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Improving Casualty Data Collection in Large-Scale Combat Operations Training

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Author Note: This report serves to summarize the culminating capstone project for Cadets Mansfield, Redelings, Ollis, Flowers, and Rivera as they conclude their undergraduate studies in the Department of Systems Engineering at the United States Military Academy at West Point. The views expressed herein are those of the authors and do not reflect the position of the United States Military Academy, the Department of the Army, or the Department of War.

Abstract: Efficient collection of simulated casualty data is essential for evaluating medical effectiveness and evacuation performance during large-scale combat operations (LSCO) training. At the Joint Pacific Multinational Readiness Center (JPMRC), legacy casualty reporting within the Data Assessment Tool (DAT) relied on time-intensive, free-text inputs that limited data consistency and analytic value. This capstone redesigns the existing casualty reporting system to improve data collection by reducing reporting burden and increasing standardization and reliability. The improved system collects consistent, time-stamped casualty data from point of injury (POI) through successive treatment levels. Across two JPMRC rotations, the cadets were able to accumulate 1,473 casualty reports of 785 individual soldiers. Of 165 casualties categorized as Died of Wounds (DOW) or Killed in Action (KIA), 38% of these deaths were preventable. This data indicates potential DOTMLPF-P changes to satisfy an operational need for organizational, training, and materiel improvements to casualty treatment in LSCO environments.

Keywords: Casualty Data Collection, Preventable Deaths, Medical Evacuation, Combat Training Centers

1. Introduction

Lethality, readiness, and warfighting have been identified as the Secretary of War's top priorities (Garamone, 2025). In accordance with this, the Dean of USMA's academic year 2025-2026 theme is "Projecting Lethality: Addressing the Multidimensional Challenges in the Indo-Pacific." To prepare for these challenges, Army theatre commands continue to prioritize the evolution and improvement of training systems. Army Regulation 350-50 states, "To support leader development, each CTC requires a robust, standardized data-collection capability for processing lessons learned" (Headquarters, 2018). To modernize U.S. Army Combat Training Centers (CTCs), the JPMRC implemented the DAT to orient training toward data-driven decision making. The CTC Data Pillar directs modernization efforts to "provide fact-based insights that inform after-action reviews (AARs), decisions, and processes related to readiness, resourcing, modernization, and DOTMLPF-P efforts across the total Army and across echelons" (Combined Arms Center, Command Data & Artificial Intelligence Office, 2025).

The team was tasked with redesigning the casualty reporting portion of the DAT to decrease Observer Controller/Trainer (OC/T) demand and increase data usability. The team designed a two-form entry system to track casualty treatment progress from point of injury (POI) to Returned to Duty (RTD) status, with an emphasis on minimizing OC/T inputs and maximizing automation of pre-collected information, such as organizational systems of record and the casualty card guide. The resulting analysis of casualty data and identification of systemic shortcomings in casualty care informed DOTMLPF-P recommendations to decrease preventable deaths across future conflicts.

1.1 Problem Statement

The previous system for JPMRC casualty tracking included Microsoft Forms with excess, redundant, and poorly validated inputs causing OC/Ts to submit inaccurate data, free text, or no data at all. This prevented summarization and analysis for real-time casualty tracking and AARs to both higher Army headquarters and rotational training units (RTUs). JPMRC Training Analysis and Feedback (TAF) cell needed a revised system that accomplishes four goals in casualty reporting:

(1) Accurately capture data with an effective user interface for OC/Ts
(2) Automate raw data transformation to enable visualization along with analysis for TAF users
(3) Integrate with the existing Data Assessment Tool architecture

(4) Identify causes of preventable deaths

2. Methodology

The research and development of the casualty tracking system followed the Software Engineering V-Model (Figure 1) with an emphasis on Human-Centered Design (HCD) for user interface optimization. This project was divided into three main phases. Phase 1 consisted of a three-week internship at the United States Army Pacific Command (USARPAC) Chief Data Office (CDO) in July 2025, which encompassed requirements specifications through initial high-level design. Phase 2 consisted of the capstone group's efforts from August to JPMRC 26-1 in November 2025, which encompassed high-level design through acceptance testing and fielding. Phase 3 consisted of feedback and improvements between JPMRC 26-1 and JPMRC 26-2 in February 2026, which repeated low-level design through testing iterations on previous system architecture.

