TASK ORDER NUMBER: W81XWH-18-9-0003

MTEC RESEARCH PROJECT NUMBER: 18-01-MEDLOG-03

EGS NUMBER: MT18001.01

TITLE: Model Use of Innovative MEDLOG Data Management Technologies and Industry Best Practices: Architecture, Data Transactions Model and Prototype for a Highly Scalable, Integrated, and Just-in-Time Defense Medical Logistics Enterprise to Support Next Gen Theater/Operational Medicine

PRINCIPAL INVESTIGATOR: Dr. Eugene Schneller (gene.schneller@asu.edu)

PERFORMING ORGANIZATION: Arizona State University,
WP Carey School of Business Department of Supply Chain Management

CONTRACTING ORGANIZATION: Medical Technology Enterprise Consortium (MTEC)

REPORT DATE: October 2020

TYPE OF REPORT: Final Report

PREPARED FOR: U.S. Army Medical Research and Development Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release; Distribution Unlimited

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
October 2020	Final	1 Aug 2018 – 31 Jul 2020

4. TITLE AND SUBTITLE
Model Use of Innovative MEDLOG Data Management Technologies and Industry Best Practices: Architecture, Data Transactions Model and Prototype for a Highly Scalable, Integrated, and Just-in-Time Defense Medical Logistics Enterprise to Support Next Gen Theater/Operational Medicine

5a. CONTRACT NUMBER
W81XWH-15-9-0001

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Dr. Eugene Schneller, Dr. Dale Rogers, George Ramos, Jim Eckler, Richard Perrin, Harvey George, Gerardo Moralez, Michael Gillespie, Carol Fraser

E-Mail: gene.schneller@asu.edu

5d. PROJECT NUMBER
MT18001.01

5e. TASK NUMBER
W81XWH-18-9-0003

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Arizona State University
WP Carey School of Business
Department of Supply Chain Management
PO Box 878706
Tempe AZ 85287-4706

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Development Command
Fort Detrick, Maryland 21702-5012

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
N/A

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
This report supports, in part, the ongoing technical refresh of the Defense Medical Logistics Standard Support (DMLSS). The overall goal of this effort is to enable Defense Health Agency (DHA) medical logistics (MEDLOG) to optimize performance and provide best-value services. In Phase 1, the ASU Team performed an analysis of current industry/academic supply chain and logistics progressive (best) practices, future trends and technical capabilities, and emerging technologies for evaluation and potential adoption. In Phase 2, the ASU Team built upon the characterization of defense medical logistics and the resulting recommendations identified in Phase 1 through two work streams: (1) the development of a prototype for recall management and (2) the development of a roadmap for targeted functions of a fully integrated supply chain organization (FISCO) to reach industry best practice (IBP) and beyond. The prototype provides visibility and tracking of alerts, provides information to shape responses, and ultimately contributes to positive patient outcomes. The roadmap identifies detailed milestones to enable DHA to advance to IBPs. Areas considered are product standardization and sourcing, authoritative data, contracting, inventory and asset management and product recalls. The roadmap considers processes, technologies, and strategies for evaluation and potential adoption to meet the end goal of enhancing defense medical logistics performance.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			USAMRMC
Unclassified	Unclassified	Unclassified	Unclassified	18	19b. TELEPHONE NUMBER *(include area code)*

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

MTEC Medical Technology Enterprise Consortium

W. P. CAREY SCHOOL of BUSINESS
ARIZONA STATE UNIVERSITY

DEPARTMENT of SUPPLY CHAIN MANAGEMENT

PO BOX 874706
TEMPE, AZ 85287-4706

(480) 965-6044
FAX: (480) 965-8629
www.wpcarey.asu.edu

July 31, 2020

Mr. Randall Fernanders, CFCM
Contracts Administrator
Advanced Technology International
315 Sigma Drive
Summerville, SC 29486

Re: Prime Contract Number W81XWH-15-9-0001: Model Use of Innovative MEDLOG Data Management Technologies and Industry Best Practices: Architecture, Data Transactions Model and Prototype for a Highly Scalable, Integrated, and Just in Time Defense Medical Logistics Enterprise to Support Next Gen Theater/Operational Medicine

Dear Mr. Fernanders,

Enclosed are the following report deliverables for the MEDLOG project:

- Final Technical Status Report
- Final Business Status Report

If you have any questions regarding these documents, please contact me at (602) 320-1512.

Sincerely,

Eugene S. Schneller, Ph.D., Professor
Dean's Council of 100 Distinguished Scholar

Enclosures

Copies:
David Thompson (david.m.thompson68.civ@mail.mil)
Cindy Crump (cindy.a.crump.ctr@mail.mil)
Annetta Hart (annetta.r.hart.civ@mail.mil)
Dr. Eugene Schneller (gene.schneller@asu.edu)
David Winkel (david.winkel@asu.edu)
Richard Perrin (raperrin@activeinnovations.org)

TABLE OF CONTENTS

Final Technical Status Report for

Model Use of Innovative MEDLOG Data Management Technologies and Industry Best Practices: Architecture, Data Transactions Model and Prototype for a Highly Scalable, Integrated, and Just-in-Time Defense Medical Logistics Enterprise to Support Next Gen Theater/Operational Medicine

