



Research Product 2019-03

**An Interactive Assessment Tool for the Expert Infantry
Badge Competition: Design, Development, and
Evaluation**

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March 2019

**United States Army Research Institute
for the Behavioral and Social Sciences**

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AN INTERACTIVE ASSESSMENT TOOL FOR THE EXPERT INFANTRYMAN BADGE COMPETITION: DESIGN, DEVELOPMENT, AND EVALUATION

EXECUTIVE SUMMARY

Research Requirement:

This research product report describes a digital assessment tool for capturing performance data, transferring data in real-time, and tracking data during Army field assessments. Here, the focus is on collecting and analyzing data from the Expert Infantryman Badge (EIB) competition; that said, this type of digital assessment tool could be employed across various other Army training and assessment contexts. The digital tool replaces the traditional paper-and-pencil approach to EIB grading. Paper-and-pencil methods have many shortcomings, such as grade sheets being damaged or lost, and delays in providing results to leaders and stakeholders. Mobile technologies provide a viable alternative, allowing Army instructors and graders to capture and share Soldier performance data during live field exercises. Mobile technologies can be networked to feed data to a database, providing real-time analysis and reporting. Even so, mobile technologies come with their own challenges. Any networked tool must be approved to run on Army networks and must comply with information technology (IT) restrictions. Moreover, the technology itself must be easily updated with current tasks and grading rubrics to remain viable.

The present research developed and tested the digital assessment tool presented in this report. The research sought to address the challenges described above in designing and deploying the mobile assessment technology, ultimately testing the technology during a train-up week of an EIB competition. Data were collected concerning the product's usability, efficiency compared to paper-based assessment processes, and pros and cons of deploying it in the field, including ergonomic concerns.

Procedure:

In developing the product, observations of scheduled EIBs were conducted to gather data on EIB logistics and to identify challenges related to the paper-based assessment process. During this time, it was decided that the main focus of the development efforts would be on the Patrol, Medical, and Weapons EIB events. An iterative development method was used to produce the digital applications, refining the products based on feedback from the EIB proponent (U.S. Army Infantry School) and other stakeholders and end-users (i.e., Station Noncommissioned Officers in Charge; NCOICs). A variety of software development tools were utilized in producing the research product.

The entire solution (i.e., mobile application, web application, and mesh network) was then tested during the train-up week of another EIB. Protocols were developed and used with Soldiers in the field and in the tactical operations center (TOC) to gather data on usability, functionality (of real time data capture, transfer, and tracking), visual and ergonomic experience (two different size iPads were used with testers), and overall efficiency of the solution as compared with current paper process. The sample size for the research product evaluation was

10 Soldiers (eight Graders/Station NCOICs and two TOC NCOICs). Based on the initial input from Soldiers, we modified the research product, then demonstrated and presented the updated version to the EIB Test Manager and several station NCOICs. After final modifications were made, the mobile application and web application code were delivered including the networking equipment and hardware (server laptops and mobile devices).

Findings:

The results indicated that none of the eight Soldiers interviewed had previously used an iPad for assessment purposes. Nonetheless, they reported it was intuitive and user friendly. Advantages of the digital solution were noted, including less paper and having real time data. An often noted shortcoming related to the battery life of the iPad. All participants felt the digital mobile solution was an improvement over paper-and-pencil based assessments, with 88% reporting that it did not change or reduce their workload. An often requested feature was to add an embedded timer/stopwatch (38%). Hardware preferences varied between the iPad mini (due to small size) and the iPad (with the hand-grip). The TOC NCOICs felt the Master Tracker application was very intuitive compared to the current spreadsheet, and that auto-populating the database alleviated the need for Soldiers to carry papers from the field to the TOC, reducing the number of people in the TOC. A laptop computer was the preferred device to house the Master Tracker application.

Two EIB Test Managers tested the solution and the real-time data capture. Their reactions were very similar to other users. Further, they worked with the research and development team to incorporate the timer/stopwatch feature and a “protest” button. Both EIB Test Managers also agreed that the layout and functionality of the Master Tracker (including filters) was appropriate. Concerning the analytics dashboard, both preferred fractions and associated percentages over pie graph displays.

Utilization and Dissemination of Findings:

The final set of programming code for both the CouchDB version and the .Net version were packaged up and delivered to ARI as well as the hardware (iPads and laptops) and network equipment (other than solar panels and masts used during one of the data collections for the mesh network set up). Features and functionalities of the digital solution as well as information about the programming of both the mobile and web applications were provided to ARI for their continued research in this area. Lastly, the results of this effort were presented to the USAIS leadership at Ft. Benning, GA in March 2018.

AN INTERACTIVE ASSESSMENT TOOL FOR THE EXPERT INFANTRYMAN BADGE COMPETITION: DESIGN, DEVELOPMENT, AND EVALUATION

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An Interactive Assessment Tool for the Expert Infantryman Badge Competition: Design, Development, and Evaluation

Introduction

When Infantry Soldiers hold the Expert Infantryman Badge (EIB), it is widely-recognized as indicating that they have achieved a high-level of skilled performance across a broad domain of Army Infantry tasks, demonstrating exceptional competence in their profession. Soldiers are motivated to sharpen their skills and competencies by the prospect of earning an EIB, a process that ultimately benefits themselves, their teams, and the Army even if they are not individually successful. Opportunities to excel and to be recognized for excellence are an essential part of any effective talent management strategy for the Army. However, executing complex assessment-based events such as the EIB Competition are labor intensive, requiring a highly-organized group of graders to assess Soldiers as well as efficient processes to centralize and analyze the resulting data. Many times, the assessment methods currently used can be inefficient, relying on paper-and-pencil scoring in field settings and data that is hand-entered—both methods prone to error and delay.

The research product described in this report is intended to help streamline existing assessment and data consolidation processes to enable more efficient and effective execution of complex assessment-based activities such as the EIB Competition. While this research focused on the EIB Competition, tools such as those presented in this report are applicable across a broad array of Army assessment contexts and are an essential feature of a future in which Army talent management initiatives focus with increasing precision on measuring and enhancing individual Soldiers' skills and competencies.

The Research Problem and Product

The U.S. Army *Talent Management Concept of Operations for Force 2025 and Beyond* (Department of the Army, Combined Arms Center, 2015) provides the conceptual groundwork to optimize the talent management activities of all Army professionals and teams so they can thrive and win in a complex world. This document defines *talent* as a unique intersection of skills, knowledge, and behaviors. Further, it explains that talent management will exert a positive effect on organizational outcomes and is a required capability impacting readiness. In the spirit of the Army's current talent management initiatives, ARI recently developed a toolkit for instructors to measure, assesses and track a student's progress in the Armor Reconnaissance Course (ARC), focusing on developing Leader attributes (Ratwani et al., 2016). The toolkit developed for ARC aided instructors in consistently and reliably assessing key Soldier competencies. ARC instructors found the toolkit to be useful in addressing a number of assessment challenges. Moreover, the toolkit was useful in providing actionable feedback to students, supporting performance optimization—a key goal of talent management initiatives (Colarusso & Lyle, 2014). An effective talent management system must be able to identify, measure, and leverage an individual's talents, applying accurate metrics to assess and track performance over time to support career-long professional development (Collins & Mellahi, 2009).

Early in this project, the EIB was selected as the venue for this research. The EIB Competition provides a context in which Soldiers perform a variety of critical tasks and are assessed on their performance. The EIB is intended to recognize Infantrymen who have demonstrated mastery of critical skills relevant to their profession. The EIB focuses on over 40 individual, procedural tasks. These include day and night land navigation, a 12-mile foot march, and weapon, medical and patrol lanes with 10 stations each, all performed over 5 days by as many as 1,500 Candidates. An EIB Competition is conducted many times a year at various Continental United States (CONUS) and Outside the Continental United States (OCONUS) locations. All Candidates must pass a physical fitness assessment prior to competing for the EIB (Department of the Army, 2019).

In the context of the EIB Competition, this research product report will describe a digital tool for performance assessment data capture, transfer, and tracking during field assessments. A prototype digital tool was developed and tested to evaluate its usability and efficiency compared to current paper-based assessment processes. It was determined that the digital assessment system would include the following three main components:

- (1) Mobile application (containing selected rubrics) used for data capture,
- (2) Web application used for rubric editing, data tracking and analytics, and
- (3) Networking solution used to transfer data captured by the mobile application in the field to the web application (Master Tracker) in the TOC.

