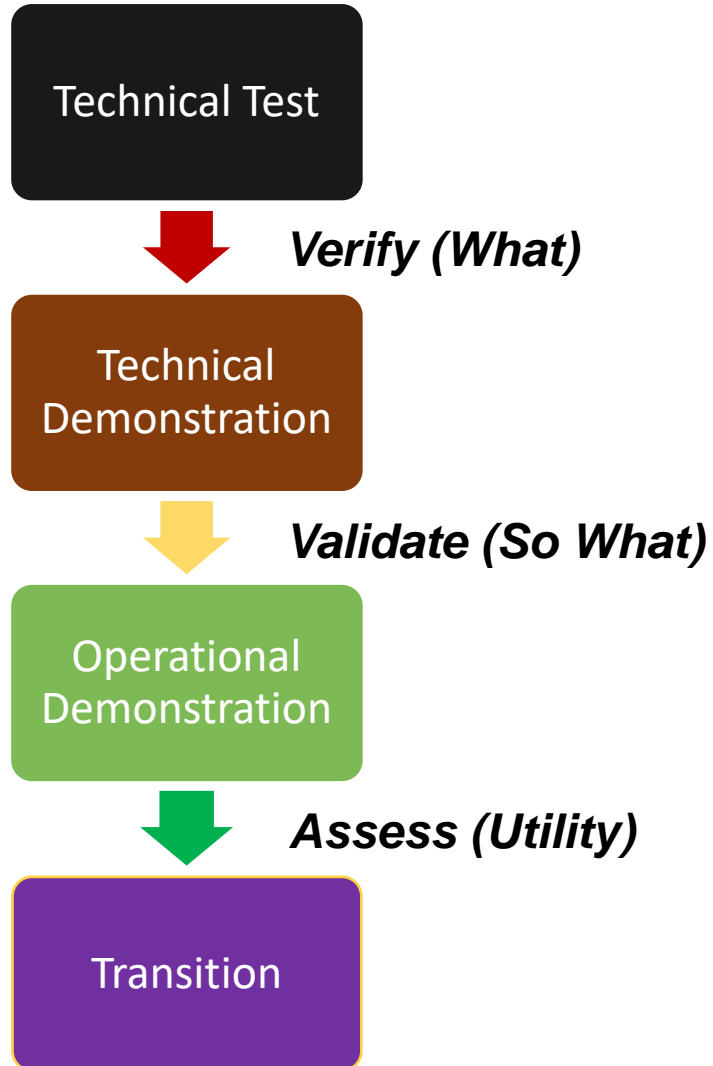


Test and Assessment Capabilities Brief

T2L Support Services LLC

Dr. Larry Solliday, DM
President
lawrence.m.solliday.ctr@mail.mil
larry.solliday@t2linc.com
812-675-7739
31 October 2023





Mission

T2L LLC provides test and assessment support to Government, Industry, and Academia seeking to verify, validate, assess, and transition new and innovative emerging and enabling technologies and capabilities.

Capabilities

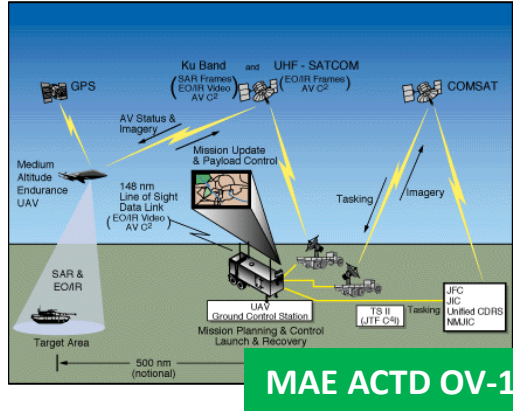
- Technology Readiness Level Assessments
- Technical Assessments
- Systems Assessments
- Utility Assessments
- Software Assessments

Technology Readiness Assessments



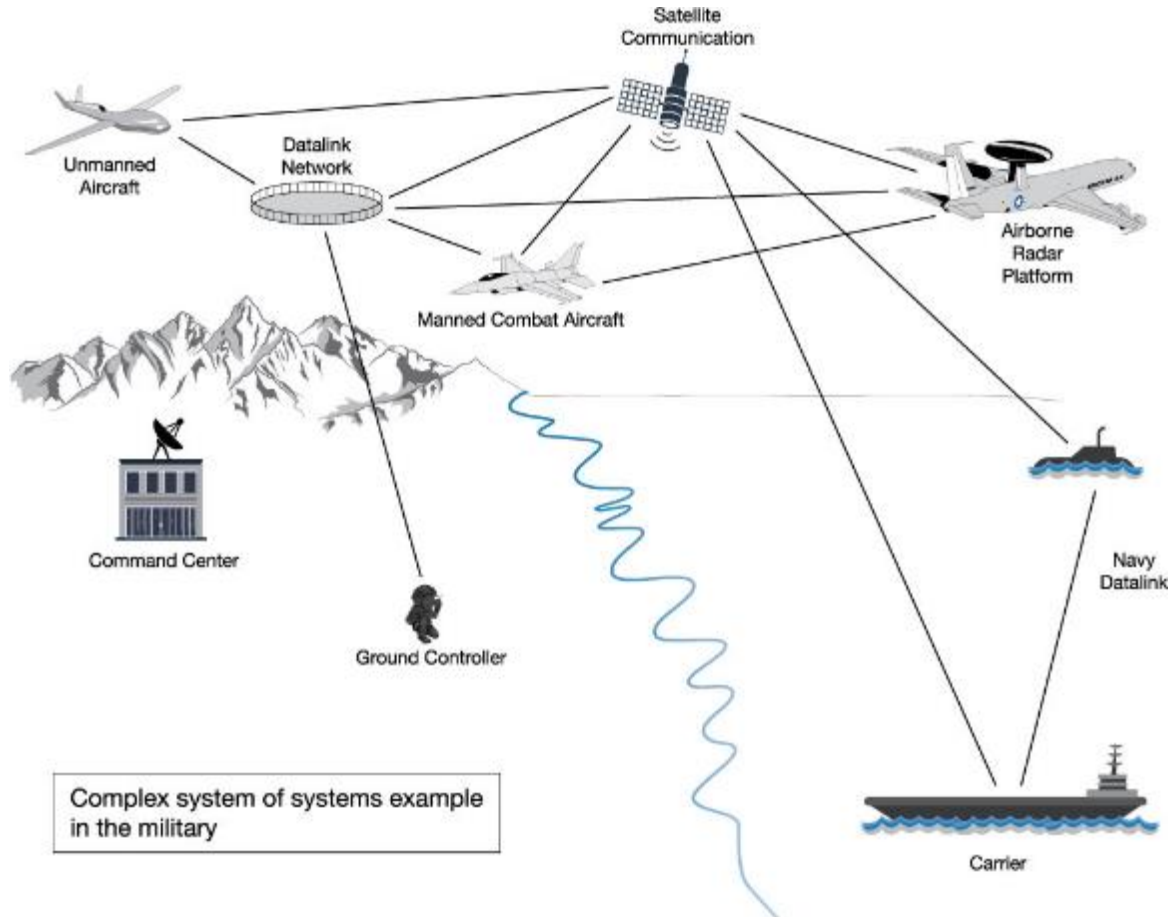
Technology Readiness Assessments

- A systematic, metrics-based technical assessment to determine the maturity of, and the risk associated with, critical technologies.
- The examination of program concepts, technology requirements, and demonstrated technology capabilities.
- Technology Readiness Levels (TRLs) are used to estimate the maturity of technologies during the acquisition phase of a program.
- TRLs enable a consistent assessment of technical maturity across different types of technology
- Conducted by an independent team.



Technical Assessments

- An assessment of a program’s technical progress measured against the expected/planned performance for a defined period of time.
- An objective means of identifying, quantifying, and monitoring a system’s technical risks.
- A rigorous method to help define corrective actions that may be needed to address and resolve identified technical risks.
- Takes place early in a system’s life cycle and continues through operations and support.



System Assessments

- An independent assessment of systems, systems-of-systems, and/or families of systems.
- Determine the technical progress of a system based on the application of technical indicators such as Measures of Effectiveness (MOEs), Measures of Performance (MOPs), Key Performance Parameters (KPPs), etc.



Utility Assessments

- An independent assessment of the operational utility of a system.
- Determines the level of operational utility based on the Concept of Operations (CONOPs) and Tactics, Techniques, and Procedures (TTPs).
- Provides post demonstration transition, CONOPs and TTP, and Doctrine, Organization, Training, Material, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P) recommendations.
- Facilitates transition to a program of record (POR), sustainment, or other alternative approaches.
- Facilitates follow-on development efforts.
- Documents applicable shortcomings in the fielded capability.
- Identifies what might be improved in a follow-on effort.

Software Assessments



Software Assessments

- Many, if not all, systems now have a software component.
- Software reliability is difficult to determine and generally requires specialized testing beyond the assessment.
- Software testing (diving into the code) is very resource intensive and may not serve the purposes of the assessment.
- Assessors limit the assessment to usage-based assessment (is the software fit for its intended use?).