Research Project No. 18-01-MEDLOG-03

EGS# MT18001.01

Reporting Period: 1 Aug 2018 to 31 Jul 2020

MTEC Research Project Awardee

Project Lead: Arizona State University

Additional Project Team Members: Active Innovations, LLC; Expression Networks, LLC; Global Health Exchange, LLC

Research Project Technical POC:
Dr. Eugene Schneller
Arizona State University
WP Carey School of Business Department of Supply Chain Management
PO Box 878706
Tempe AZ 85287-4706
480-965-6044
Gene.Schneller@asu.edu

Submitted: 31 Jul 2020

1. Project Status
    a. Accomplishments

Phase 1

- Developed list of focus areas and supporting information (relevant sub-topics, key questions, source of answers to questions, priority, etc.) for assessment during interactions with DHA personnel. Also developed an early list of best practices found in the modern healthcare supply chain management terrain.
- Completed the development of 1) Supply Chain Health Assessment Process, Systems, and Standards Questionnaire and 2) Supply Chain (SC) Director and Clinician Interview Questions. These questionnaires complement the list of focus areas and supporting information described in the previous bullet.
- Conducted first Industry Advisory Board (IAB) meeting on 26-Oct-18 at SkySong, the ASU Scottsdale Innovation Center. Attendees included representatives from General Motors, Intel, Kaiser Permanente, Banner Health, Institute for Supply Management, Philips, Johnson and Johnson, FedEx, APL Logistics, and Resilinc.
- Completed interactions with the Defense Health Agency (DHA) and other government stakeholders: Navy Expeditionary Medical Support Command (NEMSCOM), Ft. Belvoir, Army and Navy Senior Service Representatives (SSRs) at Ft. Detrick, Joint Medical Logistics Functional Development Center (JMLFDC), Walter Reed National Military Medical Center, Naval Medical Center San Diego Balboa, Naval Hospital Guantanamo, Naval Bureau of Medicine Logistics Policy, Defense Logistics Agency (DLA) Troop Support, San Antonio Military Medical Center/Brooke Army Medical Center (SAMMC/BAMC)/Lackland Air Force Base Wilford Hall Medical Facility, AmerisourceBergen, Joint Operational Medicine Information Systems, Owens and Minor, and ECRI.
- Completed interactions with IAB members and other organizations: Mercy, Banner, Kaiser, Cook Medical, Strategic Marketplace Initiative (SMI), Gates Foundation, General Motors (GM), Philips, Johnson & Johnson, Mayo Clinic, Owens & Minor, University of Pittsburgh Medical Center (UPMC), Pensiamo, JDA, Qventus, Vitreos Health, Johns Hopkins, Mercy Health ROi, Baylor Scott and White, CargoSense, Flexport, Gartner, FirstHealth, Vanderbilt, TecSys, Life365, DocBox, Crane, University of Colorado Denver, and University of Colorado Health.
- Engaged with other DHA performers to ensure awareness across performers and identify possible synergies.
- Completed and submitted the Interview Materials deliverable to the DHA on 20-Nov-18.
- Completed and submitted the Defense Medical Logistics – Enterprise System (DML-ES) Characterization deliverable to the DHA on 07-Mar-2019.
- Completed and submitted the Raw Interview Output deliverable to the DHA on 14-Feb-2019.
- Completed and submitted the Phase 1 Recommendations deliverable to the DHA on 13-Jun-2019
- Completed and submitted Risk Management report to the DHA on 2-Jul-2019.

Phase 2

- Completed a proposed high-level Phase 2 plan calling for two work streams: (1) roadmap for targeted Fully Integrated Supply Chain Organization (FISCO) functions to reach industry best practice (IBP) and beyond; and (2) prototype for recall management.
- Reviewed the high-level Phase 2 plan with DHA personnel to discuss the various roadmap sections in detail, to better understand DHA practices and future plans in those areas, to discuss recall processes, and to identify valuable DHA points of contact that can be accessed by the ASU Team going forward.
- Completed and submitted the Prototype and Roadmap Plan deliverable to the DHA on 1-Oct-2019. A revised version was submitted on 12-Nov-19.

- Completed the characterization of existing ("as-is") DHA recall process workflow and IBP recall process workflow. These workflows form the basis for the proposed recall workflow that was incorporated into the prototype deliverable.
- Carried out extensive reviews of academic and practitioner literature to ground the assessment in evidence-based observations.
- Conducted in-person reviews of the proposed recall process workflow and architecture with DHA and JMLFDC. The meetings were critical to refining the proposed workflow and ensured the prototype met sponsor expectations.
- Conducted second and final IAB meeting on 6-Nov-2019 at ASU SkySong. Attendees included GM, Intel, Gore, Mayo Clinic, Scripps Healthcare, Resillinc, Kaiser Permanente, Banner Health, Providence Health, Institute for Supply Chain Management, and senior logistics leadership from DHA.
- Conducted interviews with former clinicians to gain insight into the management and selection of products including experts from Dignity Health and the University of Colorado.
- Completed DHA-level, Market Level, Facility Recall Team Level, and Facility Department Level dashboards for the recall prototype. Also completed the manufacturer performance dashboard to perform quality assessment of manufacturers.
- Completed multiple preliminary strategic roadmap progress reviews with the DHA to ensure scope and expectations for the roadmap deliverable were aligned.
- To assist in addressing immediate Coronavirus Disease 2019 (COVID-19) issues, the ASU Team identified five strategies and associated short- and long-term initiatives for the DHA to consider.
- Completed and submitted the Strategic Roadmap deliverable to the DHA on 31-Jul-2020.
- Completed and submitted the Prototype deliverable including appropriate documentation to the DHA on 31-Jul-2020.