The assessment system was developed and tested over the course of 15 months, starting with observations of two scheduled EIB training and assessment events. Following these observations, a product backlog of user stories was generated—using Agile software development methodology—to address the technology needs. These user stories were pulled into approximately 16 sprints—i.e., short development cycles—across the 15 months. . End users, such as the EIB Test Manager and other Station NCOICs, provided feedback on various iterations of the product. After a full-scale digital tool had been developed, it was tested at an EIB site during the training week. Station NCOICs used the digital tool to capture data (using mock Candidate data) in the field and provided feedback, while the TOC NCOIC accessed the Master Tracker (containing the captured data) in the TOC and provided usability feedback.

The following sections provide additional background on the development of the digital tool, details on how to use the features of the tool, and appendices which list considerations for continued research, instructions for downloading the programming code, and a Grader/Station NCOIC quick reference guide.

The Expert Infantryman Badge Assessment Context

The paper-based system used for most EIBs¹ for the three lanes (Patrol, Medical, and Weapons) involved: (a) an EIB Candidate Grade Sheet, a cumulative grading sheet listing all events in the EIB to be carried by the Candidate, (b) EIB Lane Score Sheets, grading sheets for individual lanes to be carried by the Candidate that allows a grader to mark off attempts (first or second attempt) and to include remarks for each station, and (c) Candidate Testing Station Sheets used by the station Graders to identify the Candidate (name, rank, etc.) and to mark ‘GO’ or ‘NO-GO’ (with a space to write in an explanation for a ‘NO-GO’). The information from the Candidate Testing Station Sheets were also transferred to the EIB Candidate Grade Sheet. If the Candidate received a ‘NO-GO’ and was subsequently eliminated, the grader or a runner would deliver the Candidate Testing Station Sheet (with the ‘NO-GO’ information) and the EIB Candidate Grade Sheet to the TOC.

Figure 1 shows an EIB Candidate holding his paperwork while waiting to be called up for testing at a weapons station. Figure 2 shows a TOC NCOIC holding an EIB Candidate’s ‘NO-GO’ paperwork after it has been received and informing the other TOC NCOIC to cross the Candidate off of the main tracking board. After crossing him off the main tracking board, the TOC NCOIC then moved to the “analytics” board (image on the right) to update the general statistics by company. Figure 3 shows another TOC NCOIC entering the Candidate’s ‘NO-GO’ paperwork into an Excel spreadsheet, rendering it officially logged. The supporting paperwork was then filed in its proper box, as seen in the image on the right in Figure 3.

The TOC NCOIC also logged Candidates who successfully completed the stations at the end of the day, after those Candidates arrived at the TOC with their completed ‘GO’ paperwork. By the end of each day, all Candidates were accounted for in the Excel spreadsheet—a black line through those who were eliminated and a yellow highlight for those who were now considered “blade runners.” Blade runners are Candidates who had two first attempt ‘NO-GO’s at two different stations). Blade runners were eliminated if they received a third, first attempt ‘NO-GO’ at a station the next day. As well, during the assessment, any Candidate who received a first attempt ‘NO-GO’ was considered a blade runner until he or she re-tested at that station, since the Candidate would be eliminated if the re-test had another ‘NO-GO’ result. After our observations were complete, the elimination process was later revised to eliminate a Candidate if they have two ‘NO-GO’s at any lane on the same day (Department of the Army, 2019).

¹ Not all test sites use the individual lane score sheet.



Figure 1. Candidate with Paperwork, Awaiting Testing

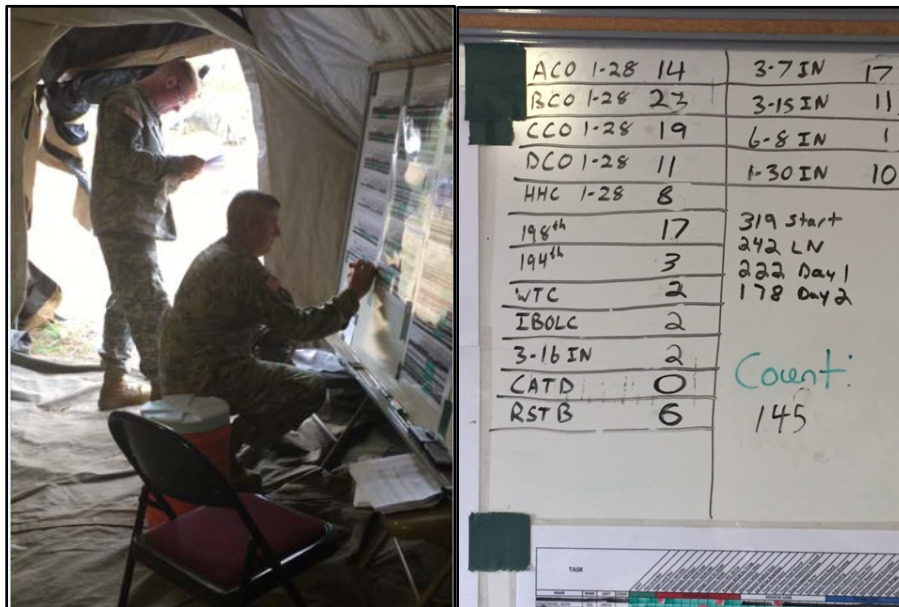


Figure 2. Eliminating Candidate on a Whiteboard and Updating Statistics (by Company)

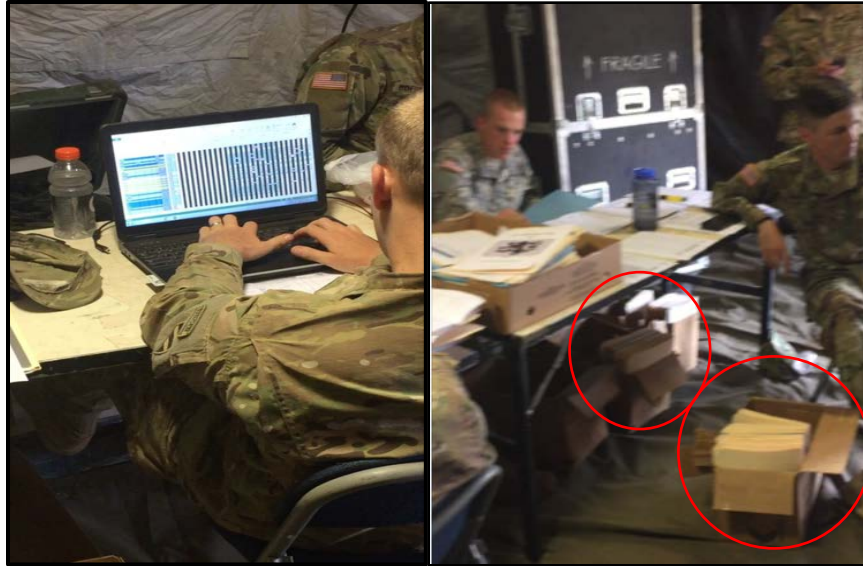


Figure 3. Entering Paperwork into Excel Sheet and Filing Away Paperwork in Folders

Mobile Application – Connected State

After observing the paper-based assessment process, reviewing the EIB Manual (Department of the Army, 2019), gathering all pertinent rubrics, and interviewing several station NCOICs, the data were compiled, analyzed, and reported in a solutions document. This document was used to produce the user stories for the digital solution (product backlog).

The mobile application was developed with React-Native and PouchDB, and runs on an iOS platform. The assessment rubrics loaded in the mobile application are constructed, edited and/or selected using the web application, which is described later in this document. Once the mobile device is connected wirelessly to the same network as the web application, the rubrics are automatically uploaded to the device.

The intended user of the mobile application is the Station Grader or Station NCOIC. Data is stored locally on each mobile device and utilized during the assessment, allowing the device to operate in either a connected or a disconnected state. The data stored on a device is also stored on all of the other devices. This data storage redundancy serves as a fail-safe, should any one device be destroyed, stop functioning, or become comprised during the assessment. The only time data from one device is not stored across the devices is when it is being captured with a device in a disconnected state. As soon as the offline device is connected, the data will be transferred and stored across the connected devices.

Before beginning his or her duty at a station, a Grader/Station NCOIC powers on the mobile device and selects the digital tool application. As seen in Figure 4, the Grader/Station NCOIC selects the appropriate lane.