Range of Assessments



Potential to address a need?

TECHNOLOGY SURVEY



Does the tech solve an operational problem?

TECHNICAL CAPABILITY TEST



Determine tech performance and its operational relevance.

TECHNICAL PERFORMANCE EVALUATION



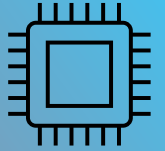
Determine tech functionality and its operational relevance to the whole capability.

SYSTEM INTEGRATION TEST



Does capability solve operational issues and mission task needs?

OPERATIONAL ASSESSMENT



MOE, MOP based driven by tech requirements and operational needs

PROGRAM of RECORD DT/OT

Increasing Scope and Complexity = Increasing Costs and Duration



Question/Issue

- Potential to address a need [Joint Urgent Operational Needs (JUONS) or other requirement].

Location

- Determined by the technology developer.

Duration

- Execute: 10-15 Working Days
- Report: 2-5 Working Days

Product

- Letter of Observation (LOO)

Decision

- Informs technology down selection and need for other assessment(s).
- Go/No-Go to another level of assessment.

Technical Capability Test



Does the tech
solve an
operational
problem?

**TECHNICAL
CAPABILITY
TEST**

Question/Issue

- Demonstrate technical merit to solve an operational problem.

Location

- Determined by the technology developer with the concurrence of the government.

Duration

- Execute: 20-30 Working Days
- Report: 5-10 Working Days

Product

- Procedural test summary and data analysis brief or report.

Decision

- Informs and recommends technical development.
- Conclusions based on demonstrated technical, not operational performance.
- Continue or stop development or proceed to other level of assessment.

Technical Performance Evaluation



Determine tech performance and its operational relevance.

**TECHNICAL
PERFORMANCE
EVALUATION**

Question/Issue

- Determine technical performance and its operational relevance against a limited operational problem set.

Location

- In a suitable test facility/range to support operations.

Duration

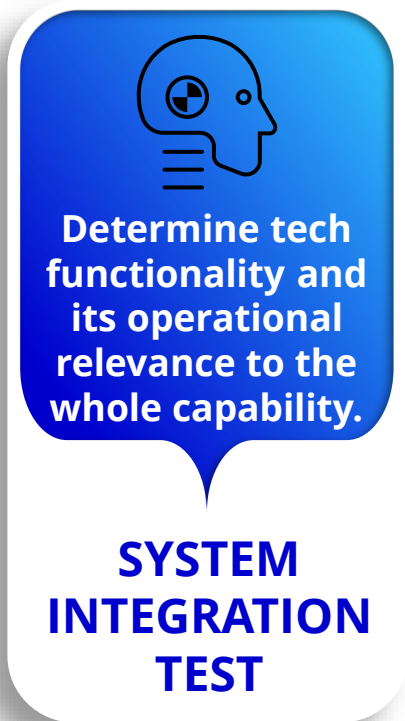
- Execute: 45-90 Working Days
- Report: 10-15 Working Days

Product

- Technical Performance Evaluation Report

Decision

- Validate technical maturity, operational relevance, need for modification, cost, availability, and DOTMILPF or suitability and effectiveness attributes.
- Findings support TRL validation.



Question/Issue

- Determine technical functionality and operational relevance of whole capability [the integration of the system(s)].

Location

- In a suitable test facility/range to support operations.

Duration

- Execute: 60-120 Working Days
- Report: 20-30 Working Days

Product

- Functional and Operational Evaluation Report.

Decision

- Collapse DT/OT into system integration assessments to speed acquisition and fielding.
- Findings are impacted by the time and resources allocated to the test.



Does capability solve operational issues and mission task needs?

**OPERATIONAL
ASSESSMENT**

Question/Issue

- Does capability solve operational issues and achieve mission task needs?

Location

- In representative environment with intended users.

Duration

- Execute: 60-120 Working Days
- Report: 5-30 Working Days

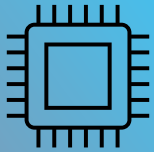
Product

- Operational Utility Assessment Report

Decision

- Demonstrate operational utility to support production-fielding decisions.
- Findings are impacted by the time and resources allocated to the test.
- Can support pre or post milestone activities (Acquisition Framework).

Program of Record (DT/OT)



MOE, MOP based
driven by tech
requirements and
operational needs

**PROGRAM
of RECORD
DT/OT**

Question/Issue

- MOE, MOP based driven technical requirements and operational needs concurrently.

Location

- Tailored to program needs.

Duration

- Execute: TBD based on individual programs.
- Report: 30-60 Working Days.

Product

- As required.

Decision

- Preliminary and critical design reviews and milestone requirements based on acquisition strategy.
- JCIDS documentation.



Range of Assessments

Key Takeaways

- The Range of Assessments provides the rigor (the formal, objective, and repeatable process) required to assess emerging and enabling technologies and bridge research and development (R&D) and prototyping to the prudent and practical application of those technologies.
- The Range of Assessments can be applied to the various tasks of assessment, and its application facilitates the demonstration, acceptance, modification, or rejection of emerging and enabling technologies on a rational basis.
- The Range of Assessments is scalable based on the complexity and duration of the technology and the event.



Assessment Planning – CRD

Client Requirements Document
[Project Name]
[Project Date]

Client POC:	Assessment POC:
Title:	Title:
Organization:	Organization:
Address:	Address:
Phone:	Phone:
Email:	Email:

BACKGROUND

XXXX

OBJECTIVES

XXXX

REQUIREMENTS

XXXX

DISCOVERY
XXXX

STRATEGIES AND OBJECTIVES
XXXX

PLANNING GUIDANCE
XXXX

PLANNING
XXXX

EXECUTION
XXXX

REPORT RESULTS
XXXX

FUNDING

XXXX

MILESTONES AND DELIVERABLES

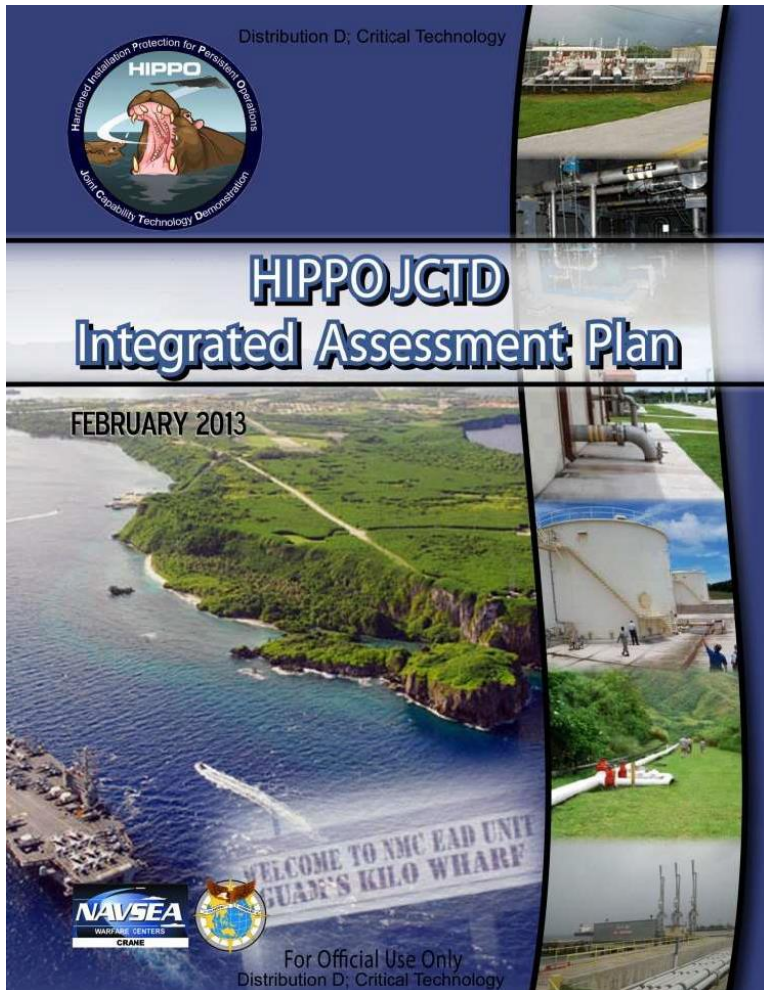
XXXX

APPROVALS

XXXX

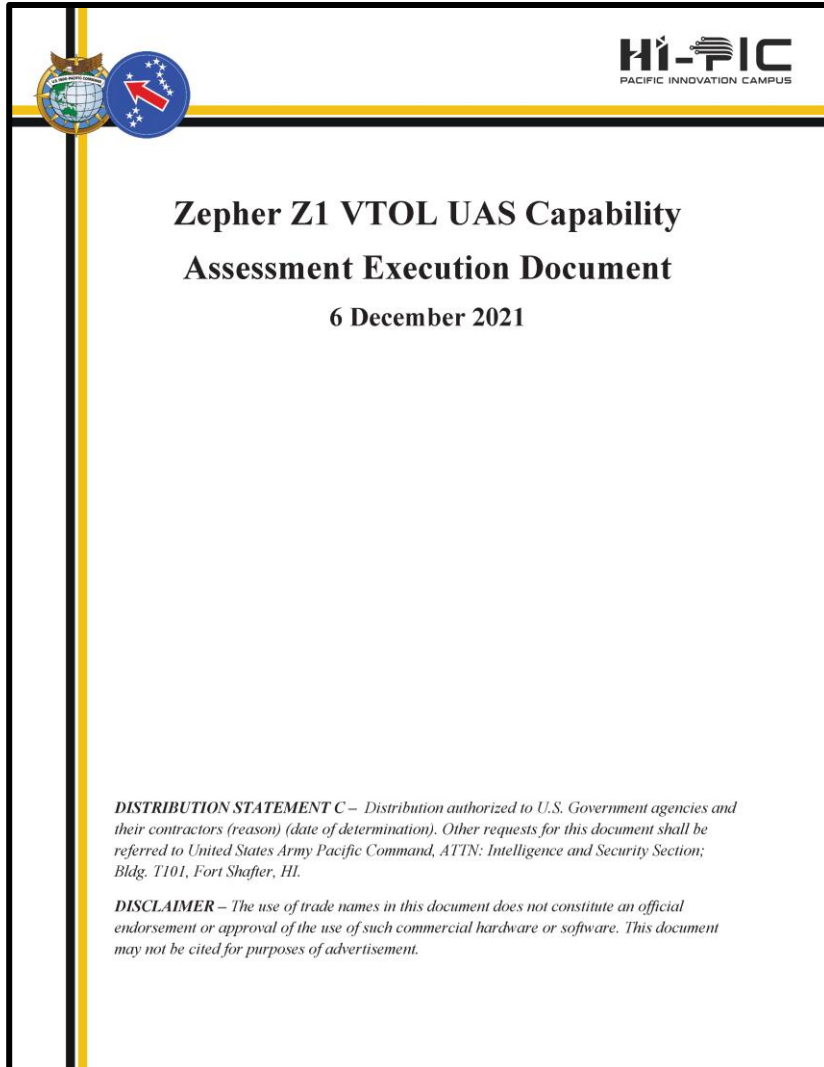
_____	_____
[Name]	Date
[Title]	
[Organization]	

_____	_____
[Name]	Date
[Title]	
[Organization]	



Integrated Assessment Plan (IAP)

- The IAP is normally prepared by the Assessment Team during the initial planning phase of the assessment program.
- The IAP provides the blueprint for the issues and objectives that the specific program utility assessment will address, the scenarios and conditions that will be addressed, and the data collection and reporting for each of the assessment issue objectives.



Assessment Execution Document (AED)

- The AED provides the detailed assessment approach and methodology for the demonstration and assessment of technologies and capabilities.
- The AED provides the data collection and analysis methodology developed by the Assessment Team to determine the technical performance and operational relevance of each technology and capability under assessment during a Vignette Assessment.
- **Note:** Certain assessment efforts may require a companion Demonstration Execution Document (DED).



Assessment Reports – SITREP

Dr. Tran,

Good morning (CT).

On 6 May 2023, the OUSD(R&E) P&E Assessments Team observed the second risk reduction flight of the Vanilla Long Endurance Unmanned Aerial Vehicle (LEUAS) integrated with the Tactical Battlefield Airborne Communication Node (TBACN) payload. The purpose of the risk reduction flight was to demonstrate the ability of the integrated Vanilla LEUAS and TBACN capability to operate inflight. The following is a summary (the who, what, where, when, and why) of that event.

1. Who

The following Assessments Team personnel observed the risk reduction event.

- Dr. Mike Tran, PhD
- Dr. Larry Solliday, DM
- Tim Solliday

The following Platform Aerospace personnel supported the risk reduction event.

- Dr. Dan Edwards, PhD
- Jonathan "JT" Rasche

The following TribalCo personnel supported the risk reduction event.

- Jason Sapp

The following NEANY personnel supported the risk reduction event.

- Steven Steptoe
- Mike Austin

2. What

The second risk reduction flight of the Vanilla LEUAS integrated with the TBACN payload.

3. Where

Webster Airfield

17682 Grayson Rd
St Inigoes, MD 20684

4. When

6 May 2023.

5. Why

The event sought to demonstrate the ability of integrated Vanilla LEUAS and TBACN capability to operate in inflight.

After a short operations and safety brief by the Platform Aerospace Team, the ground checks for each system began. Both the Vanilla LEUAS and the TBACN payload passed their ground checks. The TBACN payload was then configured for takeoff. The Vanilla LEUAS started its engine, taxied to the runway, and proceeded to conduct high speed aborts to configure the climb angle of the prop for air density.

Next, the Vanilla LEUAS proceeded with their takeoff procedures and was cleared for takeoff taking flight at 1002 ET. After takeoff, the vanilla LEUAS went through a functional test list consisting of a pattern entry, invert orbit, and a simulated landing. The functional check was performed due to the installation of a new engine into the Vanilla LEUAS platform.

Next, the Vanilla LEUAS transitioned to the St. Mary's Buoy at 2,000ft MSL and verified the TBACN payload was on and functioning. The Tribalco team then proceeded to test all four waveforms. The Trellis Ware (20 watts), Silvus (10 watts), and electronic warfare (EW) waveforms functioned normally. The Assessments Team did observe intermediate comms lost with all three waveforms. The Link 16 radios on the ground were able to communicate while the combined Vanilla LEUAS and TBACN capability was in line of sight (LoS), however, they were unable to communicate to and from the Link 16 radio in the TBACN payload.

Next, the Vanilla LEUAS proceeded to climb to 7,000ft MSL at 4.5 miles out. A second test on the TBACN waveforms were performed. Both the Trellis Ware and the EW waveforms were functioning. Both the Silvus and Link 16 radio on TBACN had no comms.

At 1111 ET, the Vanilla LEUAS began its climb to its service ceiling. At 1246 ET, the Vanilla LEUAS reached its service ceiling of 13,560ft MSL. A third test of the waveforms

on the TBACN payload was conducted with the Trellis Ware and EW waveforms function intermittently. Both the Silvus and Link 16 remained out of comms.

Next, the Vanilla LEUAS tested max distance at 900 MHz. At 1305 ET, the Vanilla LEUAS at 10,000ft MSL and 17 miles out lost comms. All four waveforms on the TBACN payload also lost comms. The Vanilla LEUAS standard operating procedures (SOP) were implemented to bring it back into communication. At 1325 ET, comms was reestablished with the Vanilla LEUAS. At 1327 ET, comms returned to the Trellis Ware and EW waveforms intermittently. Both the Silvus and link 16 radio remained out of comms.

Next, the Vanilla LEUAS proceeded to descend to 6,000ft MSL overhead to conduct a dash speed run. At 1357 ET, the vanilla LEUAS started its dash speed run and reached 70kt at 1359 ET.

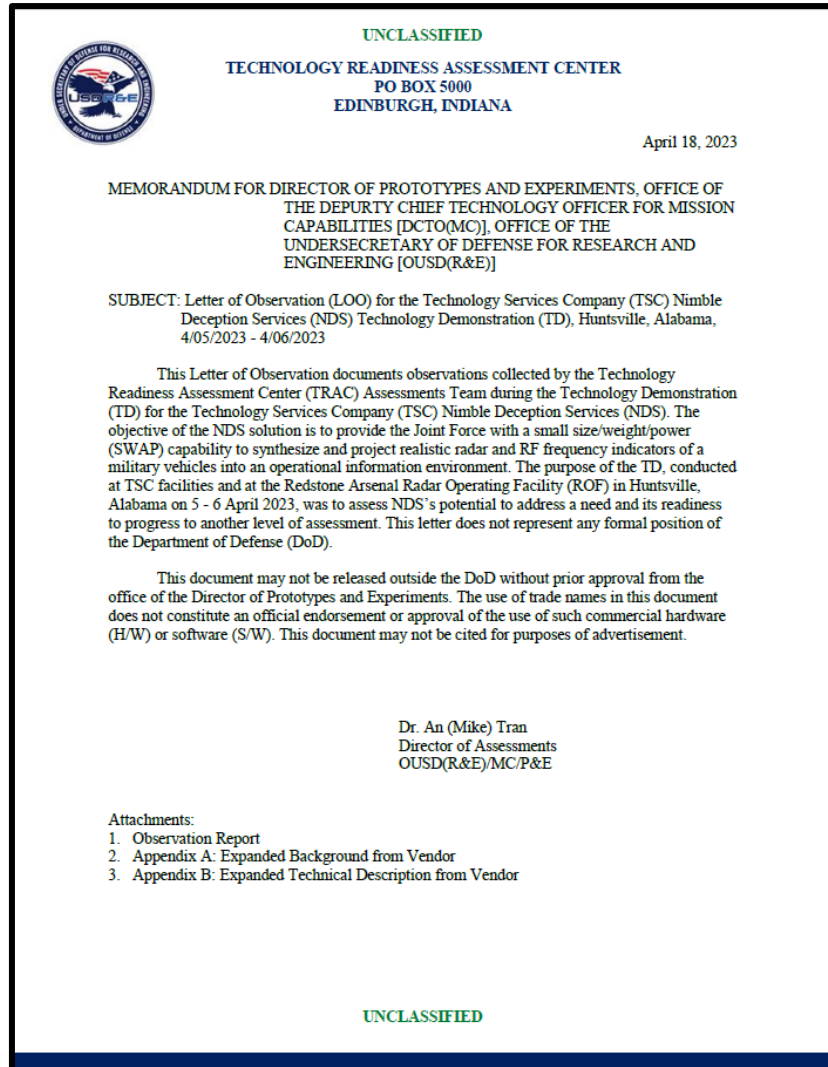
Next, then Vanilla LEUAS returned to St. Mary's buoy at 5,00ft MSL at 1400 ET and configured the Vanilla LEUAS and TBACN payload for landing and executed the landing.

