Warfighter Innovation Leveraging Expertise and Experimentation 3.0 (WILE-E 3.0) : The Deployable CBRNE Microsensor Concept

Jennifer Sekowski, PhD[1], Robert Wahl[2], Charles Harris[3], Neel Bhardwaj[4], Nathanael Tchamanbe Njine[5], and Alan Samuels, Ph.D[6].

1Biodefense Branch, CBRNE Assessment Division, R&O Directorate, 2Protection and Decontamination Test Branch, Chemical Test Division, Engineering Directorate, 3Sustainment Engineering Protection Branch, Sustainment Engineering Division, Engineering Directorate, 4Analysis Division, Engineering Directorate, 5Collective Protection & Ground Mask Acquisition Branch, Acquisition Program Management & Matrix Support Division, Engineering Directorate, 6Chemical Analysis & Physical Properties Branch, R&O Directorate, US Army DEVCOM, Chemical Biological Center, Aberdeen Proving Ground, MD, 21010

Introduction

Warfighter Innovation Leveraging (mission) Experience and Expertise (WILE-E) is a US Army DEVCOM CBC initiative that brings together a small group of diverse individuals from across CBC into a multidisciplinary team to tackle challenging problems faced by today's Warfighters. In 2022, a group of Future Oriented eXperimenters (FOXes), comprised of six (6) diverse scientists and engineers, convened for two days a week over a six-month period to understand and present solutions to a problem. In this third iteration (WILE-E 3.0) the FOXes developed an innovative Deployable CBRNE Microsensor Concept by applying the Design Thinking process (Fig.1) to deeply understand the warfighter need, define the problem space, ideate on the potential solution space, then carry out cycles of prototyping and experimenting, all the while incorporating feedback from Warfighters at every step in the process.

Methods

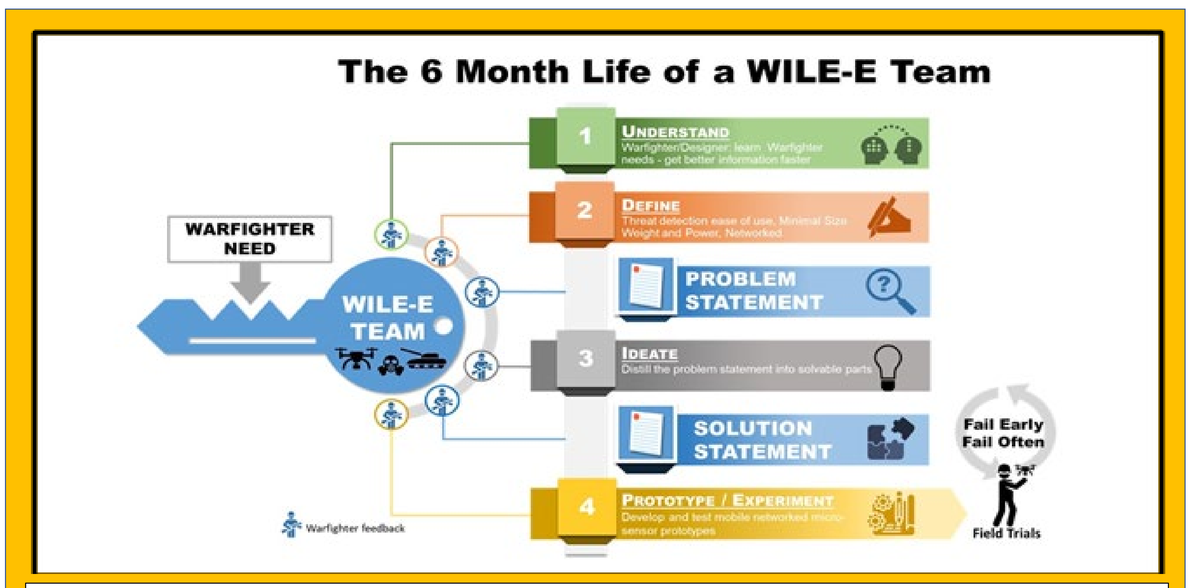

Figure 1. The Design Thinking process as put into practice by the WILE-E 3.0 Team

1. UNDERSTAND

Figure 2. Discussions with Mr. Michael Bailey, COL Scott McIntosh, MAJ Steve Deleon, Dr. Patricia McDaniel, Mr. Kevin Wallace, and Ms. Shelby Bartram helped the WILE-E Team understand both Programmatic and Warfighter perspectives

2. DEFINE

Figure 3. AIM SOFWERX initiated Q&A session for Microsensor current capabilities discussion with academia and industry helped shape definition of the problem.

Figure 4. Active participation of each WILE-E member in the SOFWERX Microsensor workshop helped shape the definition of the problem statement for WILE-E 3.0.

WILE-E PROBLEM STATEMENT (Figure 5):

"Current technology lacks a readily-deployable, integrated, platform agnostic, micro sensor capability that detects and delineates chemical vapor, over an extensive operational area that is incorporated and securely transmitted to a common operation picture for technical force protection considerations."

Methods Cont'd.