b. Reportable Outcomes

Phase 1

- The first IAB meeting was held on 26-Oct-18. Key findings from that meeting included the numerous activities undertaken by the attendee organizations to achieve a highly integrated supply chain. Examples include the following:
  - Consolidating suppliers
  - Developing long-term relationships with partners
  - Becoming more strategic (less transactional)
  - Adopting technologies (e.g., scanning technologies)
  - Engaging clinicians/physicians in decision-making
  - Working toward standardization
  - Understanding and managing risk
  - Employing appropriate design and governance
  - Developing a consolidated service center
- Additional findings from the first IAB meeting included the following:
  - Metrics and benchmarks vary widely by type of industry (e.g., manufacturing, distribution, sales)
  - Risk management is critical to maintaining continuity of manufacturing supplies for meeting production needs
  - Benchmarking can be difficult to widely implement due to data processing intensity and is perhaps best applied in limited applications between trading partners
  - Product recalls (traceability) for selected industries are handled with integrated information systems (e.g., Takata airbags for GM). Knowing lot numbers is critical.

- Healthcare participants noted expanding importance of supply costs integrated with clinical care activities, expansion into medical home care model, and tracking implants via Unique Device identification (UDI) system.

- The Interview Materials deliverable was submitted on 20-Nov-18. The materials represent the foundation of interactions that the ASU Team carried out with health and non-health sector supply chain experts.
- The Raw Interview Output deliverable was submitted on 14-Feb-2019. The report covers the results of interviews and presentations by the IAB regarding their organizations' pathways to integration and evolution as enterprise systems as well as a second set of interviews that were carried out to meet the special request by DHA medical logistics (MEDLOG) for scrutiny of recall best practices in other healthcare organizations and the non-healthcare sector. The deliverable organizes the raw data into a set of categories that were reported and also allows review of individual responses. In interview studies, this is a common practice as it allows a reader to access "rich" material that leads to a characterization. This allows for developing higher level constructs, emanating from relatively self-isolated data.
- The DML-ES Characterization Report milestone deliverable was submitted on 07-Mar-2019. The report assesses and characterizes key functional elements of the DML-ES as they compare to best practices found throughout the health sector and other sectors. The assessment is organized around the concept of a FISCO, developed by ASU, to depict the evolution through which an organization migrates as it grows to achieve critical operational and strategic objectives. The assessment illustrates that while DML-ES lags behind best practice organizations (likely 90% of US healthcare systems do as well), DML-ES is equivalent to IBP in many functions and is on a path towards best practice. The subsequent Phase 1 Recommendations report delves into these dimensions further and includes recommendations for DHA to focus its development of DML-ES on areas that will bring DHA much closer to or beyond current best practices.
- The Phase 1 Recommendations deliverable was submitted to the DHA on 13-Jun-2019. The report provides advice and recommendations for the DML-ES path forward by detailing (1) a set of recommendations emanating from the characterization of DML-ES and related DHA medical logistics entities in relation to best/progressive practices in supply chain and (2) an assessment of innovative technologies and processes that are currently employed or under consideration, in both the health sector and beyond, to be considered for DHA adoption. The selection of recommendations in this report are based on their potential to advance enterprise supply chain and logistics systems for the enhanced performance of military medical logistics and supply chain management.

<u>Phase 2</u>

- The ASU Team completed the characterization of the IBP recall process workflow. This workflow (along with the "as-is" workflow) forms the basis for the proposed recall workflow that was incorporated into the prototype deliverable. Completion of the IBP workflow leveraged work completed in Phase 1 as well as a number of interviews conducted over the course of the project. Thus, the IBP workflow represents input from some of the most prominent commercial healthcare providers in the industry.
- The Prototype and Roadmap Plan Phase 2 deliverable was submitted on 1-Oct-2019 and a revised version was delivered on 12-Nov-19. This report solidified the plan to produce this project's two main deliverables: 1) a prototype for recall management and (2) a roadmap for targeted FISCO functions to reach IBP and beyond. Included in the deliverable were current versions of the BPMN, user stories, and development schedule.
- The second and final IAB meeting was held at ASU SkySong on 6-Nov-2019. Attendees provided perspectives on their organizations' approaches to technical and operational issues including moving systems to the cloud, managing integration of complex organizations during organizational and systems integration activities, and achieving optimal operational and financial performance in support of customer needs. Many of the IAB attendees participated in panel discussions related to development of the strategic roadmap deliverable.
- The Prototype deliverable was submitted on 31-Jul-2020 following a full review of prototype system capabilities with DHA and JMLFDC personnel at Ft. Detrick in early July. The recall prototype provides