Finally, once the Vanilla LEUAS landed a check of the Link 16 radio identified the radio had been recycled enough times to "factory" reset the system. This appears to be the cause of the communications issue from the aircraft. Upon further investigation, with the technical assistance of the Marine Corps team, it was determined the battery pack installed on the Vanilla LEUAS (a universal battery pack) failed to maintain a "locked" connection with the radio and caused the reset. The combined Platform Aerospace, Tribalco, and Marine Corps team was able to replicate the failure loss multiple times and concluded modifications to the mounting bracket for the Link 16 within the Vanilla LEUAS would need to be modified to create a more secure mounting point. It is worth noting, before departing Webster Field the Marine Corps team conducted multiple tests to ensure the Link 16 radios were functioning and confirmed they were operational.

Please let us know if you have any questions regarding this SITREP. The team that observed the risk reduction flight is on the CC line. They are standing by to answer any questions you may have or provide further details related to the site visit. Attached are a few pictures from the event.



Assessment Reports – L00



Letter of Observation (LOO)

- The LOO presents the observations from the demonstration and assessment technologies and capabilities.
- The LOO is the primary report from the Technology Survey.

I. Cover Letter

II. Observation Report

- A. Purpose
- B. Background
- C. Technology Description
- D. Summary of Observations
- E. Execution of Event
- F. Capabilities Observed

III. Summary and Recommendations





Technology Readiness Experimentation 2023 (TREX23-1)
First Look Brief 24 May 2023

Dr. Mike Tran, PhD
 Director, Assessments
 Dr. Larry Soliday, DM
 Assessments Lead



Vanilla LEUAS

Pop: Tim Soliday, Assessments Team, tim.soliday@technicrator.us



<p>Technology Description</p> <ul style="list-style-type: none"> • The Vanilla LEUAS is a Group-3 unmanned aircraft with unmatched unrefueled endurance at tactical altitudes. • Vanilla LEUAS uses a high-efficiency, heavy-fuel engine running widely available Jet-A or JP-8 fuel. • The aerodynamics are sailplane-inspired for high cruise-efficiency, despite the relatively small 36-foot wingspan. • The monocoque carbon-fiber composite airframe construction is rugged for flight in the turbulence of lower altitudes and for normal autonomous landings on an improved runway. • Vanilla LEUAV takes off from a launcher in the bed of a pickup truck. • The Ground Control (GC) controls truck taxiing and runway access like any other manned aircraft and the truck is controlled like a ground vehicle after the aircraft lifts off. 	<p>Assessment Objectives</p> <p style="font-size: x-small;">Conduct a Technical Performance Evaluation (TPE) of Vanilla LEUAS to determine its technical performance, its operational relevance, and to validate the maturity of the capability in a relevant environment.</p> <ul style="list-style-type: none"> • COI 1: [Performance Effectiveness] Does Vanilla LEUAS provide the capability to conduct persistent multi-mission capabilities? • COI 2: [Suitability] Is Vanilla LEUAS operationally suitable for persistent mission capabilities? • COI 3: [Mission Impact] Does Vanilla LEUAS positively impact persistent multi-mission capabilities? • COI 4: [Expertability] Can Vanilla LEUAS be produced, sustained, and exported? <p>Initial Observations</p> <ul style="list-style-type: none"> • COI 1: Performance Effectiveness <ul style="list-style-type: none"> ▫ Vanilla LEUAS <i>successfully demonstrated</i> X out of X COI 1 Objectives. • COI 2: Suitability <ul style="list-style-type: none"> ▫ Vanilla LEUAS <i>successfully demonstrated</i> X out of X COI 2 Objectives. • COI 3: Mission Impact <ul style="list-style-type: none"> ▫ Vanilla LEUAS <i>successfully demonstrated</i> X out of X COI 3 Objectives. • COI 4: Expertability <ul style="list-style-type: none"> ▫ Vanilla LEUAS <i>successfully demonstrated</i> X out of X COI 4 Objectives. <p>Summary</p> <p style="font-size: x-small;">Vanilla LEUAS successfully demonstrated technical performance and its operational relevance and is ready to proceed to the next level of assessment.</p>
--	---

Distribution Statement F: Further dissemination only as directed by OUSD (R)

First Look Brief (FLB)

- The FLB presents a summary (a snapshot) of the emerging assessment outcomes from the demonstration and assessment of technologies and capabilities and is presented on the final day (the DV Day) of a demonstration.
- **Note:** The FLB generally proceeds the Quick Look Brief (QLB).

Assessment Reports – FLB

UNCLASSIFIED

Technology Readiness Experimentation 2023 (TREG23-1)

First Look Brief 24 May 2023

Dr. An (Mike) Tran, PhD
Director, Assessments

Dr. Larry Soliday, DM
Assessments Lead

Controlled by: OUSD(R&E)
Category: C1
Distribution: F
POC: Mike Tran, PhD, 571-344-2721
TS/MOP: 983 4548

Distribution Statement: F. Further dissemination only as directed by OJLID, P&E, or higher DoD authority.

UNCLASSIFIED

UNCLASSIFIED

TREG23-1 Overview

POC: Dr. An (Mike) Tran, Director of Assessments, aka:tran@nsl.mil

Assessment Objectives
Conduct a Technical Performance Evaluation (TPE) of prototype technologies and capabilities to assess technical performance, its operational relevance, and to validate the maturity in a relevant environment guided by four overarching critical operational issues (COIs):

- **COI 1, Performance Effectiveness:** Does the capability improve the users' abilities to...?
- **COI 2, Suitability:** Is the capability suitable for use with existing Services and joint assets?
- **COI 3, Mission Impact:** Does the capability make a mission impact?
- **COI 4, Exportability:** Can the capability be produced, sustained, and exported?

Event Description

- OUSD(R&E) Mission Capability (MC) Prototypes & Experiments (P&E) hosted a full-scale exercise, Technology Readiness Experimentation 2023-1 (TREG23-1), 10-24 May 2023 at Camp Atterbury, Indiana.
- TREG23-1 is a key FY23 Rapid Defense Experimentation Report (RDER) event which featured both static displays and tactical scenario demonstrations to discover, demonstrate, and assess new and innovative Warfighting capabilities, accelerate joint innovation, and provide a body of evidence and feedback for future Warfighting concept development.
- The scenario event featured six technologies assessed by the P&E Assessments Team to determine each capability's technical performance and its operational relevance in a relevant environment.

Observations to Date
Observations presented below are based on data collected during the initial Technology Survey and the TPE conducted at TREG23-1.

Technology	COI 1	COI 2	COI 3	COI 4
Vanilla LEUAS	Successful	Successful	Successful	Successful
TRIPON	Successful	Successful	Successful	Successful
BANDIT	Successful	Successful	Successful	Successful
NBS	Successful	Successful	Successful	Successful
STUN	Successful	Successful	Successful	Successful
SNB	Successful	Successful	Successful	Successful

UNCLASSIFIED

UNCLASSIFIED

Vanilla LEUAS

POC: Tim Soliday, Assessments Team, tim.soliday@afsc.nso.mil

Assessment Objectives
Conduct a Technical Performance Evaluation (TPE) of Vanilla LEUAS to determine its technical performance, its operational relevance, and to validate its maturity in a relevant environment.

- **COI 1, Performance Effectiveness:** Does Vanilla LEUAS provide the capability to conduct persistent multi-mission capabilities?
- **COI 2, Suitability:** Is Vanilla LEUAS operationally suitable for persistent mission capabilities?
- **COI 3, Mission Impact:** Does Vanilla LEUAS positively impact persistent multi-mission capabilities?
- **COI 4, Exportability:** Can Vanilla LEUAS be produced, sustained, and exported?