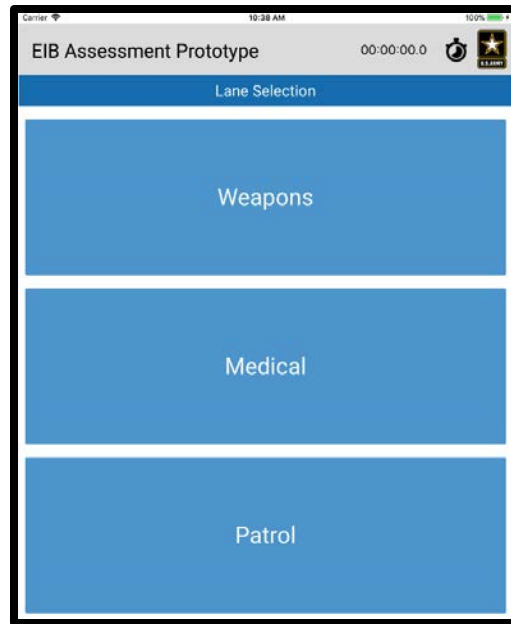


Figure 4. Select Lane

After selecting the lane (i.e. Weapons), the Grader/Station NCOIC then selects the appropriate station as seen in Figure 5.

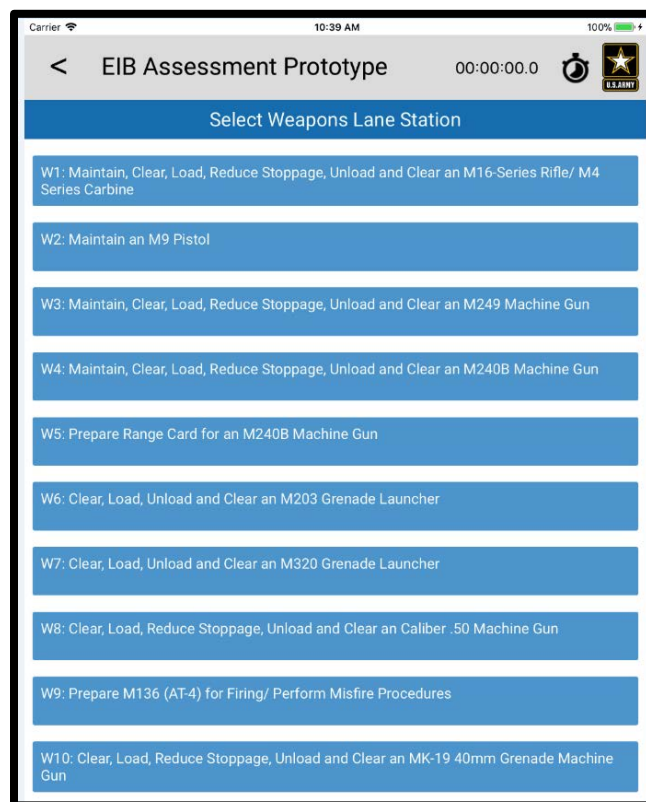


Figure 5. Select Station

After selecting the station, the Grader/Station NCOIC is ready to enter the grade of a Candidate digitally. As the Candidate approaches, he or she hands the Grader/Station NCOIC their EIB Candidate Grade Sheet, which will have a unique quick response (QR) code assigned and printed on the sheet. The Grader/Station NCOIC scans a Candidate's assigned QR code using the device's camera feature as seen in Figure 6. The scan feature allows the Candidate's information to appear on the device automatically, thereby eliminating the need for an additional paper that the Grader/Station NCOIC completes while verifying the Candidate's identification. The QR code is uniquely assigned to a Candidate without his or her personally identifiable information (PII). The QR code is typically assigned by the EIB Test Manager using the Candidate management feature of the web application, rendering Candidate PII unavailable to Graders/Station NCOICs in the field. It is only after Candidates complete the assessment, and EIB award certificates and orders are being generated, that the results captured by the digital solution are merged with PII.

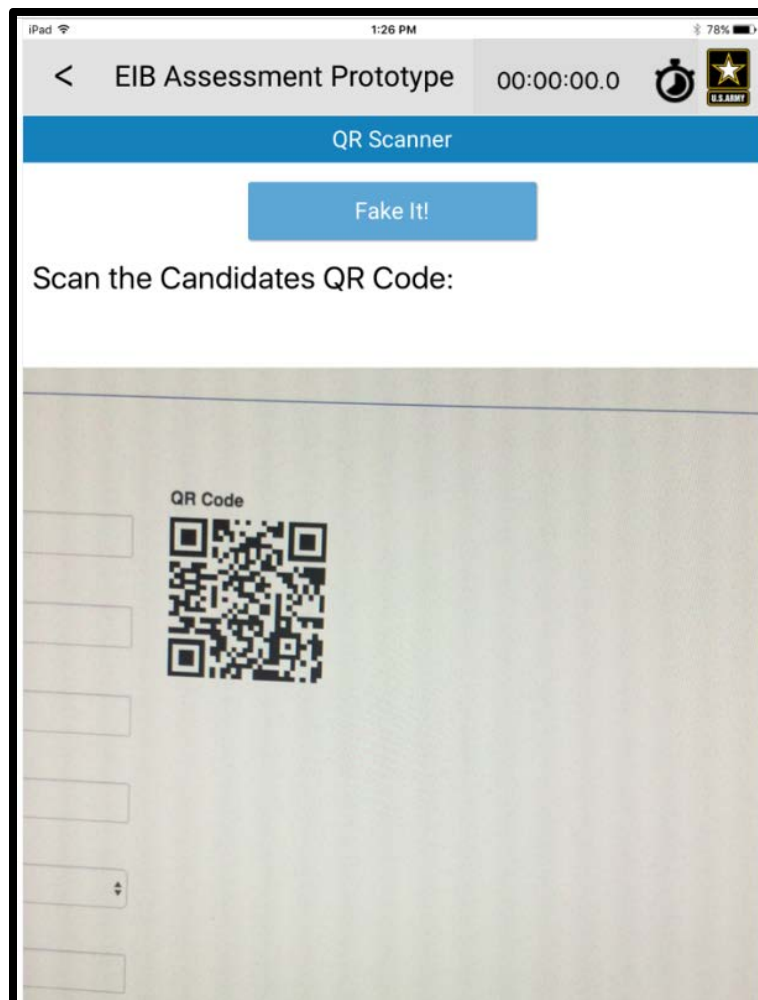


Figure 6. Scan Candidate's QR Code

A fail safe was included for Candidates who may lose their EIB Candidate Grade Sheet containing the QR code or the camera feature is not functioning properly: the "Fake It!" button.

After clicking this button, the Grader/Station NCOIC can manually search for a Candidate using last and first name and arrive at the same screen as seen in Figure 7. It is important to note that the QR code scanning feature stood up to the anticipated adversities of field conditions; damaged sheets, wet sheets, and sheets folded up and stuffed in sandwich bags all yielded successful scan results. We expect that the scanning feature should be able to withstand inclement weather and other circumstances which may reasonably impact the condition of EIB Candidate Grade Sheets.

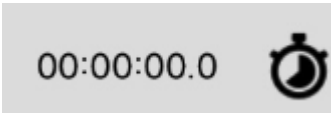
Once the Candidate's information appears on the screen as seen in Figure 7, the Grader/Station NCOIC can verify the identity of the Candidate and begin the process of the assessment (i.e. reading instructions, etc.).

The screenshot displays a mobile application interface titled "EIB Assessment Prototype". At the top, there is a status bar with "Carrier", "10:41 AM", and "100%" battery. Below the title bar, a blue header reads "Candidate Information". The main content area shows the following details: "Station: Weapons-W1", "Maintain, Clear, Load, Reduce Stoppage, Unload and Clear an M16-Series Rifle/ M4 Series Carbine", and "Candidate" information including "Last Name: Doe", "First Name: John", "Rank: PVT", "MOS: 11B", and "DOB: 01-JAN-1984". At the bottom, there are three large, colored buttons: a green "Go" button, a red "No Go" button, and an orange "Protest" button. A timer "00:00:00.0" and a U.S. Army logo are also visible in the top right corner.

Figure 7. Verify Candidate's Information and Select Candidate's Result

The information and functions that the Grader/Station NCOIC has access to on the screen in Figure 7 are also described in detail in Table 1.