visibility and tracking of alerts, provides information to shape responses, and ultimately contributes to positive patient outcomes. The largest product recall and alert gaps identified during Phase 1 were (1) the lack of visibility at the facility level, (2) the lack of lot number tracking throughout the Enterprise, (3) the lack of actionable dashboards to track mitigation status to completion, (4) the lack of predictive analytics to pre-emptively mitigate possible equipment safety issues, and (5) identification and limitation of notifications to only affected facilities. The prototype addresses these gaps with the development of a web-based recall workflow application, development of dashboards that leverage workflow status tracking and inventory data, and development of algorithms to 1) analyze bio-medical maintenance activity and predict possible impact across the Enterprise and 2) determine which facilities are affected by a recall. A critical component is the development of the recall repository database that provides the foundation for tracking and measuring progress.

- The Strategic Roadmap deliverable was submitted on 31-Jul-2020. For each of five FISCO functions, this deliverable provides a roadmap consisting of detailed milestones to enable DHA to advance to IBPs. The report discusses processes, technologies, and strategies for evaluation and potential adoption to meet the end goal of enhancing defense medical logistics capabilities. Each section addresses management tools and approaches used within private industry as well as under development in academia. The report identifies best practice organizations as well as commercial partners with which DHA may want to outsource development or collaborate with to support advancement.

c. Progress Detail

Milestone: DML-ES Characterization

- Reviewed available documents on medical logistics, including academic literature, literature supplied by DHA MEDLOG, and partner organizations.
- Developed initial and refined lists of focus areas and supporting information for assessment during interactions with DHA MEDLOG personnel. The revised list of focus areas and supporting information (relevant sub-topics, key questions, source of answers to questions, priority, etc.) was provided to the DHA on 28-Sep-2018.
- Developed the Supply Chain Health Assessment Process, Systems, and Standards questionnaire and the Supply Chain Director and Clinician questionnaire.
- Attended DHA-hosted webinars in key topical areas – Medical Master Catalog and Strategic Sourcing, Defense Medical Logistics Standard Support (DMLSS) Information Management Dashboard, Medical Materiel Enterprise Standardization Office (MMESO) Standardization, ABi, Joint Medical Asset Repository (JMAR), and ECRI.
- Developed and refined inventory of innovations for supply chain management.
- Collected and reviewed literature on innovations. Conducted review of technologies and metrics as appropriate for supply chain integration applications.
- Prepared for and completed site visits and other interactions with the DHA as described previously in this report.
- Completed a comparison of MEDLOG data to performance benchmarks across industries (as appropriate).
- Completed and submitted the DML-ES Characterization deliverable to the DHA on 7-Mar-2019.

Milestone: Interview Materials

- Developed preliminary interview protocol based on review of historical ASU Team interactions with supply chain experts from industry.
- Identified preliminary focus areas for consideration during industry interviews.
- Assembled IAB with members from health sector supplier, provider and intermediary organizations, and non-health sector companies.

- Prepared materials for and conducted first IAB meeting on 26-Oct-18 at ASU Skysong. Attendees included representatives from GM, Intel, Kaiser Permanente, Banner Health, Institute for Supply Management, Philips, Johnson and Johnson, FedEx, APL Logistics, and Resilinc.
- Completed orientation meetings with IAB members unable to attend IAB meting (Mercy, Gates, UPMC, Cook Medical).
- Completed the development of interview/discussion/survey questions for the IAB.
- Completed and submitted the Interview Materials deliverable to the DHA on 20-Nov-18.

Milestone: Raw Interview Output

- Completed interactions with the DHA and other government stakeholders: NEMSCOM, Ft. Belvoir, Army and Navy SSRs at Ft. Detrick, JMLFDC, Walter Reed National Military Medical Center, Naval Medical Center San Diego Balboa, Naval Hospital Guantanamo, Naval Bureau of Medicine Logistics Policy, DLA Troop Support, San Antonio Military Medical Center/Brooke Army Medical Center (SAMMC/BAMC), AmerisourceBergen, Joint Operational Medicine Information Systems, Owens and Minor.
- Completed interactions with IAB members and other companies: Mercy, Banner, Kaiser, Cook Medical, SMI, Gates Foundation, GM, Philips, Johnson & Johnson, Mayo, Owens & Minor, UPMC, Pensiamo, JDA, Qventus, Vitreos Health, Johns Hopkins, ROi, Baylor Scott and White, CargoSense, Flexport, Gartner, and FirstHealth.
- Compiled raw interview data.
- Completed and submitted the Raw Interview Output deliverable to the DHA on 14-Feb-2019.

Milestone: Phase 1 Recommendations

- Summarized findings of literature review on academic and industry best practices and applicable innovations. Applied findings from review of technologies and metrics as appropriate for applications in an integrated enterprise supply chain organization.
- Conducted survey of IAB and key respondents on technologies in use and/or on their planning horizons.
- Created DMLSS spreadsheet of dashboards, key performance indicators (KPIs), and metrics reports.
- Completed and submitted the Phase 1 Recommendations deliverable to the DHA on 13-Jun-2019.