Technology Description

- The Vanilla Long Endurance Unmanned Aircraft System (LEUAS) is a Group-3 unmanned aircraft with unmatched unrefueled endurance at tactical altitudes.
- Vanilla LEUAS uses a high-efficiency, heavy-fuel engine running widely available Jet-A or JP-8 fuel.
- The aerodynamics are airplane inspired for high cruise efficiency, despite the relatively small 90-foot wingspan.
- The monocoque carbon-fiber composite airframe construction is rugged for flight in the turbulence of lower altitudes and for normal autonomous landings on an improved runway.
- Vanilla LEUAS takes off from a launcher in the bed of a pickup truck.
- The Ground Control (GC) controls truck loading and runway access like any other manned aircraft and the truck is controlled like a ground vehicle after the aircraft lifts off.

Observations to Date

- **COI 1, Performance Effectiveness**
Vanilla LEUAS SUCCESSFULLY DEMONSTRATED: 4 out of 4 COI 1 Objectives.
- **COI 2, Suitability**
Vanilla LEUAS SUCCESSFULLY DEMONSTRATED: 7 out of 7 COI 2 Objectives.
- **COI 3, Mission Impact**
Vanilla LEUAS SUCCESSFULLY DEMONSTRATED: 2 out of 2 COI 3 Objectives.
- **COI 4, Exportability**
Vanilla LEUAS SUCCESSFULLY DEMONSTRATED: 2 out of 2 COI 4 Objectives.

Summary
Vanilla LEUAS successfully demonstrated technical performance and its operational relevance and is ready to advance to the next level of assessment.

UNCLASSIFIED

• Cover Page (Slide)

- Title
- Date
- POCs
- Distribution Statement

• Event Quad Chart


- OV-1
- Event Description
- Assessment Objectives
- Observations to Date

• Technology Quad Charts

- Picture(s)
- Technology Description
- Assessment Objectives
- Observations to Date
- Summary


Quick Look Brief (QLB)

- The QLB presents a summary (a snapshot) of the initial assessment outcomes from the demonstration and assessment of technologies and capabilities.
- The QLB can be updated during the drafting of the System Validation Report (SVR) to reflect the final assessment outcomes and serve as a summary of the SVR.
- **Note:** The QLB can also be proceeded by a First Look Brief (FLB) that is presented on the final day (the DV Day) of a demonstration.



Zepher Z1 VTOL UAS Technology Demonstration


Quick Look Briefing
6 December 2021



Executive Summary

This Quick Look Brief (QLB) presents a summary of the NineTwelve Institute's (NTI) observations, on behalf of the Hawaii Pacific Innovation Campus (HI-PIC), from the demonstration of the Z1 vertical takeoff and landing (VTOL) unmanned aircraft system (UAS) capabilities.

- The Technology Demonstration (TD) was conducted at the technology developer's Bingen, WA headquarters and test range 30 November – 1 December 2021. The assessment focused on the potential of Zepher's Z1 VTOL UAS to address a need [Joint Urgent Operational Needs (JUONs) or other requirement].
- NTI observations from the TD are based on four (4) critical operational issues (COI) and 34 objectives.



1. **COI 1. PERFORMANCE EFFECTIVENESS**
SUCCESSFULLY DEMONSTRATED the ability to improve user's secure and efficient data usage.
2. **COI 2. USABILITY**
SUCCESSFULLY DEMONSTRATED usefulness with existing Service and Joint assets.
3. **COI 3. MISSION IMPACT**
SUCCESSFULLY DEMONSTRATED mission impact.
4. **COI 3. SUSTAINMENT**
SUCCESSFULLY DEMONSTRATED supportability in production and sustainment.

2



Assessment Reports – QLB

Zepher Z1 VTOL UAS Technology Demonstration

Quick Look Briefing
6 December 2021

Assessment Objectives


COI	Demonstrated Capabilities	See, Sense, Understand, Sustain
COI 1: PERFORMANCE EFFECTIVENESS Does Z1 improve the user's ability to Conduct Persistent ISR?	<ul style="list-style-type: none"> ✓ Demonstrated the pack out size of one UAS [One case under the two-person lift threshold] ✓ Demonstrated the time to setup, from box to takeoff [Less than 5 minutes] ✓ Demonstrated in-field wing adjustment/CG modification procedure. ✓ Demonstrated payload module mechanical interface and the time to swap payloads [Less than 2 minutes] ✓ Demonstrated the time to pack up, from landed to box [Less than 5 minutes] ✓ Demonstrated ability to produce gaseous hydrogen in form factor needed for flight. ✓ Demonstrated operation of hydrogen fuel cell-integrated fuselage. ✓ Demonstrated the time to swap hydrogen tanks [Less than 2 minutes] 	<ul style="list-style-type: none"> • See • See • Sense • Sense • See • See • See • See
COI 2: USABILITY Is Z1 suitable for use with existing Service and Joint assets?	<ul style="list-style-type: none"> ✓ Demonstrated autopilot standardization [STANAG 4586 native] ✓ Discussed operator control interface [AFRL's Vigilant Spirit] ✓ Demonstrated avionics system [USSOCOM Mod Payload compliant] ✓ Demonstrated ability to assemble and disassemble UAS with no tools ✓ Demonstrated ability to refuel with no tools ✓ Demonstrated ability to change UAS Center of Gravity with no tools ✓ Discussed ability to provide Persistent ISR with one 463L pallet of equipment. 	<ul style="list-style-type: none"> • See, Sense • Sense • Sense • See • See • Sense • See, Sense

Executive Summary

This Quick Look Brief (QLB) presents a summary of the NineTwelve Institute's (NTI) observations, on behalf of the Hawaii Pacific Innovation Campus (HI-PIC), from the demonstration of the Z1 vertical takeoff and landing (VTOL) unmanned aircraft system (UAS) capabilities.

- The Technology Demonstration (TD) was conducted at the technology developer's Bingen, WA headquarters and test range 30 November – 1 December 2021. The assessment focused on the potential of Zepher's Z1 VTOL UAS to address a need [Joint Urgent Operational Needs (JUONs) or other requirement].
- NTI observations from the TD are based on four (4) critical operational issues (COI) and 34 objectives.

- COI 1. PERFORMANCE EFFECTIVENESS**
SUCCESSFULLY DEMONSTRATED the ability to improve user's secure and efficient data usage.
- COI 2. USABILITY**
SUCCESSFULLY DEMONSTRATED usefulness with existing Service and Joint assets.
- COI 3. MISSION IMPACT**
SUCCESSFULLY DEMONSTRATED mission impact.
- COI 3. SUSTAINMENT**
SUCCESSFULLY DEMONSTRATED supportability in production and sustainment.




Preliminary Observations

COI 1. PERFORMANCE EFFECTIVENESS

Does the Z1 improve the user's abilities to conduct Persistent ISR?


- Z1 SUCCESSFULLY DEMONSTRATED eight (8) out of eight (8) COI 1 Objectives.
- With a very fast set up time, small pack-out size, modularity, and hydrogen fuel cell power plant, the Z1 has the potential to increase performance effectiveness through increased user utility, improved performance, and reduced operator cognitive burden.



COI 2. USABILITY

Is the Z1 suitable for use with existing Service and Joint assets?


- The Z1 SUCCESSFULLY DEMONSTRATED five (5) out of seven (7) COI 2 Objectives [discussed two (2)].
- With a design based on military standards, an agnostic architecture, and assembly/disassembly with no tools required, the Z1 has the potential to impact the usability of Group 2 UAS across the force.



Technical Demonstration: Zephyr Z-1

LOE #1 - Operational Validation Pending PROJECT # LOE Lead: Dr. Larry Solisday

(U) Operational View (OV-1)



(U) Key Partners/Participants

- (U) Oversight Executive: TBD
- (U) CSIRO Sponsor(s): ROCCOM
- (U) Service Sponsor(s): ARMY
- (U) Warfighting Unit(s): TBD
- (U) Other: ARL, CMR, CSPP
- (U) Technical Manager: Jason Hernandez
- (U) Operational Manager: Dr. Larry Solisday
- (U) Transition Manager: TBD

(U) Key Deliverables:

- (U) AED 26-Nov-21
- (U) Demonstration 30-Nov - 1 Dec 21
- (U) Deployment TBD (USARPAC C37)
- (U) Validated at TED (USARPAC C37)
- (U) Assessment Time: Technology Survey
- (U) Assessment Deliverable: Letter of Observation
- (U) CONOP: TBD

(U) Technology Description

- Hydrogen fuel cell powered Group 2 VTOL UAS designed for peer conflicts and hyper-enabled operators
- Significantly improved acoustic signature, endurance, and GPS position hold due to actively controlled/variable pitch propeller reverse thrust capability
- Node based avionics architecture with CANbus for MOD Payload compliance and high reliability

(U) Program Accomplishments to Date

- Conducted the Technology Survey 30 November – 1 December 2021 at Zepher's Bingen, WA headquarters and test range
- Submitted Quick Look Brief (QLB) 7 December 2021
- Drafted the Letter of Observation (LOO) 7 December 2021. Will submit NLT 10 December 2021.

