Proceedings of the Annual General Donald R. Keith Memorial Conference
West Point, New York, USA
April 24, 2025
A Regional Conference of the Society for Industrial and Systems Engineering

Enhancing Data Operations for JPMRC

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Author Note: Team members Cadets Noah Cillo, Madison Doyle, Wyatt Hartsell, and Charles Rolenc are Systems Engineering majors at the United States Military Academy. As part of their capstone project within the Department of Systems Engineering, they collaborated with the U.S. Army Pacific (USARPAC) to develop an innovative data collection and validation solution. Their work was conducted under the guidance of Major James MacGibbon, an assistant professor in the Department of Systems Engineering. 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 Defense.

Abstract: The Joint Pacific Multinational Readiness Center (JPMRC) is the U.S. Army's newest Combat Training Center (CTC). A CTC is where Army units go to train and be validated in the most realistic combat training available. JPMRC requires efficient data operations to enhance operational effectiveness. The project, developed for U.S. Army Pacific (USARPAC), delivers an application that streamlines fire mission and fire report data using SharePoint Lists, Power BI, and Power Automate. This product enables the Tactical Analysis Feedback Facility (TAFF) and the Battlefield Effects Coordination Cell (BECC) to improve the indirect fire operations process and maintain clean, structured data for after-action reviews (AAR). Currently in operational use, this system enhances real-time decision-making and post-exercise analysis.

Keywords: Data Collection and Validation, Agile Project Methodology, Data Pipeline Engineering, User Interface

1. Introduction

The Joint Pacific Multinational Readiness Center (JPMRC) is the newest combat training center (CTC) in the U.S. Army. Army units regularly attend CTCs to train in brigade-sized and smaller operations in realistic combat situations. CTCs are regularly seen as the most difficult training of the year and units are constantly observed in order to provide constructive feedback. It was established as a CTC in 2020 and is continuously improving its operational processes (Hurd, 2023). The Chief Data Office at the U.S. Army Pacific Command (USARPAC) prioritizes refining JPMRC processes. This project focuses on the fires process for collecting data for indirect fire missions. Three main groups are directly working in the fires process: the observer controller/trainers (OC/T's), the Battlefield Effects Coordination Cell (BECC), and the Tactical Analysis Feedback Facility (TAFF). Fire missions are coordinated requests for indirect fires that involve actions from a fire direction officer, fire support officer, and the firing unit. An OC/T submits a fire mission to the BECC to create a fire mission. A fire marker will be sent out to drop an artillery simulator, and a separate adjudicating OC/T will report the battle damage assessment and casualties. These fire missions were initially recorded using three Microsoft Forms, the FOX1, FOX2, and FOX3 reports, to track the progression of the fire missions. These processes did not allow the people who input results the ability to change their answers and created separate data tables for each fire mission.

2. Background

2.1. Problem Definition

The information submitted by the OC/T's from the FOX reports fuel operations at the BECC and the TAFF. Current operations at JPMRC created three different locations for information on the same fire mission. The need for the BECC and TAFF to look for information in three places made it difficult to utilize the data efficiently. Furthermore, there was minimal data validation in JPMRC's previous collection form. Data validation occurs when there is a predetermined answer for a data collection point. When data is captured in free text, there are limitless ways to enter data. For example, one unique unit name would be written in multiple ways, making it appear as different units in data tables. These different ways to write a unique entity prevent quick data aggregation and create difficulty in explaining to rotational training unit (RTU) commanders what is happening on the battlefield. The RTU is the current unit evaluated and undergoing combat training during the JPMRC exercises. Data becomes challenging to use when it is not validated and when it is in multiple different places. A central location for all

data submitted on one fire report is essential to increase the efficiency of both the TAFF and BECC. This paper proposes a new way to streamline data collection for fire missions at JPMRC that enables real-time battle tracking and data-driven after-action reviews (AARs).