Table 1
Candidate Information and Rating Selection Screen Details

Information	Description
Station	Indicates the short name of the station (i.e. Weapons – W1).
Station Detail	Provides the full name and description of the task to be completed at this station (i.e. maintain, clear, load, reduce stoppage, unload and clear an M16-Series Rifle/M4 Series Carbine).
Candidate	Provides Candidate’s last name, first name, rank, military occupational specialty (MOS), and date of birth (DOB).
‘Go’ Button	Allows the Grader/Station NCOIC to select a ‘GO’ rating after verbally telling the Candidate that he or she has performed all of the performance measures accurately (including any measures of time and/or sequencing). <i>“You are a ‘GO’ at this time.”</i>
‘NO-GO’ Button	Allows the Grader/Station NCOIC to select a ‘NO-GO’ rating after verbally telling the Candidate that he or she has missed a performance measure (including any measures of time and/or sequencing). <i>“You are a ‘NO-GO’ at this time.”</i>
‘Protest’ Button	Allows the Grader/Station NCOIC to select ‘Protest’ after verbally telling the Candidate he or she has received a ‘NO-GO’ and the Candidate subsequently protests this rating. Selecting ‘Protest’ holds the rating in this status until there is a resolution made by the station NCOIC or the lane NCOIC at which time the Candidate’s ‘GO’ or ‘NO-GO’ rating is entered. Protesting is logged on the Master Tracker and permanently stays on the record for tracking purposes.
	Allows the Grader/Station NCOIC to select a stopwatch feature which they can use while assessing the Candidate (in place of a personal watch or stopwatch). Since the stopwatch would be used during the assessment itself, it is most likely that it would be accessed from the Candidate screen. However, it is accessible from every screen in the application in case the Grader/Station NCOIC assesses the Candidate before scanning the QR code, verifying identify, and entering the result.

If the task is time-based, the Grader/Station NCOIC can select the stopwatch feature as described in Table 1 above. The functionality of the stopwatch is similar to a typical digital stopwatch (see Figure 8), where the user clicks the start button to start and the stop button to stop timing and is able to reset and close the stopwatch. The stopwatch shows hours, minutes, seconds, and milliseconds. (Note that a Candidate's time using the stopwatch feature is not automatically stored; the stopwatch is intended to be used in place of a Grader or Station NCOIC's personal watch or stopwatch).

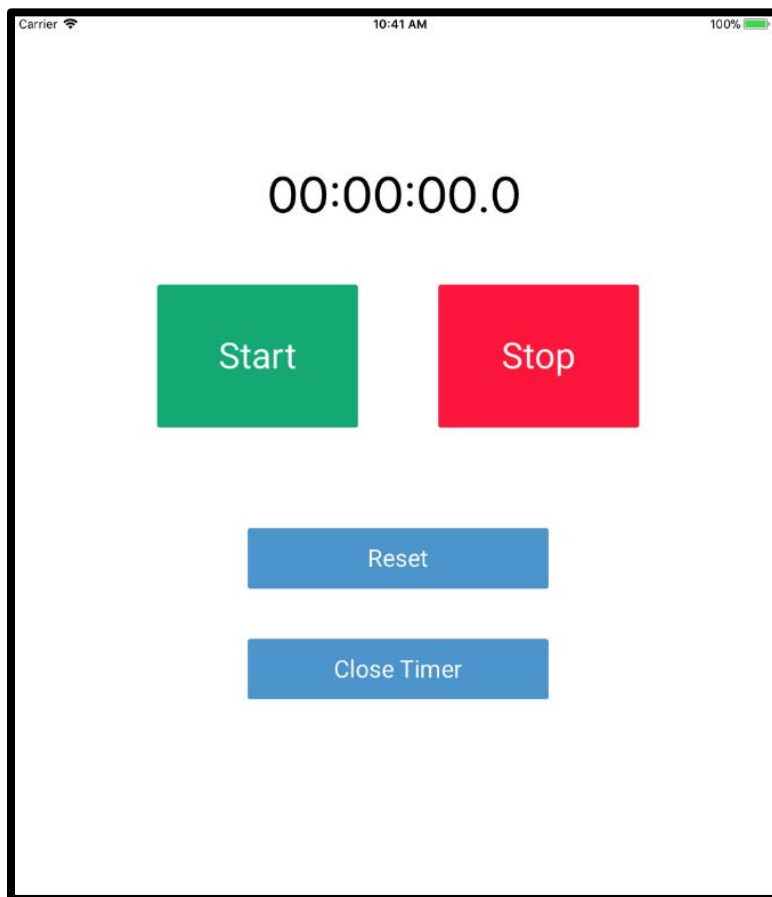


Figure 8. Procedures Performed by Candidates can be Timed with the Stopwatch Feature

If the Candidate successfully performs the task (including any time or sequencing measures), the Grader/Station NCOIC selects the 'GO' button as seen in Figure 7. After the 'GO' button is selected, the Grader/Station NCOIC will be brought to the confirmation screen as seen in Figure 9. After reviewing the information, the Grader/Station NCOIC enters an assigned Personal Identification Number (PIN) as a means of confirming the result. If a 'GO' result was selected by mistake (i.e. the Grader/Station NCOIC meant to select the 'NO-GO' button), he or she does not confirm the result and uses the 'back' button (red circle in Figure 9) to return to the Results page and is required to scan the Candidate's QR code a second time and enter (and validate) the intended result.

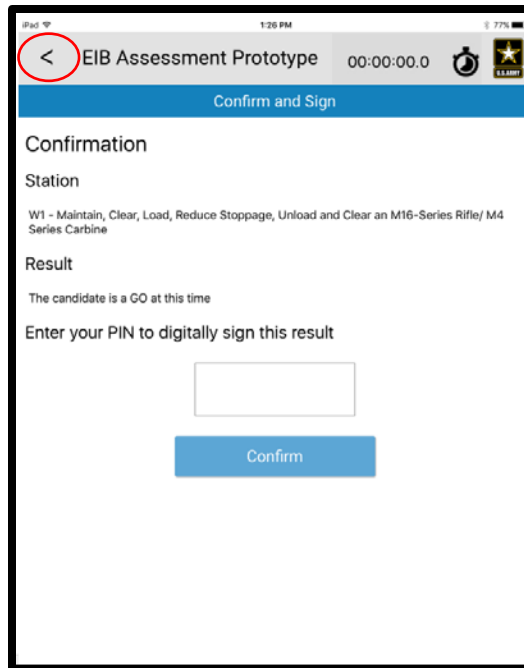


Figure 9. Confirm ‘GO’ Result with PIN

After entering a PIN and selecting ‘Confirm’, the Grader/Station NCOIC is returned to the QR Scanner screen as seen in Figure 6. This movement allows the Grader/Station NCOIC to immediately scan the next Candidate. Once a result is confirmed (and the device is in the connected state), the result is digitally time-stamped.

If a Candidate does not successfully perform the task, the Grader/Station NCOIC selects ‘NO-GO’ as seen in Figure 7. The next step is to select the reason for the ‘NO-GO’. The Grader/Station NCOIC does this by scrolling down and selecting the exact performance measure that the Candidate failed as seen in Figure 10. Note that a ‘Safety Violation’ is found at the end of every list (although it is not shown in the figure).

After selecting the reason, the Grader/Station NCOIC is able to enter any additional comments using the mobile device keypad as seen in Figure 11. After entering comments (if desired), the Grader/Station NCOIC is brought to the confirmation screen, where he or she has the ability to review the ‘NO-GO’ result before entering the PIN as seen in Figure 12. If a ‘NO-GO’ result was selected by mistake or if the incorrect performance measure was selected, the Grader/Station NCOIC does not confirm the result and uses the ‘back’ button to return to the Results page and is required to scan the Candidate’s QR code a second time and enter (and validate) the intended result.

iPad 1:27 PM 77%

< EIB Assessment Prototype 00:00:00.0

No Go

1: Clear an M-16-Series Rifle/ M4 Series Carbine (In Sequence).

1.a: Point the weapon in a safe direction

1.b: Attempt to place the selector lever on SAFE.

1.c: Remove the magazine from the weapon, if present.

1.d: Lock the bolt open.

1.e: Ensure that no ammunition is in the receiver or chamber.

1.f: Press the upper portion of the bolt catch allowing the bolt to go forward.

1.g: Close the ejection port.