(U) Expected Operational Value

- Delivers a scalable alternative fuels VTOL UAS capability with significant acoustic signature reduction, common communications protocols, advanced low-coast surveillance, and optimization of large volumes of fuel.
- Targets INDOPACOM IPL: 6 Gaps
- Targets USARPAC CIG CPA: 3 Gaps
- Targets USARPAC IPL: 3 Gaps
- Targets CBA LCOO Study: 3 Gaps

(U) Concept of Operations

- Working with USARPAC G2 Futures to develop concept of employment (use cases)
- Will schedule a meeting with 1 Copy Innovation Group to discuss potential operational demonstration (OO)
- Will schedule a follow-up meeting with USARPAC C37 the week of 13 – 17 December 2021 to discuss exercise planning

(U) Transition Strategy/Milestones

- (U) Requirements Documentation (CONOPS, Ops Requirements, System and Subsystem Functional and Performance Requirements)
- (U) Test Documentation (Plan, Report, Analysis of Alternatives)
- (U) Transition Strategy (Key Stakeholders, Cost Estimates, Residual Use Plan, ACO Insertion Point, Contracts)

(U) Assessment Determination/Milestones Leading to Fielded Capability

- (U) Transform into a higher-level assessment.
- (U) Develop next assessment plan/schedule, CONOP development
- (U) Identify resource sponsor and/or leverage Program of Record

(U) Key Deliverables Timeline:

- AED Development (26 Oct - 26 Nov 21)
- Assessment Report (2 - 19 Dec 21)
- CONOP Development (13 Dec 21 - TBD)
- Meet with Vendor (28 Oct 21)
- Final AED (TBD)
- QA (7 Dec 21)
- Test Survey (28 Nov - 1 Dec 21)
- IT/OP (Only)
- Use Case (TBD)
- COI Fair Assess (TBD)
- TCO SLA RC (TBD)
- T3 Decision (NLT 17 Dec 21)
- Meet with Vendor (NLT 17 Dec 21)
- SP Sponsor/roll (NLT 17 Dec 21)

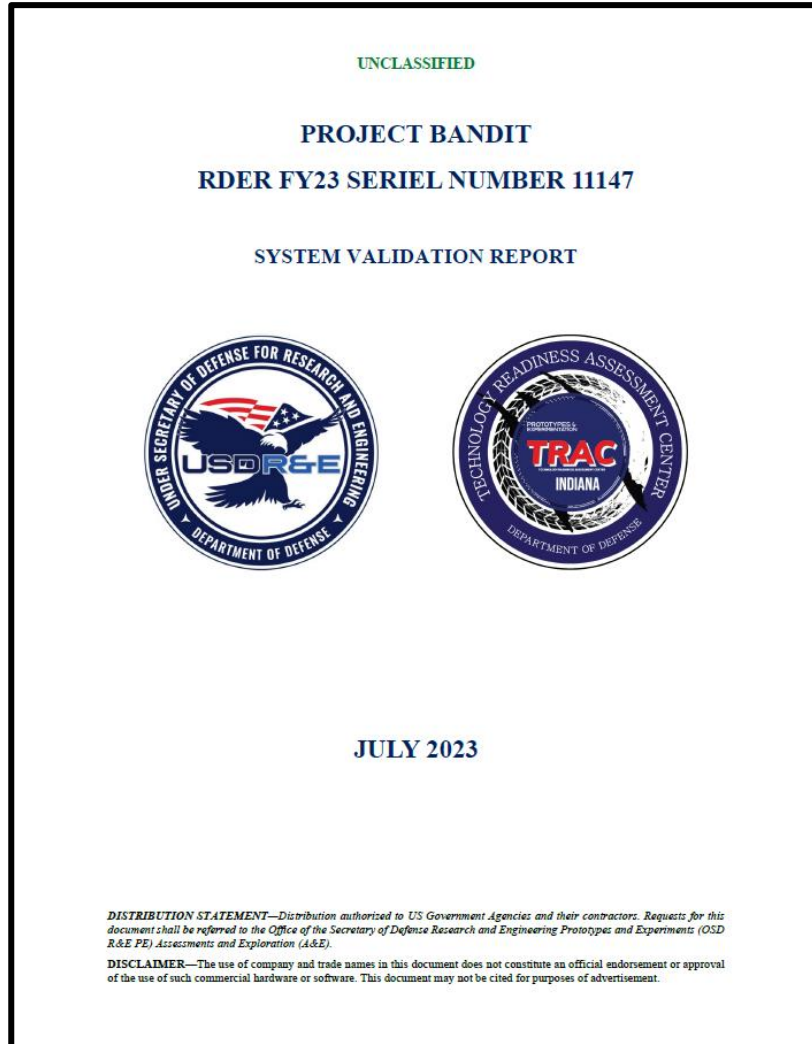
Assessment (28 Nov - 9 Dec 21) Determination (13 - 17 Dec 21)

UNCLASSIFIED

Preliminary Observations

- Transform into a higher-level assessment.** The Z1 VTOL UAS demonstrated potential to address a need (JUON or other requirement). The Z1 has the potential to advance capabilities in Persistent Intelligence, Surveillance, and Reconnaissance (ISR), fit into existing Service usability parameters, significantly impact missions, and remain supportable in production and sustainment.
- Develop next assessment plan/schedule:** It is recommended that the Z1 be scheduled for a Technical Capability Test (TCT) to demonstrate and assess the technical merit of Z1 to solve an operational problem.
- CONOPS development.** It is recommended that USARPAC develop concept of operations (CONOPS) for how the Z1 could be incorporated into fielding. These CONOPS would provide valuable end user feedback to the technology developer for continued platform development, as well as being utilized as demonstration scripts for an OD.
- Identify resource sponsor and/or leverage Program of Record.** The Z1 was developed under a prime contract with the Army Research Laboratory (ARL) in accordance with a United States Army Special Operations Command (USASOC) requirement. Funding under this contract has been expended, and Zepher is currently operating under internal funding. In order to 1) secure and sustain the existing Z1 workforce and 2) ensure the remaining Z1 developmental items can be completed, it is recommended that USARPAC identify a resource sponsor and/or a leverage Program of Record (POR).

Assessment Reports – Test and Assessment Report



Test and Assessment Report

- The Test and Assessment Report presents the conclusions and recommendations from the demonstration and assessment of technologies and capabilities.
- The Test and Assessment Report presents a summary of all the assessment activities, methods used for assessment, and a summary of the assessment results to date.
- **Note:** The Test and Assessment Report can present the conclusions and recommendations for a demonstration event or can focus solely on all the demonstration and assessment activities for a specific technology or capability to date.



Assessment Reports – Test and Assessment Report

I. Executive Summary

II. Introduction

- A. Purpose
- B. Background
- C. Operational Problem
- D. Technology Description
- E. Objectives and General Assessment Approach
- F. Integrated Management Team (IMT) Participants

III. Execution

- A. Location
- B. Schedule
- C. Scope and Test Design
- D. Limitations

IV. Results

- A. Analysis of Objectives
- B. COI 1 (Performance Effectiveness)
- C. COI 2 (Usability)
- D. COI 3 (Mission Impact)

- E. COI 4 (Exportability)

V. Conclusions and Recommendations

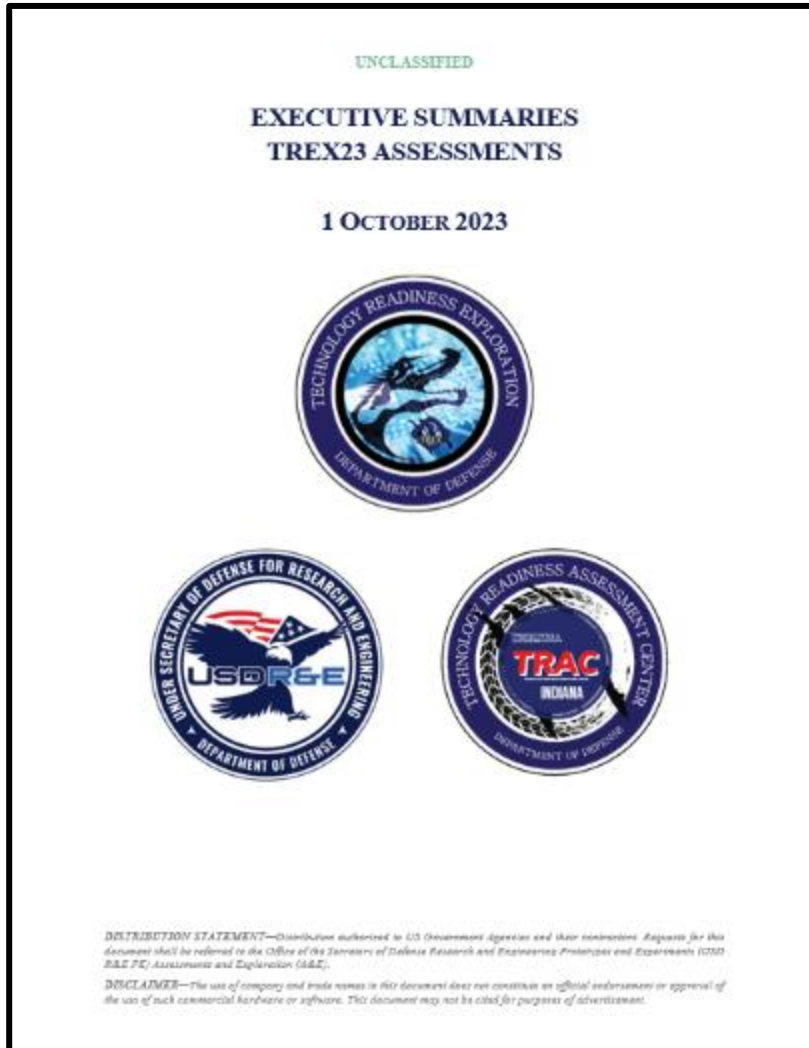
- A. Conclusions
- B. Recommendations

VI. Appendix A: Supporting Material

VII. Annex A-1: Acronyms

VIII. Appendix A-2: Units of Measure

Assessment Reports – EXSUM



Executive Summary (EXSUM)