2.2. Stakeholder Analysis

Stakeholder analysis enables a diverse perspective on the problem while providing helpful insight for developing and evaluating potential solutions (Parnell & Henderson, 2011). Stakeholder engagements aim to understand the issue better and determine the necessary actions for resolution.

2.2.1. Identification of Stakeholders

This project was initiated through USARPAC's Chief Data Office. The initial stakeholders engaged in this project are the TAFF, the BECC, and the OC/Ts. The TAFF is the central contact for combat analysis and after-action reviews during the training rotation. The 196th Infantry Brigade (196th IN BDE) operates the JPMRC task force and assigns OC/Ts. OC/Ts are the coaches and mentors attached to each unit during the training rotation. Their tasks include observing and monitoring each training unit while providing assessments and data submissions to the BECC. The BECC uses the data to operate fire missions throughout JPMRC rotations to provide realistic combat sights and sounds to the RTU.

2.2.2. Stakeholder Classification

Table 1 shows the stakeholder classifications for the project's stakeholders. This project must satisfy the TAFF and the BECC by enabling accurate, validated data collection to ensure precise battle-tracking and meaningful visualizations. Battle-tracking plays a crucial role in the BECC. It creates a shared understanding of people, processes, and their location in time and space. Battle-tracking enables real-time coordination of fire missions, efficient training, and maximizing operational effectiveness. The OC/Ts, who are co-located with the RTU, will use this product during operations at JPMRC. JPMRC's operating environments vary from the jungle to the Arctic. Therefore, any product they use must withstand the extremes of that operating environment. Additionally, this project will work directly with the decision authority overseeing this project, the 196th IN BDE. Any decisions regarding this project's use, implementation, and design will go directly through the 196th IN BDE and JPMRC.

Table 1: Stakeholder Classification Table.

Stakeholder	**Classification**
TAFF	Client/End User
BECC	Client/End User
OC/Ts	End User
JPMRC (USARPAC)	Owner
Chief Data Office (USARPAC)	Owner
196th IN BDE	Decision Authority

3. Methodology

This project utilizes agile project methodology throughout its duration. Specifically, the team heavily leveraged the Scrum methodology because of its flexibility and focus on continuous improvement. The team focused its efforts into three individual phases, known as sprints within Scrum methodology (Adobe Communications Team, 2022). Each sprint lasts a set period, typically 2 to 4 months. There are several steps that all sprints follow and repeat. Each sprint begins with a meeting between the team and stakeholders when the group identifies the project requirements. Next, the team synthesizes the requirements and comes to a consensus about a general plan for the project's development. The third step is rapidly developing a working prototype based on the plan, considering the project requirements. The group then tests the product they created, assessing its performance against the plan and requirements and noting potential improvements to be made. Prototyping continues until the group develops a sufficient product for the stakeholders. Finally, the group reviews the product with stakeholders and re-evaluates the requirements. The process then repeats itself following the same model steps. The team revisits the initial steps with the new information they have gained. Scrum methodology is helpful because of the adaptability it provides to the project. New requirements and ideas for the product regularly emerged throughout the project's development, but the structure

of the sprints helped the group adapt to any change. This iterative process ensured that feedback from various stakeholders was continuously integrated, leading to meaningful improvements at each stage.

4. Development

The project's development followed an iterative sprint-based approach, spanning three distinct phases. Each sprint was informed by stakeholder feedback, real-time observations, and hands-on testing during the JPMRC training rotations. Sprint 1 focused on defining initial requirements and building a baseline application. Sprint 2 emphasized implementing stakeholder-driven improvements and conducting a formal design test at JPMRC 25-2. Sprint 3 centered on refining the product based on AAR feedback from JPMRC 25-2 and preparing the system for future operational use. The following subsections outline each sprint's key objectives, activities, and outcomes.