Figure 10. Select Reason for 'NO-GO' (i.e. 1.a. Point Weapon in a Safe Direction)

iPad 1:27 PM 77%

< EIB Assessment Prototype 00:00:00.0

Comments

Failed Measure: Point the weapon in a safe direction

Comments

Enter any additional information related to the No-Go decision here...

Submit

Figure 11. Enter Comments for Failed Measure (Point Weapon in a Safe Direction)

Confirm and Sign

Confirmation

Station

W1 - Maintain, Clear, Load, Reduce Stoppage, Unload and Clear an M16-Series Rifle/ M4 Series Carbine

Result

The candidate is a NO-GO at this time

Failed Criteria

Point the weapon in a safe direction

Comments

Test comment

Enter your PIN to digitally sign this result

Confirm

Figure 12. Confirm ‘NO-GO’ Result with PIN

After providing a verbal result of “you are a ‘NO-GO’ at this time”, if the Candidate protests this rating, the Grader/Station NCOIC does NOT select ‘NO-GO’ from the Candidate Screen. Instead, he or she would select ‘Protest’ as seen in Figure 7. The same procedures follow as with a ‘NO-GO’; therefore, the Grader/Station NCOIC will have to select the reason for the ‘NO-GO’, enter comments (if desired), and enter a PIN to confirm the protest (see Figures 10, 11, and 12). After this result has been logged, manual protest procedures will follow (i.e., the protest is brought to station or lane NCOIC for review, etc.). Once the protest is resolved, the Grader/Station NCOIC re-scans the Candidate’s QR code (as seen in Figure 6) and enters the result. If it is indeed a ‘NO-GO’, the Grader/Station NCOIC will need to re-enter the reason, enter comments (if desired) and confirm the result by entering a PIN. Regardless of the end result, the fact that this Candidate protested at this particular station is stored as data in the web application, which produces analytics to allow stakeholders to track any patterns of Candidates who excessively protest and/or stations with an unusually high number of protests.

Mobile Application – Disconnected State

In a disconnected state, the mobile application operates in a similar way to the connected state. Data is stored locally on the mobile device, and once the device returns in range of the network, the device will link up with the web application and local data will be uploaded to the Master Tracker. Two caveats for operating in a disconnected state are:

- The time-stamp of the result will not be the actual time that the Grader/Station NCOIC submitted the result. It will be delayed to the time when the device was synched with the web application. Considering this fact, it was determined that digital time-stamping should not be used as a means to determine whether or not a Candidate has missed the re-test window (1 hour from first attempt ‘NO-GO’). This process would need to remain manual.
- Although all connected devices contain the data from every other connected device, if a device is destroyed while disconnected from the network, any data entered while it was disconnected will be lost.

Web Application – Rubric Management

The web application was built using CouchDB and later converted to a .NET solution (SQL server) running on a laptop computer. The web application must be run on a network (set up specifically for the purpose of the EIB) and connected to the mobile devices.

The web application is used to create a new rubric, edit a rubric, and to select rubrics for that particular EIB. Specifically, with regard to the rubrics, if a new rubric is loaded or an existing rubric is modified using the web application, the mobile devices must be synched with the network in order to receive the updated rubrics. The web application is also used for the roster management, the Master Tracker, and the data analytics dashboard. Note that several stations/rubrics are mandatory for all EIBs, and these are indicated as mandatory in the web application. The intended user of the web application concerning roster management and rubric management is the EIB Test Manager (or anyone to whom he or she delegates this task). The intended user concerning the Master Tracker is the TOC NCOIC, and the intended user concerning the analytics dashboard is the TOC NCOIC as well as any EIB stakeholders (i.e., Unit Commanders who enter the TOC during the assessment).

Before any tasks/stations can be added to the EIB (i.e., rubrics transferred to the mobile devices), the user must first create these rubrics in the web application. Once the web application is open, the user selects the ‘Rubric Management’ tab as seen in Figure 13. In this case, rubrics have already been added, and these rubrics can be edited or deleted by selecting either the pencil icon or trashcan icon (left-hand columns of the interface). To create a new rubric, the user selects ‘Create Rubric’ (bottom of the page of the interface).

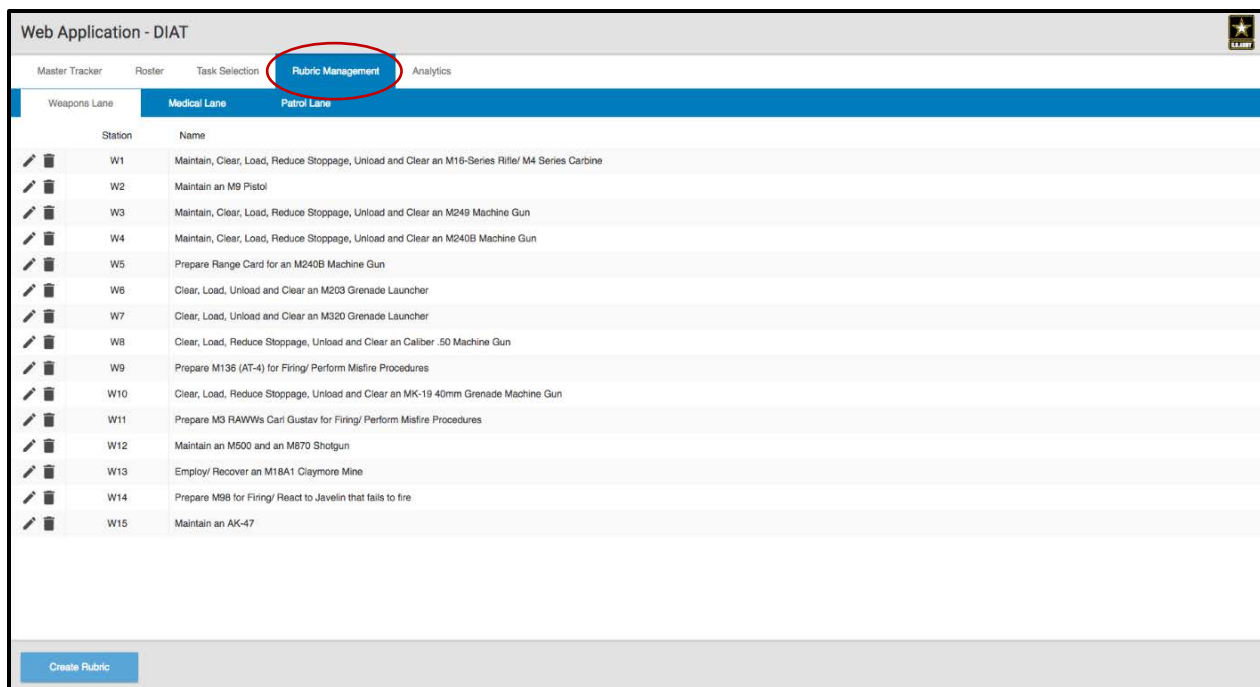


Figure 13. Access Rubric Management Main Screen

When creating a new rubric (or when editing a rubric), the user is able to select the lane (either Weapons, Medical or Patrol), name the station (e.g. P1 Adjust Indirect Fire), add a task performance measure or add subtask measures as seen in Figure 14. During the creation or editing of a rubric, the user is also able to remove a task performance measure or subtask. The user selects 'Save' to save the rubric change.