- The EXSUM summarizes the technology or capability, the potential of the technology or capability, the assessment conducted, the critical operational issues (COIs) assessed, the outcomes of the assessment, and the recommendations going forward.
- Commonly referred to as the “Reader’s Digestion” version of the IAP, AED, and SVR.
- **Note:** The EXSUM can summarize the outcomes and recommendations of a demonstration event (such as T-REX23-2) or can focus solely on a specific technology or capability.



Assessment Reports – EXSUM

UNCLASSIFIED

EXECUTIVE SUMMARY

The BlueShield – SIPR - NIPR in a BOX (SNB) demonstrated technical performance and operational relevance by providing seamless, interoperable communications (voice and data) across disparate military and commercial communication networks (e.g., SATCOM, radios, cellular, and IP-based networks). SNB features a modular design and open architecture enabling tailorable solutions to meet mission needs. It fuses heterogeneous soldier, combat net, and multiband tactical radio communication technologies into a fully integrated mesh network regardless of communications spectrum, waveform, or protocol. The SNB capability, when integrated into a deployed communications architecture, provides secure strategic and tactical communications directly supporting Joint All-Domain Operations (JADO).

The Office of the Under Secretary of Defense (OUSD) Research and Engineering (R&E) Prototypes and Experiments (P&E) [OUSD(R&E)/P&E] Assessments Team observed Technical Demonstrations (TDs) of the United States Central Command (USCENTCOM) sponsored SNB capability. The first TD event was a Technology Survey conducted on 2-3 March 2023 at the TribalCo facility in Tallapoosa, GA. The second TD event involved a Technical Performance Evaluation (TPE) conducted during the Technology Readiness Exercise (T-REX) FY23-1 at Camp Atterbury, Edinburg, Indiana, 16-24 May 2023. Observations from the TDs were based on four Critical Operational Issues (COIs). During the TDs, SNB successfully demonstrated each COI. A synopsis of SNB's technical and mission assessment by COI is captured in Table 1 on the following page.

Based on observations and the evidence collected and presented in this report, it is reasonable to assign the SNB capability a minimum Technology Readiness Level (TRL) of 6. SNB is recommended for further experimentation by OUSD(R&E)/P&E in future utility assessment events and/or appropriate joint military exercises. This could include, but not be limited to, a situationally and operationally relevant Operational Demonstration (OD) and/or Operational Assessment (OA) to develop concept of operations (CONOPS) for how the SNB capability could be incorporated into fielding.

UNCLASSIFIED

Table 1: SNB T-REX 23-1 Assessment Results

COI	Assessment Stoplight	Assessment Summary
COI 1 (Functional & Performance Attributes) Does SNB provide seamless communication across disparate military and commercial communications networks in its intended Kill Chain capacity?	●	<ul style="list-style-type: none"> SNB successfully demonstrated seamless classified and unclassified communications across six disparate technologies including: Silvus, TrellisWare, Link-16, Starlink SATCOM, Wi-Fi, and Commercial Cellular (LTE). Target track information and representative airborne sensor video were successfully exchanged between forward deployed elements and decision makers.
COI 2 (Usability & Deployment Complexity): Is SNB suitable for use with existing service and joint assets in providing seamless interoperable secure communications?	●	<ul style="list-style-type: none"> SNB can be implemented in multiple deployment form factors depending on mission application ranging from larger Command Post units to man portable units. As a measure of expeditionary value, SNB was tailored to establish a classified node on the Marine Corps FMF Grid.
COI 3 (Security & Mission System Interoperability): Does SNB have a positive mission impact in providing seamless, interoperable secure communications?	●	<ul style="list-style-type: none"> SNB successfully demonstrated the integration of the STUN transport layer application to provide secure covert data exfiltration over commercially open SATCOM. SIPR VTCs successfully conducted between edge node Private Access Cell user and actively deployed forward mission asset (USS BATAAN) through SNB.
COI 4 (Maintainability & Expandability): Can SNB be maintained and adapted to the mission environment needs?	●	<ul style="list-style-type: none"> SNB is the integration of currently deployed hardware and software familiar to operational users and maintainers. Troubleshooting system operation issues and system faults in the field require no additional specific SNB knowledge, skills, or abilities.
Key	●	Likely to Meet Standards; Significant Improvement Over Current Capability
	●	Unlikely to Meet Standards; Not a Significant Shortfall; Marginal Improvement over Current Capability
	●	Unlikely to Meet Standards; Significant Shortfall; Not an Improvement Over Current Capability
	○	Inconclusive or Not Tested



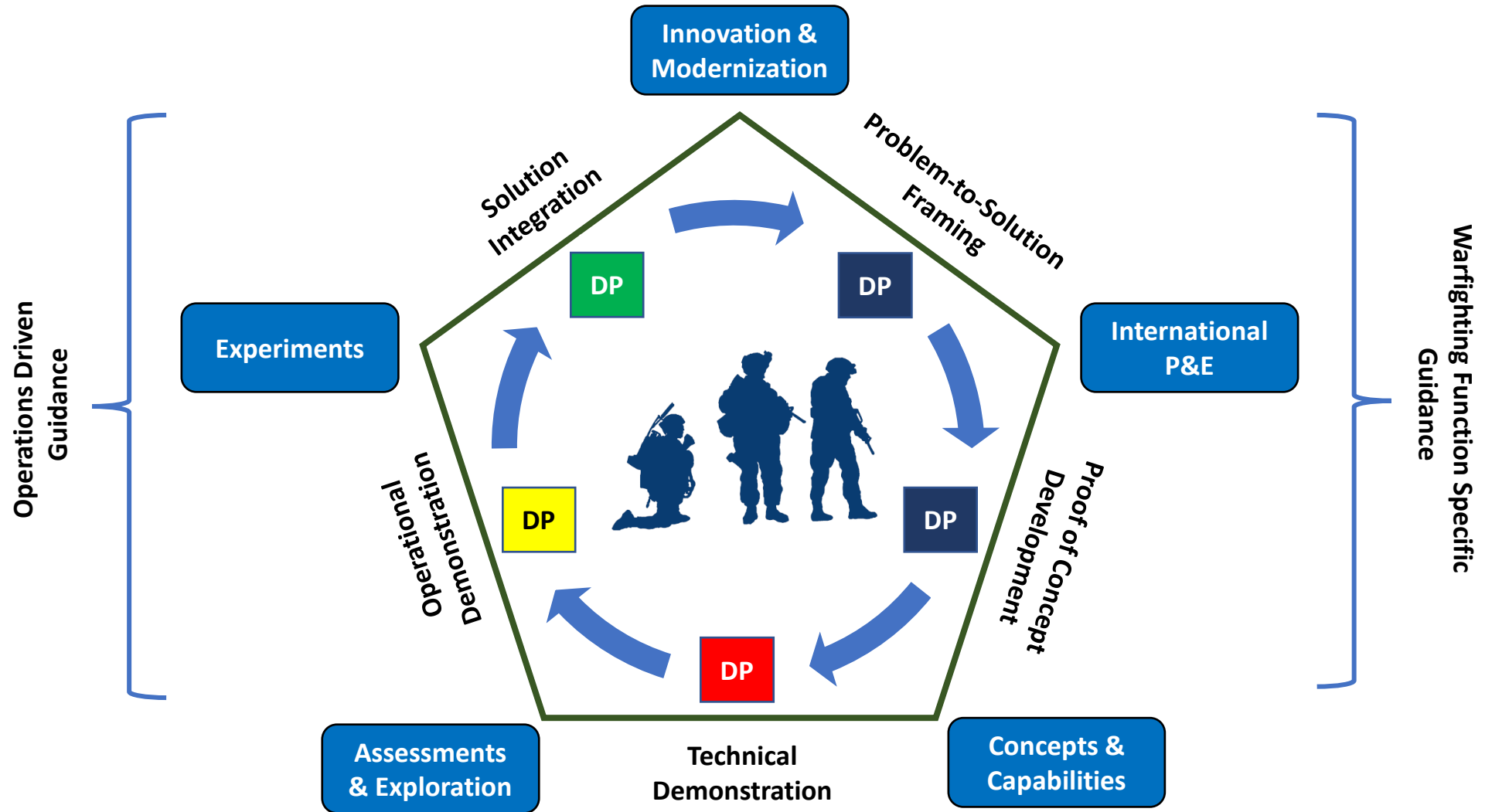
OUSD(R&E)



Office of the Under Secretary of Defense for Research and Engineering (R&E)

- T2L LLC developed and implemented unique processes and methodologies to conduct technical and operational demonstrations and assessments for all OUSD(R&E) Prototype and Experimentation (P&E) programs (up to 80 each year).
- T2L LLC planned and conducted inaugural Technology Readiness Experimentation (T-REX) event supporting OUSD(R&E)'s Rapid Defense Experimentation Reserve (RDER) initiative.
- T2L LLC developed and taught curriculum and course content for first ever Assessment Academy (ASMT 101 – Fundamentals of Assessment).