4.1. Sprint 1

The group started Sprint 1 at a cadet internship with USARPAC over the summer of 2024. During stakeholder meetings, the project was defined, and initial requirements were given to create an app allowing data validation and ease of use for OC/Ts. The original plan was to use PowerApps, a Microsoft Suite product, to provide a baseline product. This sprint continued into the semester, with the cadet team planning the product's design and developing a baseline application. In addition, the team also conducted research on data pipeline engineering and user interface due to the importance of these criteria on the product's requirements. Sprint 1 continued with an in-person observation of the first JPMRC rotation of the 2025 training cycle, JPMRC 25-1. This stakeholder test allowed the team to analyze how the users would utilize the product. The team also met with the BECC and TAFF to reevaluate the requirements needed from their product after JMPRC 25-1. These updated requirements forced the team to turn its focus to data pipeline engineering.

4.1.1. Data Pipeline Engineering

Efficient data pipeline engineering ensures the seamless collection, validation, and processing of data in real-time operational environments. Data pipeline engineering is a critical component of data collection that processes the flow and organization of raw data through a complex chain of activities that manipulate, organize, and validate data (Raj, Bosch, Olsson, & Wang, 2020). This project requires data input from the OC/T's to be validated and collected. Data will be streamlined for the BECC to fire simulation during training. Furthermore, the TAFF will collect and store the data for analysis and AARs. The BECC and TAFF were set on the Microsoft Suite because its ease to feed data into PowerBI for visuals through using PowerAutomate. The Microsoft Suite allows for the easy data flow between different Microsoft Platforms. Therefore, the team set constraints on its solutions to using a platform that is within Microsoft. Two primary candidates were PowerApps and SharePoint List. Data collected by these platforms would be validated and then flow through PowerAutomate to enable real-time notifications and data visualization. Once the data was properly engineered, the team shifted its focus to the user interface.

4.1.2. User Interface

The stakeholder analysis informed the group of the need for an easy-to-interpret interface for the OC/Ts to use in austere environments. A well-designed user interface ensures efficient and intuitive interactions between users and digital systems, particularly in mission-critical environments. The user interface is the point of interaction between humans and machines. It encompasses all visual, tactile, and interactive elements that users engage with when using software or a device. Good user interface designs provide an easy and interactive relationship between the user and the system (Stone, 2005). SharePoint List and PowerApps were still viable solutions that met the user interface requirements.

4.2. Sprint 2

The team began Sprint 2 by meeting with the BECC and TAFF, after JPMRC 25-1, to identify their requirements for product improvement and proper implementation. The team created a product on SharePoint List and implemented many of the suggestions gained from the stakeholder meetings. The product was finalized and tested in the actual application during the JPMRC 25-2 rotation. Insights gained from testing fueled the reevaluation of the product and its requirements.

4.2.1. Requirements

As the team returned from observing JPMRC 25-1, they refined the requirements for this project. The comments from OC/Ts, the BECC, and the TAFF helped shape this project's requirements. The team observed difficulty with the OC/T's having to submit three different reports for one fire mission. To make a change, the OC/T's had to submit an adjudication form. This

made it difficult to make simple changes, so the data collection application needed a feature to edit the fire mission easily. All three fires reports must be combined into one report mechanism and one line of data. The application must provide as much validated, predetermined data as possible to increase the efficiency of BECC and TAFF operations and allow for real-time battle tracking. The team also wanted to make sure anyone involved in the fire mission could track the stage of each fire mission. This allows for a better shared understanding among all individuals and minimizes the need for extra communication.

The project required a user-friendly interface to enhance the efficiency of OC/Ts in recording battle-tracking and AAR data while enabling seamless data modification. This was achieved through features such as validated text boxes and pre-filled drop-down menus. Additionally, the system was designed to capture key timestamps, including when a fire mission was initiated and the processing duration at each echelon. The data collection platform was required to submit a single line of data per fire mission, which was quickly modifiable, with color-coded indicators to visually represent the mission's phase.