2.1 The Software Engineering V-Model

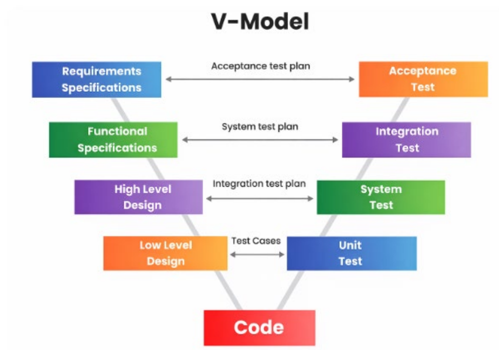

Figure 1. Software Engineering Design Process V-Model (Parikh, 2023)

2.1.1 Requirements Specifications

The process began with requirements specifications in July 2025. Cadets Mansfield, Gohlich, and Ollis attended a three-week Academic Individual Advanced Development (AIAD) internship with the USARPAC CDO at Fort Shafter, HI. During this internship, the cadets conducted stakeholder engagements with members of JPMRC as well as former OC/Ts working in the Joint Multinational Simulation Center - Indo-Pacific (JMSC-IP). Key stakeholder engagements were conducted with Mr. Dave Brocious, TAF Chief of Operations, Mr. Charles Owen, TAF Data Collection Manager, Mr. Richard Pomeroy, TAF Sustainment lead, and previous rotation OC/Ts currently working in the JMSC-IP. From these meetings, the team was able to define the general requirements specifications stage of the Software Engineering V-Model. Mr. Brocious defined a two-fold purpose: 1) Real-time battle tracking of casualties through the treatment process and 2) End-of-mission report card visualizations and write-ups for unit/rotation AAR.

2.1.2 Functional Specifications

The project's functional specifications were developed through meetings with Mr. Charles Owen and OC/Ts at the JMSC-IP. Mr. Charles Owen specified functional constraints regarding the current system of usage and desired mirrored integration. This translated to Microsoft Forms for data collection and entry, SharePoint lists for data aggregation, and Power BI for data visualization to satisfy goal 3 of the project. All products had to be stored on the JPMRC-EXCON SharePoint site. This ensured consistency and harmonization across new and existing products. Past rotations had also encountered issues regarding user access permissions. Microsoft Forms was utilized to grant access to foreign partners, as well as OC/Ts without Common Access Card (CAC) permissible devices. Mr. Charles Owen and the OC/Ts helped develop the functional specification of *Simplify User Input* as shown in the functional hierarchy (Figure 2). The team prioritized minimizing the time required for OC/Ts to input casualty data. In previous rotations, complex casualty report forms led many OC/Ts to disregard them entirely. Inconsistent formatting in aggregated data further reduced its usability for analysis. Using this feedback, the team created three subfunctions for the S*implify User Input* function: *Automate Pre-Existing Data, Standardize Input Options, and Provide Total User Accessibility*.

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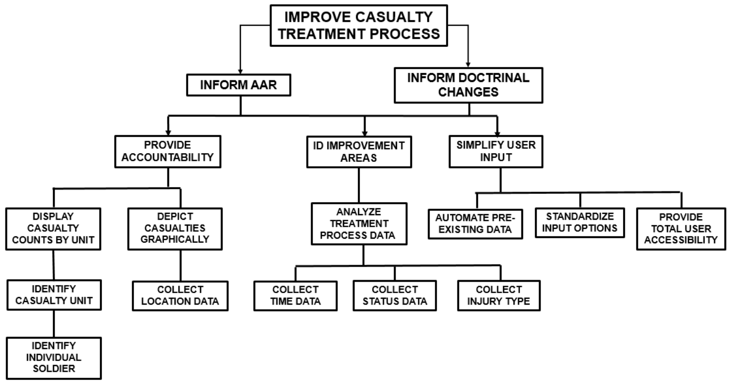

Figure 2. Functional Hierarchy

2.1.3 High-Level Design

Cadets Mansfield and Gohlich developed the initial prototype during the AIAD. The main systematic improvements developed during the AIAD laid the foundation for the project. The cadets developed a two-form system consisting of initial casualty reports and casualty progress reports. The intention was to remove redundant information that was previously required every time a soldier's status was updated. They centered the project around battle roster number, a combination of initials and Social Security Number, as a unique identifier of soldiers and the primary key for queries across the two datasets. This identifier provided the platform to both automate additional soldier information and connect initial casualty reports to casualty progress reports. Injuries are allocated using the Enhanced Miles Casualty Cards (EMCC) that contain all pertinent information about 48 different possible injuries service members could receive. This information was to be recorded utilizing casualty card number as a primary key. The cadets linked the SharePoint Lists to Power BI, where they created a simplistic visualization of casualties reported that updated in near-real time. The cadets briefed the prototype to Maj. Gen. James Bartholomees, the Chief of Staff of U.S. Army Pacific (USARPAC), at the conclusion of their time in Hawaii.

