

# **Cost and Risk Considerations for Testing Unmanned and Autonomous Systems of Systems**

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**SPHERES** 

**Case Study** 

Figure 3: SPHERES at

# Introduction

Unmanned and Autonomous Systems of Systems (UASoS) have become increasingly complex and bring interesting challenges to testing and evaluation. Currently no traditional testing techniques or programs of record exist.



Figure 1: PATFrame Approach

To ensure UASoS are effective, safe, suitable and survivable the **P**rescriptive and **A**daptive Testing **Frame**work for UASoS is being created.

### **Problem Focus**

International Space Station Figure 2: PATFrame Focus and Contributions • Net-centricity of the **PATFrame covers** environment net-centric focus Testing a system in a five domains – SoS environment Testing a SoS in space, air, land, Testing a system SoS environment sea and undersea Ultimate Goal UAST focus PATFrame Focus: Complexity Testing Autonomous of the system System in SoS environment inder te • Testing SoS

## **Problem Statement**

Current T&E processes lack the ability to determine the effort required for testing UASoS. The questions arises, "When am I done testing?" We hypothesize that the effort required for testing is directly related to the risks as well as technical and organizational cost drivers, which influence the testing and evaluation process. By using a risk based testing and cost model approach we seek to answer this question to determine the ultimate test stop point.

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The Synchronized Position Hold Engage **R**eorient **E**xperimental **S**atellites testbed serves a dual role as both a risk mitigation unit and distributed satellite system of systems

Principles of
<b>Risk Mitigation</b>

- Modularity
- Requirements Balance
- □ Enabling field of study
- **Iterative Research**
- Incremental Technology Maturation
- Optimized utilization of Resources



#### **Initial Technical and Organizational Cost Drivers**

	Time Const	raints	Num	ber of interf	aces, requirements and systems	
Personnel experience				Integration complexity		
and capa	bility	MOD		In	teroperability of manned and unmanned systems	
Itisite coordination ticularly geographi	c	Hierarchy c	of initial		Degree of autonomy of systems	
		survey responses			Diversity and coordination of system platforms	
akeholder team cohesion	Orgar	nizational	Tech	nical	Varying levels of system maturity	
	LOST	Drivers	Cost D	<b>Urivers</b>	Complexity of test	
Number of organizations		Drivers develo	ped base	d /	Communication breakdown	
involved	Changes in requirements/budget					
Architecture understandi	ng of SoS	and works	shops	Mat Rate of test	urity level of test t data collection	
Sec	curity level o	f project	Power availa	r availability for adapting new technologies		





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### **Future Work**

...continue knowledge acquisition to minimize risk by developing PATFrame as a decision support system for testing and evaluating UASOS

Test Strategy/

System under te

est Infrastructure



...develop the inputs for a tool to be used by test planners and testers to determine the effort required for testing

...include parameters that will calculate the probability of accomplishing a task in given resources and test cost driver inputs

...use both qualitative data from subject matter experts and quantitative data from test projects to validate inputs and ultimate stop point for testing

Adaptive



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