4.2.2. SharePoint List

The team initially focused on using PowerApps and creating a data collection method through this application. However, after the completion of stakeholder meetings and requirements development, the team decided to transition to creating a SharePoint List application. This is due to its usability and accessibility. It has a clean user interface that enables project success. Using SharePoint List enabled the integration of all three fires reports into a single, streamlined system. It consolidated fire mission data into one line per mission, tracked mission phases by target number, and allowed OC/Ts to edit data at any time. Additionally, the team created a notification system via PowerAutomate to alert the BECC when missions were created or changed. The data from the SharePoint List integrates with PowerBI. This streamlines the data pipeline and assists in creating clean data visualizations for AARs. Overall, SharePoint List is the application that allows the group to meet all project requirements.

4.2.3. Design Test: JPMRC 25-2

The SharePoint List was used in Alaska's JPMRC 25-2 rotation. The final SharePoint List had approximately 30 columns. Its key identifier was the Target Number, which is unique to every fire mission. The list enabled real-time battle tracking by color-coding the list by the phase of the fires proccess it was in. The list also tracked what part of the BECC the fire mission had gone through. This enabled a shared understanding of how far along the fire mission was between the BECC and OC/T's with the firing unit. After the exercise, a meeting was held with users of the list, and those insights were communicated to the project team afterward.

4.3. Sprint 3

Sprint 3 started after the JPMRC 25-2 rotation. The main goal of this sprint was for the capstone team to receive feedback from the OC/Ts and the BECC on the SharePoint List and edit it based on the AAR comments. A stakeholder meeting was conducted to discuss the AAR comments that the OC/Ts and BECC from 25-2. The capstone team developed a plan incorporating AAR feedback and brainstorming the most effective way to refine the SharePoint List. This process resulted in a more concise and user-friendly version, enhancing navigation for OC/Ts and the BECC. Utilizing JPMRC 25-2 data, the team created visualizations to support stakeholder decision-making. The final testing and review of the design will be addressed in future work.

4.3.1. Reevaluation of Requirements

AAR comments were provided after the JPMRC 25-2 rotation by the TAFF and the BECC. The AAR comments from the BECC and TAFF provided direction for the group to improve the product and its implementations for further rotations. Most AAR comments were technical, focusing on data navigation, user interface, and tracker functionality. AAR comments from the BECC also highlighted a struggle to get OC/Ts to buy-in to the new product. This showed that the group could be more intentional in explaining how to use the product to all users. The capstone team created videos to instruct the BECC and OC/Ts on operating the SharePoint List and addressing the unit's questions while operating the system. Furthermore, the team reduced the number of fields on the data collection form to those essential. This decision was intended to lessen the work needed from the user and refine the scope of the product.

Further analysis showed that processing times were not recorded for any fire mission. The purpose of this data was to record processing times at multiple echelons to show field artillery competencies. Due to incomplete data collection, the capstone team created simulated time data. This allowed the capstone team to demonstrate the utility of collecting and visualizing processing times.

5. Future Work

Future groups can continue refining the system through AAR comments after the next JPMRC rotation. Further refinement can be done through improving user conformity, implementing more meaningful data visualizations, and accelerating automation. One course of action is the implementation of more insightful data visualizations. The work below has been drafted but has not yet been implemented.

5.1. Data Visualization

Data visualization and data storytelling are imperative to ignite change in an organization. Data storytelling is done by explaining, enlightening, and engaging the audience about the data visualization (Dykes, 2020). To be able to do this, it starts with making a data visualization that is easy to read and is insightful. A good data visualization is simple, focused, and truthful (Cabanski Christopher & Sofia, 2018). Since the group deals with multiple stakeholders, creating a shared intent and understanding of the data visualization is essential to ensure all parties are content with the product (Morelli et al., 2021). To do this, the capstone team will need multiple stakeholder meetings to provide a shared understanding of the visual and its purpose. Additionally, the team will have to explain to the stakeholders how the data visualization can be used to give insights to RTU commanders. The team has created a data visualization that can be used in JPMRC. It would need to be implemented into future TAFF operations.