2.1.4 Low-Level Design & Code

The next step of the Software Engineering V-Model consisted of refining and improving existing processes, as well as completing many of the desired functions generated from the previous stage. This began in August 2026. A Power Automate flow was built that automatically appended the casualty card information to records, using the card number as a primary key. This automated method of injury, diagnosis, litter/ambulatory status, triage category, evacuation category, required level of care, and required time to care information is stored in a pre-existing EMCC dataset. An additional flow appends the soldier information (name, rank, unit) to the records. Using this automation, the team was able to generate a comprehensive report with minimal MS Form input, significantly decreasing the required manual inputs for OC/Ts and standardizing data format, satisfying goal 1 of the project.

After initial stakeholder engagements with CPT Riley Lane, the Medical Operations Officer for JPMRC, the group was provided a PowerPoint slide example of a Power BI Dashboard that was intended for leaders to use in parallel with other common operating picture (COP) dashboards. The cadets then constructed a Power BI dashboard (Figure 3) to mirror their proposal, as well as an interactive map displaying casualty counts by location of care. The dashboard pulls data from SharePoint Lists to display counts of soldiers Wounded in Action (WIA), Killed in Action (KIA), Returned to Duty (RTD), and located at Casualty Collection Points (CCP), Mortuary Affairs Collection Points (MACP), and Personnel Holding Areas (PEHA). Using Data Analysis Expressions (DAX), the system generates coded queries and tables that rank, sort, and filter information to produce unit-specific, live-updating data for tactical decision-makers to satisfy goal 2 of the project.

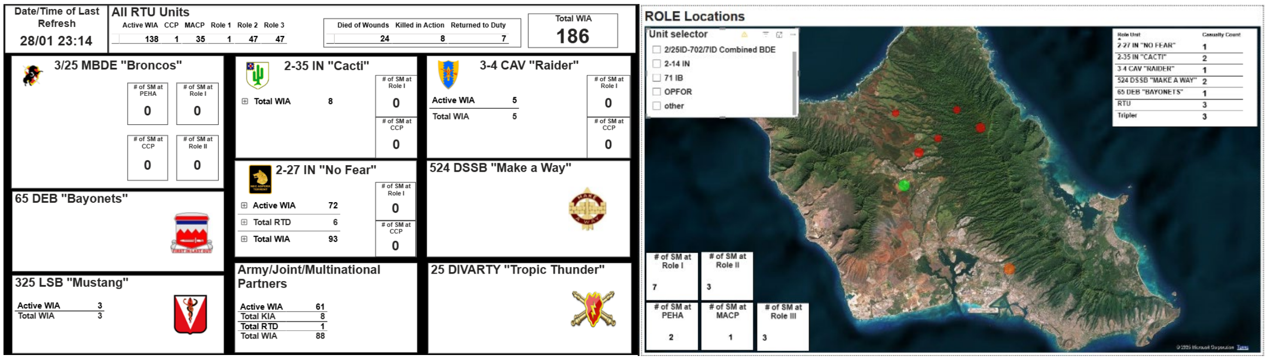

Figure 3. JPMRC Casualty Tracking Power BI Dashboard & Map

2.1.5 Testing and Implementation

To evaluate the effectiveness of HCD principles in the system, the cadets conducted a structured learning-rate test in which personnel completed three iterations of an initial report followed by three iterations of a progress report. Performance improvements across iterations showed a 46% learning rate for the initial report and a 69% learning rate for the progress report, demonstrating rapid user adaptation and efficient task execution once users understood the system structure. Based on these findings, the team developed a short training program to prepare OC/Ts to use the reporting system effectively prior to and during training rotations. These results were provided to JPMRC to establish a minimum number of OC/T practice submissions before the start of the rotation. The team also conducted stress testing by submitting rapid entries, incorrectly formatted inputs, and inverse time progressions to evaluate system robustness. Pre-rotation testing for JPMRC 26-1 identified several technical issues that were corrected. The team travelled to Schofield Barracks, HI to be on-site for the implementation of the system and were able to make real-time corrections and improvements.