Milestone: Prototype and Roadmap Plan

- Worked with the DHA to review the content of the Phase 1 Recommendations report and determine priorities to selecting recommendations addressed by prototype and roadmap deliverables.
- Identified a proposed high-level Phase 2 plan for the roadmap and prototype.
    - The roadmap would include five main sections, each based on one of five “fundamental” FISCO functions prioritized by DHA. Furthermore, the content each of the five sections would overlap with additional “support” FISCO functions prioritized by DHA.
    - The recall prototype would provide visibility and tracking of alerts, provide information to shape responses, and ultimately contribute to positive patient outcomes.
- Completed a Prototype and Roadmap Plan deliverable that (1) summarized the recall management prototype to be developed and (2) summarized the objective of the roadmap deliverable and how the FISCO functions prioritized by DHA would be addressed; the deliverable was submitted to the DHA on 12-Nov-2019.

Milestone: Prototype

- Completed characterization of the “as-is” DHA recall process workflow as well as the IBP recall process workflow.

- In support of development of the IBP workflow, conducted interviews with the following (in addition to any Phase 1 interactions that may have occurred with these partners): ECRI, Mayo/SMI, Darnall Army Medical Center, Provincial Health Services Authority, Brooke Army Medical Center, Ontario Health, Dignity Health, Mercy Health, UPMC, Kaiser Permanente, Wilford Hall Lackland Air Force Base, inmarRASMAS, MMESO, United States Army Medical Materiel Agency (USAMMA), and McKinsey.
- Using the "as-is" DHA recall process workflow and IBP recall process workflow, completed an initial recall process workflow for the prototype (referred to as the Business Process Model and Notation or BPMN) that received approval from the DHA and JMLFDC. The workflow was iteratively improved and refined over the course of prototype development through interactions with the DHA and JMLFDC. Examples of refinements include:
  - Rest endpoints
  - Added a DHA priority field (urgent)
  - Determined autofill for alert vs recall at DHA workflow level
  - Determined autofill for actions to take at DHA workflow level
  - Determined autofill for affected facilities at DHA workflow level
  - Defined the facility sub-processes
  - Defined the duplicate/update processes
  - Modified the DHA form
  - Added serial/lot number as separate form area
- Reviewed JMLFDC data files to be used as prototype data sources including:
  - Medical Materiel Quality Control Messages (MMQC) message
  - ABi catalog
  - Market San Antonio Receipts and Issues
  - Market Receipts and Issues
  - Alert vs Recall
  - In Enterprise (Yes/No)
  - MMC file
  - Facility inventory data
- Reviewed ECRI data and identified areas for improvement.
- Built multiple levels of workflow into the prototype: DHA-level for Enterprise, Market Level, Facility Recall Team Level, and Facility Department Level.
- Met with the DHA on a monthly basis to review various aspects of the prototype over the course of development – prototype objectives and goals, development environment, dashboard design, user roles and privileges, data availability, data cleansing, ability of prototype to interface with existing DHA tools, recall process workflow, user forms, data, status of previous month's sprint, plans for future month's sprints, and any other outstanding questions and issues.
- Met with JMLFDC regularly to discuss sprints, prototype visualizations, data calls and development environment that JMLFDC will support.
- Developed algorithms to determine
  - Alert vs recall
  - Required actions
  - DHA priority
  - Affected facilities
- Completed epics (a broad, top-tier hierarchy) and user stories and linked to tasks in JIRA.
- Imported data such as MMQC messages and ABi catalog data to MongoDB.
- Imported MMQC_Message.xls and ABi catalog into Postgres for analysis.

- Programmed DHA-level, Market Level, Facility Recall Team Level, and Facility Department Level dashboards including tree views and metrics as appropriate. Also programmed manufacturer performance dashboard to perform quality assessment of manufacturers.
- Developed data cleansing approach to ensure better usage of MMQC messages. This approach was reviewed with JMLFDC.
- Completed rigorous prototype quality assurance testing.
- Completed required prototype documentation.
- Completed the Prototype deliverable and submitted to the DHA on 31-Jul-2020.

Milestone: Strategic Roadmap

- Conducted research into each area of the roadmap (the five "fundamental" FISCO functions prioritized by DHA) – product sourcing and standardization, contracting and purchasing, inventory management, asset management, and authoritative data. Recall management was also researched as an additional section to the five sections originally selected through discussion with the DHA.
- In addition to interviews mentioned in the Prototype section (which also informed the roadmap), interviews relevant to the roadmap were conducted with Johnson and Johnson, Philips, Cohealo, and Dignity.
- Engaged in multiple preliminary progress review meetings with the DHA throughout the course of roadmap development by preparing and reviewing slides for each of the five areas.
    - The first preliminary progress review meetings were held on 28-Oct-19 and 31-Oct-19. For each of the five fundamental FISCO functions, the objective was to provide an overview of the function, the identified gaps within each function, and the proposed milestones to address the gaps.
    - The second preliminary progress review meetings were held on 19-Feb-20 and 24-Feb-20. For each of the five fundamental FISCO functions, the objective was to provide an overview of opportunities for advancement to IBPs, strategic plans, and management plans.
    - A third progress review was held on 18-May-2020 following the submission of a draft roadmap report. Discussions during this meeting focused primarily on the addition of a chapter on the interrelatedness of the various components of the roadmap.
- Incorporated feedback from the DHA on preliminary progress reviews into each of the five sections as appropriate.
- Prepared materials for and conducted second IAB meeting on 6-Nov-19 at ASU Skysong.
    - Attendees included GM, Intel, Gore, Mayo Clinic, Scripps Healthcare, Resillinc, Kaiser Permanente, Banner Health, Providence Health, Institute for Supply Chain Management, and senior logistics leadership from DHA.
    - Preparations included holding panel pre-meeting discussions that covered the five roadmap sections as well as recall management.
    - Post-meeting activities included a de-brief meeting with DHA personnel and dissemination of a workshop summary, a summary of the post-meeting de-brief discussion with DHA, and raw audio workshop transcript file to the DHA.
- Met with JMLFDC to ensure that the roadmap deliverable format will support plans to socialize the document.
- Met with DLA personnel to confirm the ASU Team's understanding of MMESO's standardization processes.
- Received DHA Patient Safety Working Group charter in lieu of interviews; incorporated information from the charter into the roadmap as appropriate.
- Completed the Strategic Roadmap deliverable and submitted to the DHA on 31-Jul-2020.

