systems in various configurations and missions. This will provide a 12 person cadre for each of Space, Air, Ground, Marine and Undersea systems.

The personnel can be considered experts when: a) They acknowledge that the challenges are not about test and evaluation. Rather, the objective is to generate and convey adequate, accurate and timely knowledge regarding the expected effects of unmanned autonomous systems in anticipated, albeit ambiguous situations. b) They understand how to generate, vet and convey the necessary and sufficient knowledge needed by warfighters and support organizations (including in-service engineering or equivalent) and they know when to do this (during UAS development, integration, initial deployment and throughout operational life). c) They know how to qualify not only a specific UAS vehicle and a whole UAS system but also diverse UAS's that coordinate, cooperate, collaborate, or co-learn.

Second thrust: Develop and evaluate three prototype UAS qualification systems. Proto 1 addresses the top three technical challenges in qualifying a whole system associated with a selected UAS vehicle with respect to its measures of operational effectiveness. Proto 2 addresses UAST preparation cycle time by defining a systems design and engineering process and selecting a tool suite for a 'family of systems' paradigm then demonstrating composable UAST's. Proto 3 addresses the key challenges in qualifying UAS with respect to mission-specific or engagement-specific operational capability, wherever and whenever needed (not just at Test Ranges).

For each prototype the project team will reframe the systems problem inherent in

autonomy. a) They will reconceptualize T&E (and IV&V, LVC, M&S, etc.) into an integrated capability for qualify UAS's by anticipating effects in operation. Such anticipation and qualification will be done not only during development of each UAS but also during all subsequent years of operation and evolution. b) They will seize the opportunity to create a national asset, a pervasive, persistent intelligence collection, analysis and production capability across all UAS's throughout their respective like cycles. c) They will conceive ways to determine the limits, both external and internal, that a UAS encounters when it is seeking to produce desired effects and avoid unintended consequences while engaged in an N-party, non-deterministic situation.

For each prototype the project team will perform a "design for prevention" kind of systems design, architecting and engineering both initially and throughout the evolution of multiple versions during the system life cycle. a) Evolve the Effects and Capabilities approach to design and engineer systems for inspecting, exercising, observing and analyzing UAS-based systems. b) Apply model-based systems engineering and emulation technology and practices to ensure that these UAS qualification capabilities co-evolve with the new UAS developments. c) Use modeling and simulation to verify understanding of a system but never to justify a design.

For each prototype the project team will demonstrate the method for composing a family of systems. a) Design the meta model of UAST Enable engagement-driven (as contrasted to procurement-driven) effects estimation (Joint, NetCentric, etc.), b) Apply new technology to enable quick, inexpensive detection by inspection of faults and incompatibilities in software, systems and systems of systems. c) Apply emerging technology to anticipate emergent characteristics of candidate compositions in engagement contexts.

Third thrust: Update and harmonizing relevant DOD direction such as doctrine, policy, regulations, standards, guides, handbooks and practices for the era of autonomy, especially regarding: a) Measures of Effectiveness and Standards of Acceptance as THE primary "requirements." b) Focus on UAS self-test of operational readiness and in-operation malfunction detection. c) Systems engineering and system of systems engineering guides and handbooks to include "design for prevention" of nth-order implicit systems.

Urgency: Future autonomous systems will consist of multiple components each exhibiting respective degrees of autonomy. These will comprise the UA vehicle platform and the UA payload as well as the personnel and tools that will determine suitability, perform targeting, and plan/direct recovery and refurbishment. The innovations recommended herein will assess the synergy and limitations of the tools and personnel as well as the platform and payload, especially when joint commands field systems of heterogeneous UA systems.

Author Bio:

Mr. Ring is a Systemist. He has over fifty years of designing, constructing, renovating and operating intelligent enterprises, many of which actually worked. To name a few, he is a Fellow, International Council on Systems Engineering www.incose.org, Industrial Fellow, School of Systems and Enterprises, Stevens Institute of Technology, Enterprise Architect, Planet Starshine, www.starshineacademy.com, Co-founder, Educe LLC, Co-founder, OntoPilot LLC, Co-founder, Kennen Technologies LLC, www.kennentech.com, Co-founder, OntoPilot LLC, Co-founder, Educe LLC, Sr. Analyst, Cyon Research Corp., and Owner, Innovation Management.

Work Experience

Educe LLC / Managing Member
January 2010 - Present
Accelerating learning.

OntoPilot LLC / Managing Member
January 2009 - Present
Facilitating knowledge exchange and choice making among humans.

Kennen Technologies LLC / Member
2008 - Present
commercializing semantic technologies

Innovation Management / Owner
1988 - Present
Coaching
Edelbrock Corp.
Ascent Logic
Strawberry Tree Inc.
MRJ Associates
IBM Object Technology Practice
Duke Power Corp.
Miles Burke Associates
Time Life Books
Office of CIO, Province of Manitoba
Prometal Corp.
Geomagic Corp.
Parker Hannafin Aerospace
Unmanned Autonomous Systems Test, U.S. DoD

Honeywell / Director
1978 - 1987
Product Manager of Separately Priced Software, Multics, CP6, CIM and Advanced Projects.

General Electric / Manager
1957 - 1977
Manager of software-based control and information systems.

Education

Emporia State University
BA, Physics, 1957