3. Results

Combining both JPMRC 26-1 and 26-2 rotations, 785 unique battle roster numbers were tracked across the casualty treatment process. The team received 1,473 total reports, including 204 initial casualty reports and 1,269 casualty progress reports. The discrepancy in count of initial versus progress reports is due to the planned function of individual casualties having multiple progress reports associated with each singular initial report, as well the reality of greater demands on the OC/T at the POI versus OC/Ts at higher echelons of care. Following the rotations, the team was able to analyze the aggregated data to determine key metrics to analyze casualty treatment. Out of the 165 total deaths between the two rotations (including all DOW and KIA), 125, or 76% were categorized as DOW at Role 1. When categorizing a casualty as DOW, OC/Ts were required to select a reason for DOW from a dropdown menu. Across both rotations, 139 casualties were categorized as DOW, with 25 due to Improper Care, 29 due to Medical Command and Control, 6 due to Manning/Equipment, and 79 due to Mission/Enemy. All casualties DOW from Improper Care, Medical C2, and Manning/Equipment were deemed preventable, with the addition of 2 Mission/Enemy DOW casualties as further information was provided by the OC/T in the comments. Based on these conclusions, 62 out of 165 deaths, or 38%, of total deaths at both JPMRC 26-1 and 26-2 were preventable.

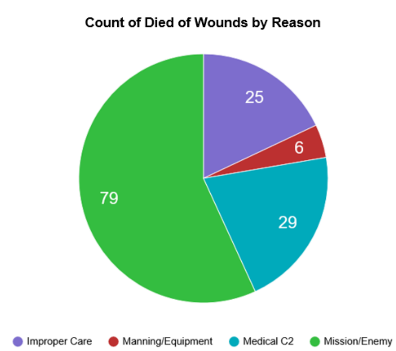

Figure 4. Combined Rotation's DOW count

The system collected time-stamped data that provided interval periods between POI and successive levels of care, with a binary result of survival or death of a casualty. For DOW instances, the average time between the initial report at POI and "DOW" status updates was 289 minutes. The average time from "Arrival at Role 1" to "DOW" status updates was 131 minutes. This can be compared to patients that were successfully treated and survived injuries. For successfully treated patients, who were casualties that survived their injuries, the average time from the initial report at POI to "Arrived at Role 2" was 36 minutes. The average time from "Arrival at Role 1" to "Evacuated from Role 1 to Role 2" was 43.7 minutes. DOW casualties were prevented from receiving the proper level of care for significantly longer than survivor casualties.

3.1 Limitations

Limitations in the data conclusions arise from incomplete casualty treatment sequences. Most incompletions are due to casualties not having an initial casualty report. This is pertinent information as the initial report includes the type of injury, time of injury, and therefore informs the acceptable time window to the next echelon of care. Regarding specifically casualties categorized as DOW, it is difficult to determine the cause for DOW aside from the 5 drop-down categories without an initial report that paints a comprehensive picture of what occurred. Because of this, many casualties that were documented at some point in the treatment process had to be excluded from data analysis as their report sequence was incomplete. The cadets attribute the lack of initial reports to multiple factors, including connectivity issues, environmental conditions (Alaska), competing demands, and lack of training on reporting processes.

A major limitation identified is the siloed nature of current Army CTCs, which creates a repetitive adjustment period each time units and OC/Ts rotate to different training centers. JPMRC is making progressive efforts to improve casualty data tracking in their realm, but the Army still lacks a unified system for aggregating data across all four Combat Training Centers.

3.2 Feedback

Feedback following JPMRC 26-1 was extremely helpful and insightful. Unfortunately, many of these changes could not have been implemented in time for the 26-2 rotation, but are worth noting for future rotations. First, it was recommended that casualty reports be embedded in contact reports. OC/Ts must fill out multiple reports every time their unit takes contact, and frequently there are casualties associated with these contact reports. This would cut down on the quantity of separate reports, as well as paint a more holistic picture of the casualty instance, to include relevant causal information. OC/Ts also requested an option to input multiple casualties on a single casualty report, especially for MASCAL instances. This is a feature that is not attainable in Microsoft Forms, but may be included in future variations on Power Apps. Follow-on capstone projects should direct their attention to these two main areas of improvement, specifically developing a combined casualty and contact report that allows multiple casualty entries. Another point of friction was the outdated editions of the MILES Casualty Cards. The automated card information was based on the latest card edition data, and OC/Ts who brought their own cards from past rotations input incorrect numbers. This was corrected by issuing all OC/Ts the current version card deck for JPMRC 26-2.