The concluding step was to create more robust data visualizations using data from the SharePoint List. The team developed a variety of charts and graphs to identify how JPMRC can better train their units to call for fire. The simulated data was created in Excel using subject matter expertise to set upper and lower limits and distributions on the generated data. This was used to create visualizations to show each echelon's processing times for fire missions. A clustered bar chart, seen in Figure 1, visualizes the average processing times at each echelon per fire mission. The times from left to right show the order in which a fire mission occurs: (1) Observer, (2) Battalion Fires Support Element, (3) Brigade Fires Support Element, (4) Battalion Fires Direction Center, (5) Platoon Fires Direction Center, and (6) Gunline. The data visualization has the unit to fire on the Y-axis and the average processing time on the X-axis. This data visualization allows you to expand each unit further and show its individual fire missions.

The purpose is to show the processing times by unit so commanders can easily see their unit's strengths and weaknesses. The left-hand side of this dashboard shows a table that expands on each unit and the number of rounds shot for each fire mission. This sprint played a significant role in strengthening the integration of the SharePoint List into JPMRC's training. Ultimately, this process allows senior leaders to quantitatively assess their units' lethality to enhance their effectiveness at all levels. The continued refinement of this system will ensure that units are prepared for real-world challenges.

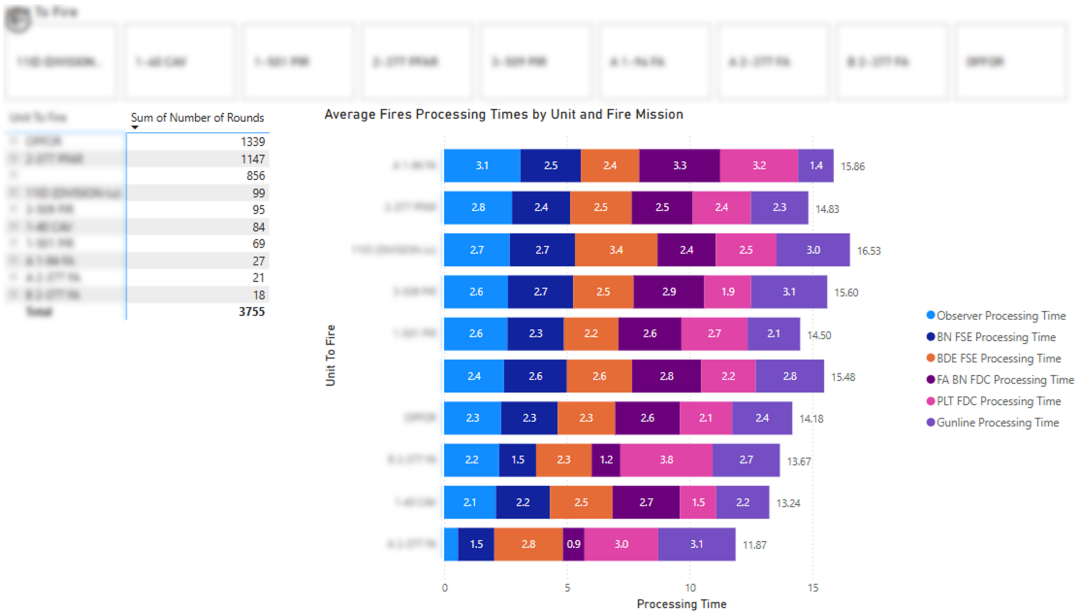

Figure 1: Unit Processing Times

6. Conclusion

This project has successfully modernized the data collection and reporting system at JPMRC by introducing a streamlined, user-friendly method through the SharePoint List, along with integrated tools such as Power Automate and Power BI. Adopting agile methodology ensured that the team remained adaptable and responsive throughout the development process, allowing for rapid iteration and refinement. The capstone project emphasized the role of data during decision-making for a modern military. Future training can be improved by commanders when new data visualizations are implemented to give more information to RTU commanders. As JPMRC continues to evolve, this solution sets the foundation for ongoing improvements and feedback-driven enhancements, ensuring that future operations will be more efficient and effective. The team's commitment to facilitating this transition and providing thorough training ensures that the new system will remain sustainable and scalable for years to come.

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ISBN: 97819384969-9-8