OUSD(R&E) P&E Assessment Process





OUSD(R&E) P&E – Exemplar

Technology Readiness Experimentation (T-REX)

T-REX is a new and enduring campaign of experimentation developed to support OUSD(R&E)'s Rapid Defense Experimentation Reserve (RDER) initiative.

T-REX serves as a key exercise venue to accelerate joint innovation and provide real-world data to OUSD(R&E) for future Warfighting concept development.

T2L LLC designed and implemented the test and assessment processes and methodologies that underpin T-REX and led the successful pilot implementation in FY23.





OUSD(R&E) P&E – Exemplar



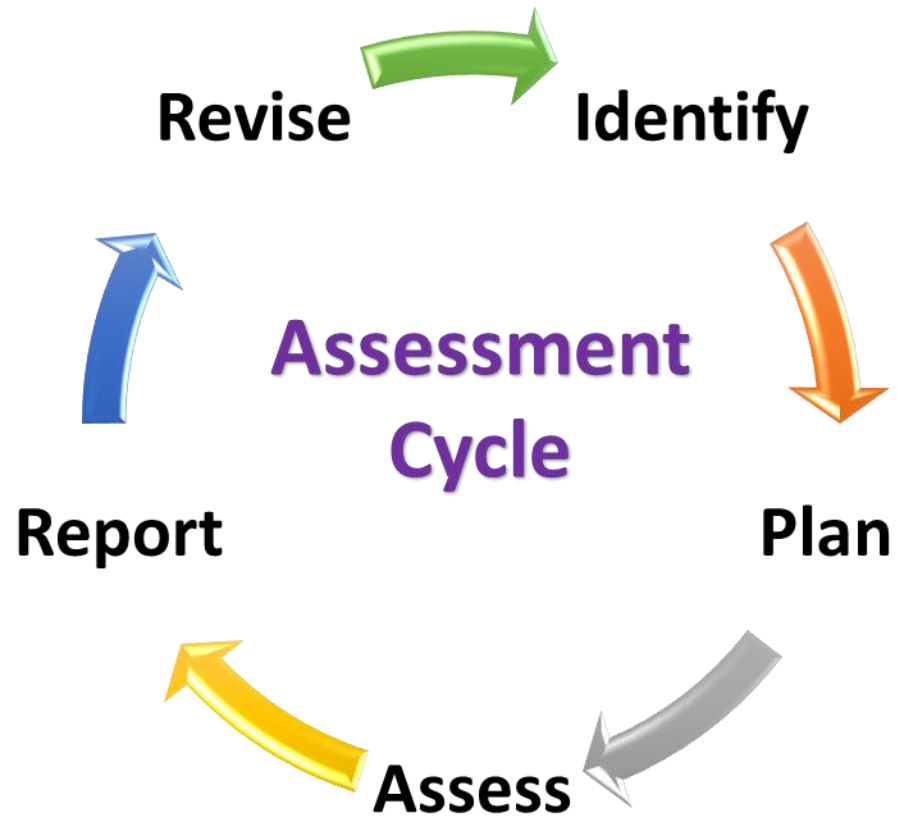
As a key RDER event, T-REX 23-1 was a full-scale exercise featuring tactical scenario demonstrations based on a “disaster scenario” supported by the participation of the 26th Marine Expeditionary Unit (MEU) and a Prototype Technology Display to **discover, demonstrate, and assess** new and innovative Warfighting capabilities.

T-REX 23-1 Feedback . . .

"A key attribute of RDER is the focus on a campaign of experimentation that enables the collection of a body of evidence to accelerate technology transition to the field," Browning said. "T-REX is integral to the success of this enduring campaign of experiments."



OUSD(R&E) P&E ASMT 101 – Fundamentals of Assessment



- ASMT 101.U01** The Role of Assessment
- ASMT 101.U02** Identifying Assessment Requirements
- ASMT 101.U03** Assessment Processes
- ASMT 101.U04** Technical Demonstration
- ASMT 101.U05** Operational Demonstration
- ASMT 101.U06** Operational Assessment
- ASMT 101.U07** Range of Assessments
- ASMT 101.U08** Interoperability
- ASMT 101.U09** Data Management
- ASMT 101.U10** Assessment Planning
- ASMT 101.U11** Assessment Conduct
- ASMT 101.U12** Assessment Observation and Analysis
- ASMT 101.U13** Assessment Reporting
- ASMT 101.U14** Assessment Practical Exercise



OUSD(R&E) P&E ASMT 101 – Fundamentals of Assessment

Day One

- 0800 – 0900 The Role of Assessment
- 0900 – 1000 Identifying Assessment Requirements
- 1000 – 1200 Assessment Processes
- 1200 – 1300 Break
- 1300 – 1400 Technology Demonstration
- 1400 – 1500 Operational Demonstration
- 1500 – 1600 Operational Assessment
- 1600 – 1700 Team Building Exercise

Day Two

- 0800 – 1000 Range of Assessments
- 1000 – 1100 Interoperability
- 1100 – 1200 Data Management
- 1200 – 1300 Break
- 1300 – 1500 Assessment Planning
- 1500 – 1700 Assessment Conduct

Day Three

- 0800 – 1000 Assessment Observation and Analysis
- 1000 – 1200 Assessment Reporting
- 1200 – 1300 Break
- 1300 – 1700 Assessment Practical Exercise

Day Four

- 0800 – 1200 Assessment Practical Exercise
- 1200 – 1300 End of Course Wrap Up

T2L LLC developed and conducted the first ever OUSD(R&E) sponsored course on conducting assessments.



USARPAC

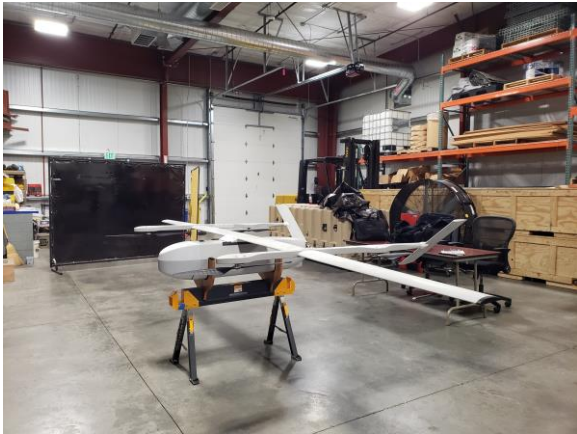


United States Army, Pacific (USARPAC) ISR/PED Innovation

- T2L LLC designed and implemented an innovative capability to identify, demonstrate, assess, and validate the operational utility of disruptive technologies and capabilities to address USARPAC and identified ISR/PED capability gaps in the Theater Army and/or other USARPAC formations.
- T2L LLC led 46 assessments from 5 January to 1 December 2022 producing 186 test and assessment artifacts for USARPAC.



USARPAC – Exemplar



Zepher Z1 VTOL UAS

- T2L LLC conducted a Technology Survey and Technical Capability Test (TCT) to assess the technical merit of the Z1 Vertical Takeoff and Landing (VTOL) Unmanned Aircraft System (UAS) to solve an operational problem based on United States Army Pacific (USARPAC) Intelligence and Security Section (G2) identified gaps.
- Working with USARPAC, T2L LLC developed four (4) Critical Operational Issues (COIs) and 34 associated objectives to frame the technology demonstration and assessment to include 33 demonstrable tasks that address Conduct Persistent ISR, Use with Existing Service and Joint Assets, Mission Impact, and Production and Manufacturability.



How can we help you ? ? ?



Questions



Dr. Larry Solliday, DM

President

lawrence.m.solliday.ctr@mail.mil

larry.solliday@t2linc.com

812-675-7739