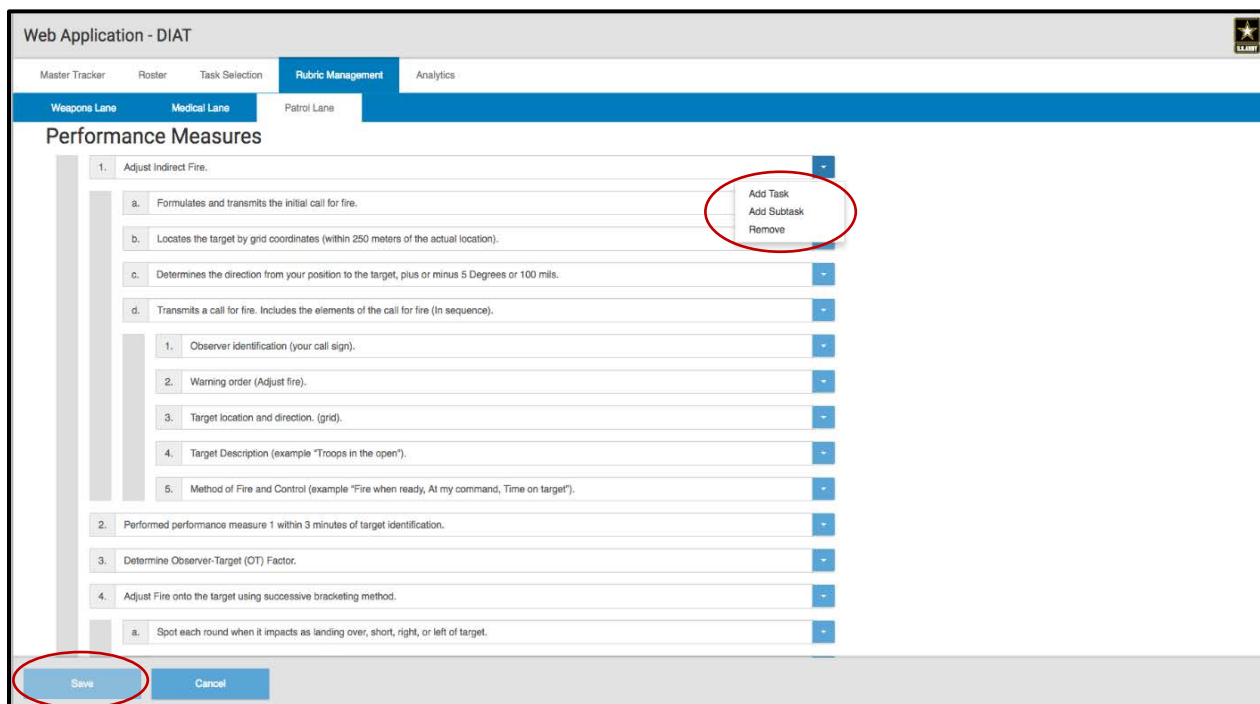
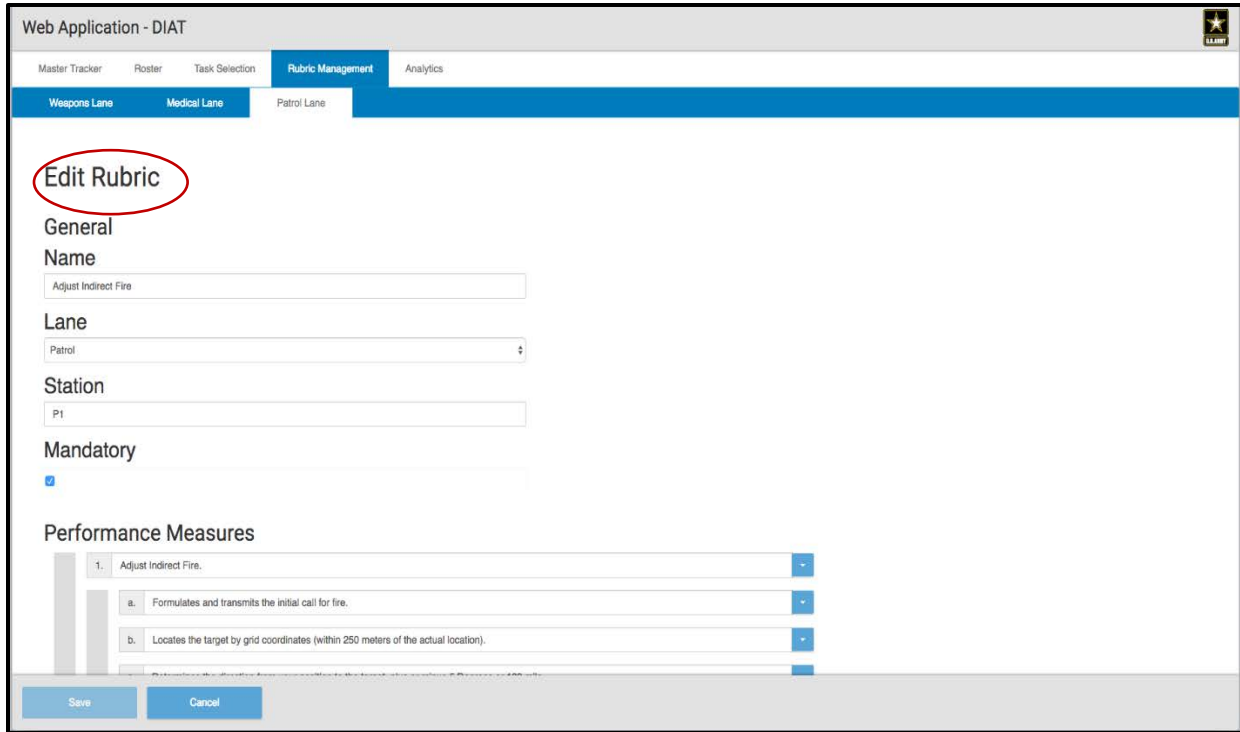


Figure 14. Add/Edit Performance Measures

If the user wants to edit an existing rubric, this can be done from the rubric management main screen as seen in Figure 13 by selecting the edit function (pencil icon). Once a particular rubric is selected to be edited, the user can edit any aspect of the rubric as seen in Figure 15.



Web Application - DIAT

Master Tracker Roster Task Selection **Rubric Management** Analytics

Weapons Lane Medical Lane Patrol Lane

Edit Rubric

General

Name

Adjust Indirect Fire

Lane

Patrol

Station

P1

Mandatory

☒

Performance Measures

1.	Adjust Indirect Fire.	
a.	Formulates and transmits the initial call for fire.	
b.	Locates the target by grid coordinates (within 250 meters of the actual location).	

Save Cancel

Figure 15. Edit Existing Rubric

From the 'Edit Rubric' screen, the user is able to edit the station identifier (i.e. P1), the station name, or the lane name. The authorized user (EIB Test Manager) is also able to change whether or not this task is mandatory for an EIB. Not all tasks are mandatory; some options are allowed based on the availability for example of the weapon at that unit. Any rubric selected as mandatory will automatically be selected as a rubric to be transferred to the mobile devices.

Web Application - Task Selection

Once all of the rubrics have been created (or edited), the EIB Test Manager uses the web application to select the tasks for that particular EIB event. This is done by selecting the 'Task Selection' tab in the web application. Once on the task selection screen (Figure 16), the user will see those tasks/stations which are mandatory (with green asterisk) and will pull in the other approved stations using the 'Add a Task' button until a total of 10 tasks/stations per lane has been selected. The user can delete an optional (not mandatory) task by using the black 'trashcan' icon. As seen in Figure 16, the user sees a 'thumbs up' icon for each lane, indicating that all tasks/stations have been added. Note that all task/station rubrics must first be created in the 'Rubric Management' tab before task selection can take place. The user cannot use the 'Task Selection' tab to create a task/station in the web application. This tab is only used once the rubrics exist within the web application.