3. IDEATE

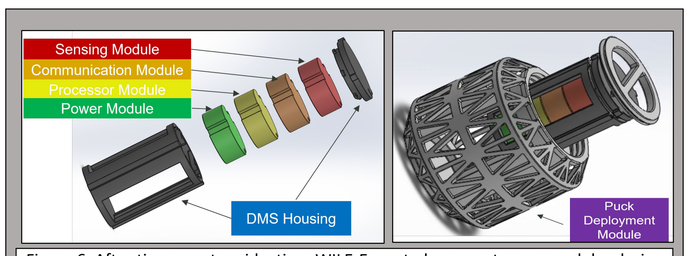

Figure 6. After time spent on ideation, WILE-E created an easy to use, modular design concept for the DMS. Housing (left) contains subcomponents (sensing, communication, processing, and power modules) that are easily upgradable and tailorable for specific missions (i.e. different sensors). The modular sensor can be hand emplaced or UAS-deployed in the Puck deployment module (right) .

WILE-E SOLUTION STATEMENT (Figure 7)

WILE-E defined seven technical areas to be addressed toward developing an ideal fieldable chemical vapor DMS concept over time.

4. PROTOTYPE AND EXPERIMENT

Figure 8. UAS puck deployment test dropped pucks from various heights

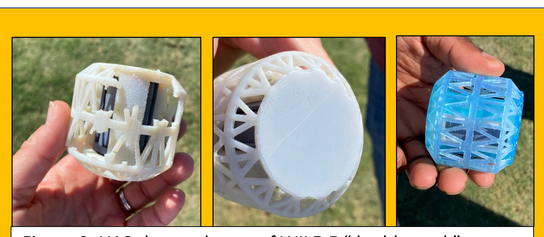

Figure 9. UAS-dropped tests of WILE-E "double puck" system helped determine best additive manufacture materials for DMS prototype

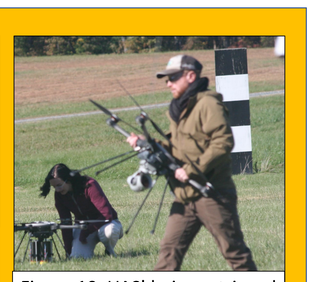

Figure 10. UAS' being retrieved and readied during the WILE-E Integration Experiment tests (20 OCT 2022)

Results & Deliverables

1) DCMS Trade Space Analysis - Tool to assess the relative importance to the Warfighter of different features of the DMS system concept. Can be used to inform requirements now and assess technologies in the future.

2) DMS SysML Model - Digital Systems Engineering Model of the systems concept that can be used throughout the lifecycle of the CBC Microsensors campaign to define interfaces and other architectural specifications.

3) DMS Prototype - 3-D Printed Conceptual prototype to show key features of the WILE-E 3.0 DMS Concept and provide a visualization for stakeholders. CAD design is part of a provisional patent application pending submission.

4) DMS Conceptual Video - ADM-developed video that visualizes the art of the possible for DMS use in a tactical environment. Designed in partnership with MSCDID and MSCOE.

5) DMS Integration Experiment - The Integration Experiment held on CBC's M-field, was a large group effort, including many participants from CBC, C5ISR, and Industry, which showcased and tested the concept of integrating multiple relevant technologies to advance the DMS concept.

Figure 11. The 3-minute long Concept Video illustrates the DMS concept in an operational scenario.

Figure 12. Warfighters and CBC WILE-E Architect, Lowry Brooks, and MSCOE LNO, David Glynn, discuss the single and double puck DMS concepts

Acknowledgements

WILE-E 3.0 was funded under the 2363 program (APR-OCT 2022). The authors also extend their appreciation to the following individuals for their hard work and assistance with the execution of this technical program:

Lowry Brooks (Dep.Dir., Engineering), Meg Hower (Assoc.Dir.Ops., Engineering), Amanda Leahy, Sabrina Rawlings-Seiple, and Genna Rowe (DEVCOM CBC) for being the architects of the WILE-E program; COL Scott McIntosh, MAJ Steve DeLeon, David Glynn LNO, and Mike Cress LNO (DEVCOM CBC) for advising WILE-E 3.0 on current Army operations; MSCDID (CW3 Macio Brown, CPT Jorge Munoz-Negron), MSCoE for providing input to the Trade Space analysis and Concept Video, and access to their Soldiers, without which WILE-E could not have been successful; AIM SOFWERX, especially Kevin Wallace and Michael Guinn ; Dr. Patricia McDaniel (Microsensors Program PI, ST for Chemistry) and Ms. Shelby Bartram (Microsensors PM) for their overarching support, communication, and encouragement. Design West Technologies, Inc. and Lyten, Inc. for showcasing their technologies and supporting technology integration efforts at our integration experiment; DEVCOM C5ISR Center; Joe Domanico for providing his expertise in pyrotechnics and ballistics to provide an example of deployment methods for C-MS at the Integration Experiment; JD Severtsen and Brad Ruprecht for teaching WILE 3.0 Solidworks and for creating 3D Prototypes of our C-MS Concept through the Advanced Design and Manufacturing (ADM) Makerspace, and for helping us with the actual prototype fabrication; Harold Wylie for piloting all UAS' in preparation for and during our integration experiment; Bri McNamara and the team on ADM's Interactive Software and Visual Media Branch for bringing the DMS concept to life through our concept video; Kelley Betts for her graphic design of the WILE-E Process, Mark Hull for supporting all M-Field range activities for our integration experiment; CBC Chemical Release Team (Aime Goad, Angela Ziegler, Chris Zimmerman, Dan McCready, Jana Kesavan) for handling chemical release activities for our integration experiment; CBC Network Integration Branch (Fiona Wiggins, Max Bottiger, Craig Knox, Josh Schulte) for supporting integration of the DWT Puck dropper into the ATAK environment for demonstration at our integration experiment.