Other

- Attended project Kickoff meeting at the DHA on 17-Sep-2018.
- Attended Interim Progress Review (IPR) meeting at the DHA on 23-Apr-2019.
- Remotely attended IPR meeting at the DHA on 19-May-2020.
- To assist in addressing immediate COVID-19 issues, the ASU Team identified five strategies and associated short- and long-term initiatives for the DHA to consider.

2. Problems / Issues

The ASU Team monitored problems and issues throughout the duration of the project. Frequent communications with the DHA were essential to deliverables meeting baseline scope, budget, and schedule requirements. These communications were especially productive during Phase 2 as in-progress reviews of the roadmap and prototype deliverables were conducted on a regular basis. Note that the first two quarters of 2020, the impact of COVID-19 shifted support to virtual meetings. The ASU team continued to work diligently to ensure there were no adverse impacts from team efforts due to restrictions on travel and in-person meetings.

3. Financial Health

The project was completed on time and within budget. Official invoices have been provided separately from ASU.

Travel conducted during the period of performance included the following:

Trip Name	Date	Destination	Personnel that Traveled	Purpose
Kickoff	9/17/18	Ft. Detrick	Schneller, Ramos, Winkel, Perrin, Eckler, Miller, Fraser, Ray, Grizzaffi, Lynch, and Allison.	Project kickoff meeting
IAB meeting #1	10/26/18	Tempe, AZ	Perrin, Grizzaffi	ASU Team members outside of Tempe, AZ traveled to ASU to attend the IAB meeting
SMES - NEMSCOM	11/28/18	NEMSCOM	Schneller, George Ramos, Grizzaffi, Perrin, and Eckler	Members of the ASU Team traveled to various sites to interact with on-site DML-ES or other relevant personnel.
SMEs - Ft. Belvoir	11/29/18	Ft. Belvoir	Schneller, Ramos, Grizzaffi, Perrin, and Eckler	Members of the ASU Team traveled to various sites to interact with on-site DML-ES or other relevant personnel.
SMEs – SSR	11/30/18	Ft. Detrick	Schneller, Ramos, Grizzaffi, Perrin, Eckler, Fraser, and Conner	Members of the ASU Team traveled to various sites to interact with on-site DML-ES or other relevant personnel.
SMEs - Totten	12/3/18	Ft. Detrick	Perrin, Fraser	Members of the ASU Team traveled to various sites to interact with on-site DML-ES or other relevant personnel.
Characterization Report	1/3/19 and 1/4/19	Tempe, AZ	Grizzaffi, Johansen	Members of the ASU Team traveled to Tempe to collaborate on DML-ES Characterization Report content.
SMEs – Walter Reed	1/28/19	Walter Reed National Military Medical Center	Perrin, Fraser	Members of the ASU Team traveled to various sites to interact with on-site DML-ES or other relevant personnel.
Mercy and ROi	2/6/19	St. Louis, MO	Conner, Eckler, Fraser, Grizzaffi	Members of the ASU Team interviewed to non-military healthcare SMEs to understand industry best practices.
Phase 1 Report Content and Prototype	3/4/19	Washington, DC	Conner	A member of the ASU Team traveled to Washington DC to collaborate with the team on Phase 1 Report recommendations and prototype planning.
KPIs and Metrics	3/5/19	Ft. Detrick	Perrin, Fraser, Conner	Members of the ASU Team met with DHA personnel at Ft Detrick and relevant subject matters at Johns Hopkins to discuss knowledge performance indicators (KPIs), metrics, and dashboards
Phase 1 Report Content and Roadmap	3/13/19	Tempe, AZ	Perrin, Grizzaffi	Members of the ASU Team traveled to Tempe, AZ to collaborate with the team on Phase 1 Report recommendations and roadmap planning.
Phase 1 Review	3/18/19	Ft. Detrick	Schneller, Fraser	Members of the ASU Team met with DHA personnel at Ft Detrick to review the DML-ES Characterization report,