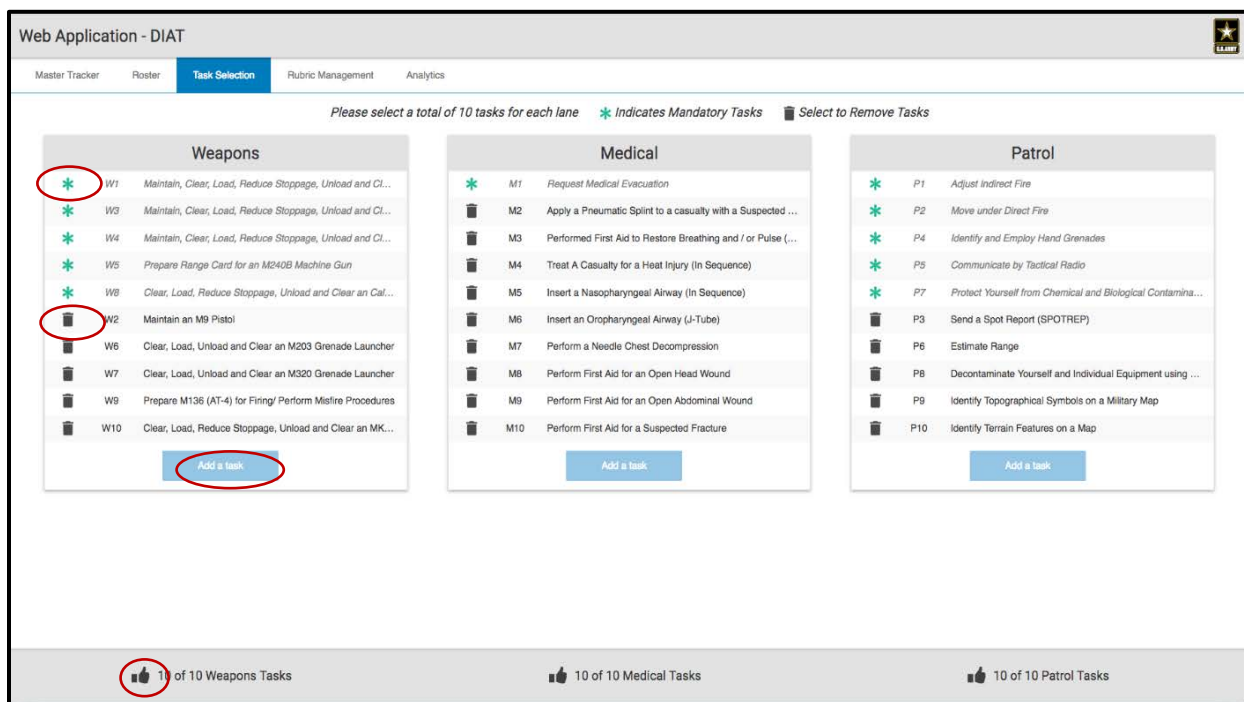


Figure 16. Select Task/Station for the EIB

After all tasks/stations have been selected, and the mobile devices are connected to the same wireless network as the web application, the rubrics will automatically download to the mobile devices. There is no need for any manual connection or manual application download.

Candidate Roster Management

The EIB Test Manager (or the person to whom this task might be delegated) is able to manage the roster of Candidates in the web application. Excel spreadsheets containing a Master Roster can be imported into the web application, and new Candidates can be added, or existing Candidates can be deleted or edited in the web application. One important feature of the Candidate Roster Management is the assigning of a QR code for each Candidate in order for the EIB Candidate Grade Sheet with the QR codes to be generated for the EIB event. It is recommended that these steps occur during the validation stage (occurs prior to any training or testing and is approved by USAIS EIB Manager) of the EIB in order to provide enough time to generate and print out the QR code grading sheets. Candidates who drop out at the last minute can easily be deleted from the roster or deemed ineligible, and those QR coded EIB Candidate Grade Sheets can be discarded. The Candidate 'Roster' tab is selected in the web application as seen in Figure 17.

Web Application - DIAT

Master Tracker **Roster** Task Selection Public Management Analytics

	Last Name	First Name	MI	Rank	Unit	MOS	DOB	Gender	Foreign	Ineligible	Reason
	Candidate001	Test	X	SGT	Delta	11B	01-DEC-1990	F			
	Candidate002	Test	W	PVT	Charlie	11B	10-DEC-1977	M			
	Candidate003	Test	W	SSG	Bravo	11B	09-JUL-1978	F			
	Candidate004	Test	M	MSG	Romeo	11B	12-DEC-1976	M			
	Candidate005	Test	E	SPC	Alpha	11B	12-DEC-1976	M	Y	Y	Age Restriction
	Candidate006	Test	J	PVT	Delta	11B	10-DEC-1987	M			
	Candidate007	Test	G	1LT	ICF	11B	01-JAN-1968	M			
	Candidate008	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate009	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate010	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate011	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate012	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate013	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate014	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate015	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate016	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate017	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate018	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate019	Test		PVT	ICF	11B	01-JAN-1968	M			
	Candidate020	Test		PVT	ICF	11B	01-JAN-1968	M			

New Candidate Print Candidate Roster

Figure 17. View Existing Candidate Roster

To edit an existing Candidate, the user selects the ‘pencil’ icon next to the last name and is then able to edit Candidate information (see Figure 18). A Candidate can be deleted from the roster by selecting the ‘trashcan’ icon. Different from deleting a Candidate from the roster (which would mainly be due to error or prior notification that a Candidate is no longer participating), a Candidate can be deemed ineligible and a reason can be given for this ineligibility (i.e., recent injury). Rendering a Candidate ineligible is done in the edit screen as seen in Figure 18. When editing, the user either enters in text, selects from drop down menu (e.g., male or female) or checks boxes (e.g., foreign or ineligible). A new Candidate is added from the main roster screen (Figure 17) by selecting ‘New Candidate.’ The new Candidate screen is structured the same as the edit screen (Figure 18) and includes the uniquely generated QR code for the newly added Candidate.

Web Application - DIAT

Master Tracker **Roster** Task Selection Rubric Management Analytics

Edit Candidate

Last Name
Candidate002

First Name
Test

Middle Initial
W

Unit
Charlie

Rank
PVT

MOS
11B

Birth Date
10-DEC-1977
01-JAN-1977

Gender
Male

Foreign
☐

Ineligible

QR Code

Save Cancel

Figure 18. Edit Existing Candidate Roster

Once all Candidates are in the web application (QR code assigned), the EIB Candidate Grade Sheets can be printed out using the 'Print Candidate Sheets' button (see Figure 17). After selecting this button, the user will be brought to the 'Print Candidate Grade Sheets' screen and can simply press the 'print' button (see Figure 19).

Web Application - DIAT

Master Tracker **Roster** Task Selection Rubric Management Analytics

PRINT CANDIDATE GRADE SHEETS

Print

Total: 19 sheets of paper

Destination: HP OfficeJet 3830 se...
Change...

Pages: All
Copies: 1
Color: Color

+ More settings

Print using system dialog... (VWP)

Open PDF in Preview

EIB CANDIDATE GRADE SHEET

Name: (Last, First, MI)
Candidate001, Test A

RANK: SGT

APT EVENT

TASK * (Candidate sign initials for GO/NO-GO) GO NOGO TEST DATE/TIME GRADER RANK/NAME

APT

LAND NAVIGATION EV

TASK * (Candidate sign initials for GO/NO-GO) GO NOGO TEST DATE/TIME GRADER RANK/NAME

Day Land Navigation

Night Land Navigation

WEAPONS LANE

TASKS * (Candidate sign initials for GO/NO-GO) GO NOGO TEST DATE/TIME GRADER RANK/NAME

1 W1

2 W2

3 W3

4 W4

5 W5

6 W6

7 W7

8 W8

9 W9

10 W10

MEDICAL LANE

TASKS * (Candidate sign initials for GO/NO-GO) GO NOGO TEST DATE/TIME GRADER RANK/NAME

1 M1

2 M2

3 M3

4 M4

5 M5

6 M6

7 M7

8 M8

9 M9

10 M10

PATROL LANE

TASKS * (Candidate sign initials for GO/NO-GO) GO NOGO TEST DATE/TIME GRADER RANK/NAME

1 P1

2 P2

SGT Test Candidate001

Figure 19. Print Grading Sheet

Master Tracker

The TOC NCOIC will use the web application to access the Master Tracker during the actual assessment (in real-time) to see Candidate results as they automatically populate in the web application based on the results entered by the Graders/Station NCOICs. The TOC NCOIC accesses the Master Tracker by selecting the ‘Master Tracker’ tab in the web application.

As seen in Figure 20, Candidates who receive a 'GO' on their first try at the station receive a green check mark. Since Candidates have the opportunity to re-test at a station (no more than two times at two different stations), the Master Tracker will include a forward slash (/) for any Candidate who needed to re-test at that station. Candidates who receive a 'GO' on their second attempt will show a red x mark, followed by a green check mark (). Candidates who receive a second 'NO-GO' will show a red x mark, followed by a second red x mark (). This Candidate's entire row will then be highlighted in red to signal that he or she has now been eliminated. The Status Toggles found on the upper left of the screen allow the TOC NCOIC to view all Candidates that are 'true blue' (blue colored dot: zero 'NO-GO's at all), 'blade runners' (yellow colored dot: only one 'NO-GO' left before elimination), 'eliminated' (red colored dot: return to duty), 'completed' (green colored dot: all stations are completed), and 'in progress' (white colored dot). 'In progress' Candidates are those Candidates (not eliminated) who have not yet completed, and are classified as 'true blue' or a 'blade runner'. Further, these Candidates may have one 'NO-GO' (first attempt 'NO-GO' resolved with a 'GO'). By selecting the toggle color, the user is able to view only those Candidates classified under that color (i.e., select the red or eliminated toggle to see all eliminated Candidates). All completed Candidates (whether 'true blue' or completed all stations despite a first attempt 'NO-GO' results) will show a 'thumbs up' to the left of the Candidate's name. This allows a user to distinguish between a 'true blue' and a 'completed' (green color) Candidate. If the 'thumbs up' icon is not displayed next to a 'true blue' Candidate's name, this Candidate is currently 'true blue' but has not yet completed all the stations for that lane.