4. Discussion

4.1 Recommendations

Using key metrics derived from data collected across JPMRC 26-1 and 26-2 rotations, the group can recommend DOTMLPF-P changes to decrease preventable deaths incurred at CTCs, satisfying goal 4 of the project. The data indicate that preventable DOW casualties are occurring due to an inability to evacuate casualties to a higher level of care and, correspondingly, an inability to provide necessary care at lower echelons. This is backed by most casualties being categorized as DOW at Role 1, and the majority of DOW cases occurring due to Mission/Enemy. Regarding organizational changes, the team recommends increasing the number of medical evacuation vehicles available, specifically for transport between Role 1 and Role 2. In addition, they recommend increasing the medical capabilities at lower echelons to include greater resuscitative and surgical capabilities. In coordination with increased medical equipment, medical personnel at lower echelons will require a greater level of training. Role 1 physician's assistants must be capable of facilitating prolonged field care and sustaining patients throughout the increased time to the evacuation window. This concern is being exacerbated by medical doctrine surrounding the challenges of LSCO. The data support an article in The Journal of Trauma and Acute Care Surgery that states, "Injured service members will require prolonged far-forward care followed by delayed or lengthy evacuation to the next point of care" (Remondelli, et. al., 2023).

With the increase of casualties deprived of evacuation, Role 1 aid stations will likely incur sustainment issues regarding medical supplies. In terms of material changes, the team recommends augmenting logistics units with drone delivery capabilities. This will allow medical personnel to receive timely resupplies at their location, on demand, instead of relying on long-duration, vulnerable ground-transport resupplies.

4.2 Future Integration

Future iterations will involve AI-Enabled Data Fusion, integrating the DAT with platforms like Palantir's Maven and Vantage. This will allow the TAF to automatically label and fuse unstructured data, such as field notes with structured sensor data, reducing the manual labor required for AAR production. Currently, OC/Ts are required to submit many different event-based reports, including the casualty report that the team developed. However, as the number of forms the OC/T has to complete increases, the likelihood they complete the other forms decreases. If an OC/T was able to report multiple different types of events in one form, this would potentially both decrease the time needed for form submission and increase the likelihood of completion. This supports the recommendation of combining contact and casualty reports. Another recommendation is to implement Large Language Model (LLM) AI software in the collection process. During Joint Readiness Training Center (JRTC) rotations, OC/Ts report casualties in a MS Teams chat. This information is processed by data processing teams outside of the simulation and compiled manually. An AI LLM is able to process text information at an exponentially faster rate and higher efficiency than a human can, though some formatting and guidelines would have to be emplaced to minimize erroneous reports from the LLM. Pairing an improved reporting format with already-integrated display software would allow us to display casualty data alongside the COP for senior leaders to use as a decision-making tool.

5. Conclusion

This capstone project is a step in the right direction to fulfill the Army-wide initiative of data-centric decision- making. JPMRC is leading CTCs in their attempts to collect training data that can be used for objective feedback, AARs, and DOTMLPF-P changes across the force. This casualty tracking system significantly improved its predecessor in terms of minimizing OC/T time to completion, aggregation of usable information, data validation, and valuable feedback. In just two rotations, the capstone team was able to identify that the inability to conduct timely casualty evacuations, as well as limited capabilities at lower care echelons, were the main causal factors in preventable deaths and DOW casualties. From this information, they are able to recommend potential DOTMLPF-P changes, including increasing the quantity of MEDEVAC vehicles and medical equipment at lower echelons, providing higher-level training to lower echelon medics, and utilizing drone delivery systems to treat and sustain casualties at the POI. As the Army prepares for the future of warfare, casualty treatment and evacuation must evolve to meet the constraints of the modern battlefield. Data, such as what they have collected from JPMRC, will inform us of the changes the force must make to be prepared for the next major conflict. The proliferation of the importance of CTC data collection will be the difference that saves the lives of soldiers and prevents unnecessary deaths in combat.

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