				discuss the Phase 1 Recommendations report, and discuss Phase 2
IPR Meeting	4/23/19	Ft. Detrick	Schneller	The PI (Schneller) traveled to Ft. Detrick to attend the Interim Progress Review meeting
Roadmap and Workflows	6/25/19	Baltimore, MD	Schneller, Eckler, Rogers, Ramos, Perrin, Gillespie, George, Fraser, and Ray	The ASU Team met in Baltimore to collaborate on the various sections of the roadmap and discuss recall process workflows.
Recall and Workflows with DHA	6/26/19	Ft. Detrick	Schneller, Eckler, Rogers, Ramos, Perrin, Gillespie, George, Fraser, and Ray	The ASU Team met with DHA personnel in Frederick to discuss the various roadmap sections in detail, to better understand DHA practices and future plans in those areas, to discuss recall processes, and to identify valuable DHA points of contact that can be accessed by the ASU Team going forward
Darnall Recall	7/16/19	Darnall Army Medical Center	Moralez	A member of the ASU Team traveled to Darnall Army Medical Center to discuss their recall processes.
Brooke Recall	7/17/19	Brooke Army Medical Center	Moralez	A member of the ASU Team traveled to Brooke Army Medical Center to discuss their recall processes.
Dignity Health	7/19/19	Dignity Health (Phoenix AZ)	Schneller, Ramos, Eckler	Members of the ASU Team traveled locally to Dignity Health to discuss IBP recall processes.
Prototype Workflow Review (DHA)	9/10/19	Ft. Detrick	Fraser, Conner, Ray, Robinson, Perrin, George	Members of the ASU Team traveled to Ft. Detrick to meet with DHA personnel regarding the recall prototype.
Prototype Workflow Review (JMLFDC)	9/10/19	Ft. Detrick	Fraser, Conner, Ray, Robinson	Members of the ASU Team traveled to Ft. Detrick to meet with JMLFDC personnel regarding the recall prototype.
Prototype Workflow Review (USAMMA)	9/10/19	Ft. Detrick	Perrin, George	Members of the ASU Team traveled to Ft. Detrick to meet with USAMMA and other SSRs and personnel regarding recall workflow processes.
IAB meeting #2	11/6/19	ASU SkySong (Scottsdale, AZ)	Perrin, Johansen, Gillespie	The ASU Team met with the IAB to review project progress and obtain expert input.
IAB meeting de-brief	11/7/19	ASU Tempe Campus	Perrin, Johansen, Gillespie	The ASU Team conferred with DHA to discuss the input received at the IAB meeting.
Prototype Development Update and Review	12/9/19	Ft. Detrick	Fraser, Perrin	The ASU Team met with DHA to review currently developed aspects of the prototype.
Prototype Development Update and Review	1/23/20	Ft. Detrick	Fraser, Perrin	The ASU Team met with DHA to review currently developed aspects of the prototype.
Team meeting for roadmap report	2/26/20	Tempe, AZ	Perrin, Gillespie	The ASU team convened to collaborate on roadmap report development.
Prototype Development Update and Review	2/27/20	Ft. Detrick	Fraser	The ASU Team met with DHA to review currently developed aspects of the prototype.
Prototype Capabilities Review	7/7/20	Ft. Detrick	Fraser	The ASU Team met with DHA to review prototype capabilities as developed and delivered.

4. Personnel Effort

Personnel	Role	Percent Effort
Dr. Gene Schneller	Principal Investigator	100% (8/1/18 to 8/12/18) 40% (8/13/18 to 5/20/19) 100% (5/21/19 to 8/11/19) 40% (8/12/19 to 5/17/20) 95% (5/18/20 to 7/31/20)
Dr. Dale Rogers	Co-Investigator	50% (8/1/18 to 8/12/18) 15% (8/13/18 to 5/20/19)

		50% (5/21/19 to 8/11/19) 15% (8/12/18 to 5/17/20) 20% (5/18/20 to 7/31/20)
George Ramos	Research Specialist	100%
Amanda Koeller	Coordinator	37%
David Winkel	Project Manager	15% (8/1/18 to 1/26/20) 0% (1/26/20 to 4/19/20) 15% (4/20/20 to 6/30/20) 25% (7/1/20 to 7/31/20)
Lisa Whelan	Project Manager	0% (8/1/18 to 1/26/20) 15% (1/26/20 to 4/19/20) 0% (4/20/20 to 7/31/20)

(a) Note that ASU faculty appointments (Schneller, Rogers) include an allocation for research activities during the academic (i.e. non-summer) year. Thus, percent effort for ASU faculty as shown in the table during the academic year does not represent billed effort.

5. Protocol and Activity Status

a. Human Use Regulatory Protocols - No human subjects research was necessary to complete the Statement of Work

b. Use of Human Cadavers for RDT&E, Education or Training - No RDT&E, education or training activities involving human cadavers was necessary to complete the Statement of Work

c. Animal Use Regulatory Protocols - No animal use research was necessary to complete the Statement of Work

Final Business Status Report for

Model Use of Innovative MEDLOG Data Management Technologies and Industry Best Practices: Architecture, Data Transactions Model and Prototype for a Highly Scalable, Integrated, and Just-in-Time Defense Medical Logistics Enterprise to Support Next Gen Theater/Operational Medicine

Research Project No. 18-01-MEDLOG-03

EGS# MT18001.01

Reporting Period: 1 Aug 2018 to 31 Jul 2020

MTEC Research Project Awardee

Project Lead: Arizona State University

Additional Project Team Members: Active Innovations, LLC; Expression Networks, LLC; Global Health Exchange, LLC

Research Project Technical POC:
Dr. Eugene Schneller
Arizona State University
WP Carey School of Business Department of Supply Chain Management
PO Box 878706
Tempe AZ 85287-4706
480-965-6044
Gene.Schneller@asu.edu

Submitted: 31 Jul 2020

1. CURRENT STAFF

Personnel	*% of Effort on project*
Dr. Gene Schneller[(a)]	100% (8/1/18 to 8/12/18) 40% (8/13/18 to 5/20/19) 100% (5/21/19 to 8/11/19) 40% (8/12/19 to 5/17/20) 95% (5/18/20 to 7/31/20)
Dr. Dale Rogers[(a)]	50% (8/1/18 to 8/12/18) 15% (8/13/18 to 5/20/19) 50% (5/21/19 to 8/11/19) 15% (8/12/18 to 5/17/20) 20% (5/18/20 to 7/31/20)
George Ramos	100%
Amanda Koeller	37%
David Winkel	15% (8/1/18 to 1/26/20) 0% (1/26/20 to 4/19/20) 15% (4/20/20 to 6/30/20) 25% (7/1/20 to 7/31/20)
Lisa Whelan	0% (8/1/18 to 1/26/20) 15% (1/26/20 to 4/19/20) 0% (4/20/20 to 7/31/20)

(a) Note that ASU faculty appointments (Schneller, Rogers) include an allocation for research activities during the academic (i.e. non-summer) year. Thus, percent effort for ASU faculty as shown in the table during the academic year does not represent billed effort.

2. CURRENT EXPENDITURES

Contract Expenditures	Current QTR Invoiced Expenditures[(a)]	Cumulative To Date Invoiced Expenditures[(a)]
Labor (Personnel and Fringe)	NA	$439,269.10
Supplies/Materials	NA	$156.25
Travel	NA	$15,873.95
Equipment	NA	$47.87
Subcontractors and Consultants	NA	$1,568,377.45
Other Direct Costs	NA	$525.25
Indirect Costs	NA	$375,640.13
Total	NA	$2,399,890.00

(a) The expenditures provided in this table should be considered unofficial. ASU will provide final invoices following the conclusion of the period of performance.

3. STATUS OF MILESTONES

MTEC Milestone Number	Milestone Description	Due Date	% Completed this Reporting Period	Cumulative % Complete
1	Monthly Report	9/15/2018	-	100%

2	Monthly Report	10/15/2018	-	100%
3	Quarterly Report 1 (Inception-Sep)	10/25/2018	-	100%
4	DML-ES Characterization	3/7/2019	-	100%
5	Interview Materials	11/20/2018	-	100%
6	Monthly Report	11/15/2018	-	100%
7	Monthly Report	12/15/2018	-	100%
8	Raw Interview Output	2/14/2019	-	100%
9	Monthly Report	1/15/2019	-	100%
10	Quarterly Report 2 (Oct-Dec)	1/25/2019	-	100%
11	Phase 1 Recommendations	4/25/2019	-	100%
12	Phase 1 Travel	N/A	N/A	N/A
13	Monthly Report	2/15/2019	-	100%
14	Monthly Report	3/15/2019	-	100%
15	Monthly Report	4/15/2019	-	100%
16	Quarterly Report 3 (Jan-Mar)	4/25/2019	-	100%
17	N/A	N/A	N/A	N/A
18	Monthly Report	5/15/2019	-	100%
19	Monthly Report	6/15/2019	-	100%
20	Prototype and Roadmap Plan	7/31/2019	-	100%
21	Monthly Report	7/15/2019	-	100%
22	Quarterly Report 4/Annual Business and Technical ReportsY1	7/25/2019	-	100%
23	Monthly Report	8/15/2019	-	100%
24	Monthly Report	9/15/2019	-	100%
25	Monthly Report	10/15/2019	-	100%
26	Quarterly Report 5 (Jul-Sep)	10/25/2019	-	100%
27	Monthly Report	11/15/2019	-	100%
28	Monthly Report	12/15/2019	-	100%
29	Monthly Report	1/15/2020	-	100%
30	Quarterly Report 6 (Oct-Dec)	1/25/2020	-	100%
31	Monthly Report	2/15/2020	-	100%
32	Monthly Report	3/15/2020	-	100%
33	Monthly Report	4/15/2020	-	100%
34	Prototype	7/31/2020	-	100%
35	Quarterly Report 7 (Jan-Mar)	4/25/2020	-	100%
36	Monthly Report	5/15/2020	-	100%
37	Draft Final Technical/Business report	6/1/2020	-	100%
38	Monthly Report	6/15/2020	-	100%
39	Strategic Roadmap	7/31/2020	-	100%
40	Phase 2 Travel	N/A	N/A	100%
41	Final Technical/Business Report	7/31/2020	-	100%

4. DEVIATION FROM PROJECT PLAN

No major deviations from the agreed upon project plan occurred.