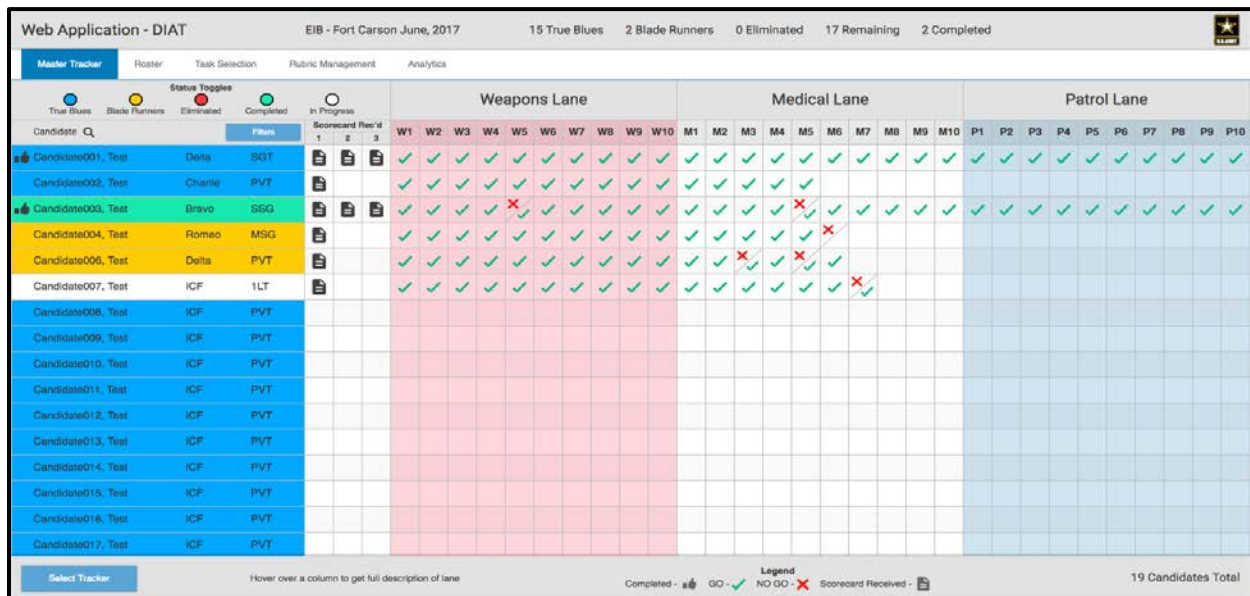


Figure 20. View Results on the Master Tracker

Other features of the Master Tracker include a cursor roll-over function, allowing the TOC NCOIC to roll the cursor over the station's short name (e.g., W1) in order to see the full name of the station. The TOC NCOIC can also select 'Scorecard received' next to the Candidate's name in order to digitally track the physical collection of the EIB Candidate Grade Sheet at the end of the day.

The Master Tracker also includes two data analytics features that could be easily accessed by EIB stakeholders who enter the TOC during the EIB assessment (or at the end of each day). First, the banner at the top of the screen (see Figure 20 and Figure 21) provides a quick glance display of the number of 'true blue', 'blade runner', 'eliminated', 'remaining' ('in progress'), and 'completed' Candidates. In Figures 20 and 21, the stakeholder could see that, so far, there are no 'eliminated' Candidates. Second, the Master Tracker includes a filter function. The TOC NCOIC (or EIB stakeholder) can select the 'Filters' button to apply a specific filter to the data on the Master Tracker. As seen in Figure 21, the TOC NCOIC (or EIB stakeholder) can apply a filter (e.g., Bravo company), and after selecting 'Show Me,' the results for that filter are displayed in the Master Tracker. The categories for the filter include: company, gender, eligibility, and foreign participant.

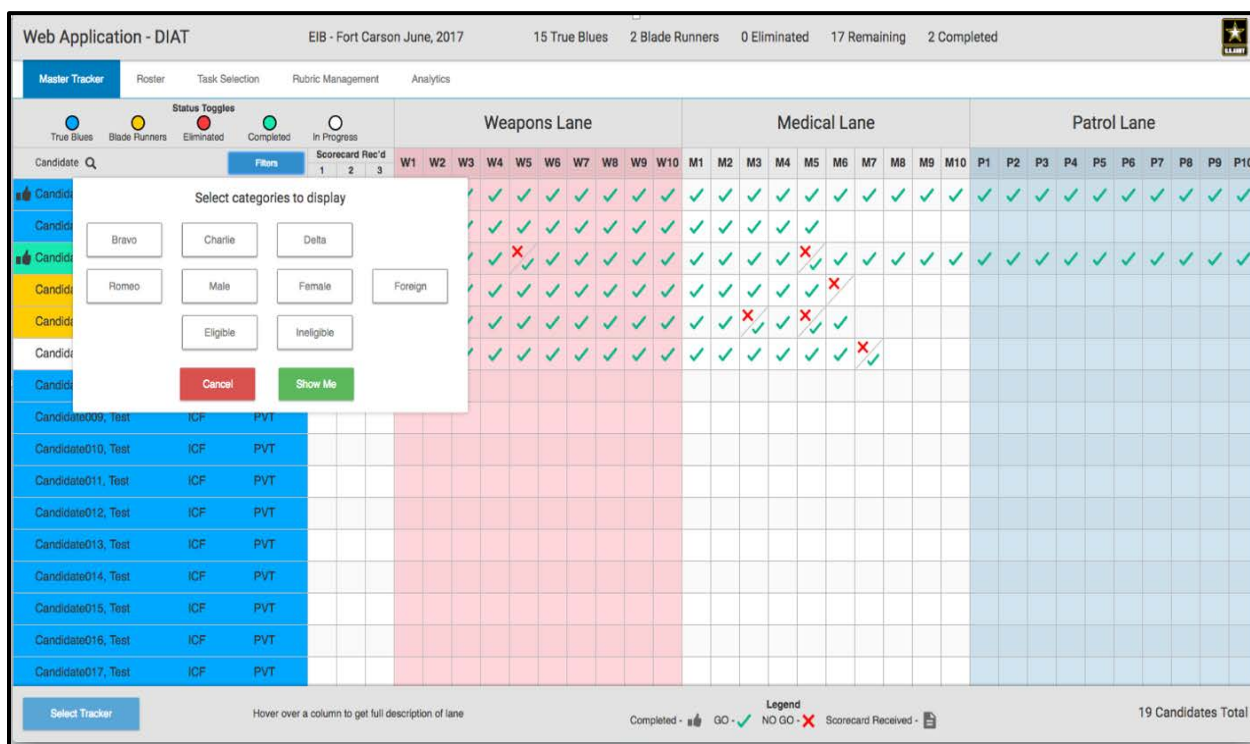


Figure 21. Apply a Filter to the Master Tracker

All data from the Master Tracker can be exported to an Excel spreadsheet. Since the web application uses a SQL server database, the web application can run on government issued laptops. Instructions for downloading the web application code to the laptop are included in the Appendix B of this report.

Analytics Dashboard

In addition to the analytics features inherent in the Master Tracker, the web application also includes a simple analytics dashboard. As seen in Figure 22, the TOC NCOIC or other EIB stakeholder accesses the analytics dashboard by selecting the ‘Analytics’ tab in the web application. The data visualization capabilities include pie charts and displays of simple metrics after filters are applied. The pie charts at the top of Figure 22 provide a visualization of: (a) the total number of ‘ineligible’ and ‘eligible’ Candidates, (b) the number of ‘true blues’, ‘blade runners’, and ‘in process’ Candidates out of the total number of remaining Candidates, and (c) the number of ‘true blues’ or ‘eliminated’ Candidates out of the total number of ‘completed’ Candidates. Concerning the simple metrics and filters, the example in Figure 22 shows a selection of ‘Rank’ as the option selected and ‘True Blues’ as the statistic selected. The TOC NCOIC or other EIB stakeholder can quickly view the number of ‘true blues’ and the count by rank (either in the metrics box or by viewing the pie chart to the right of the metrics box).

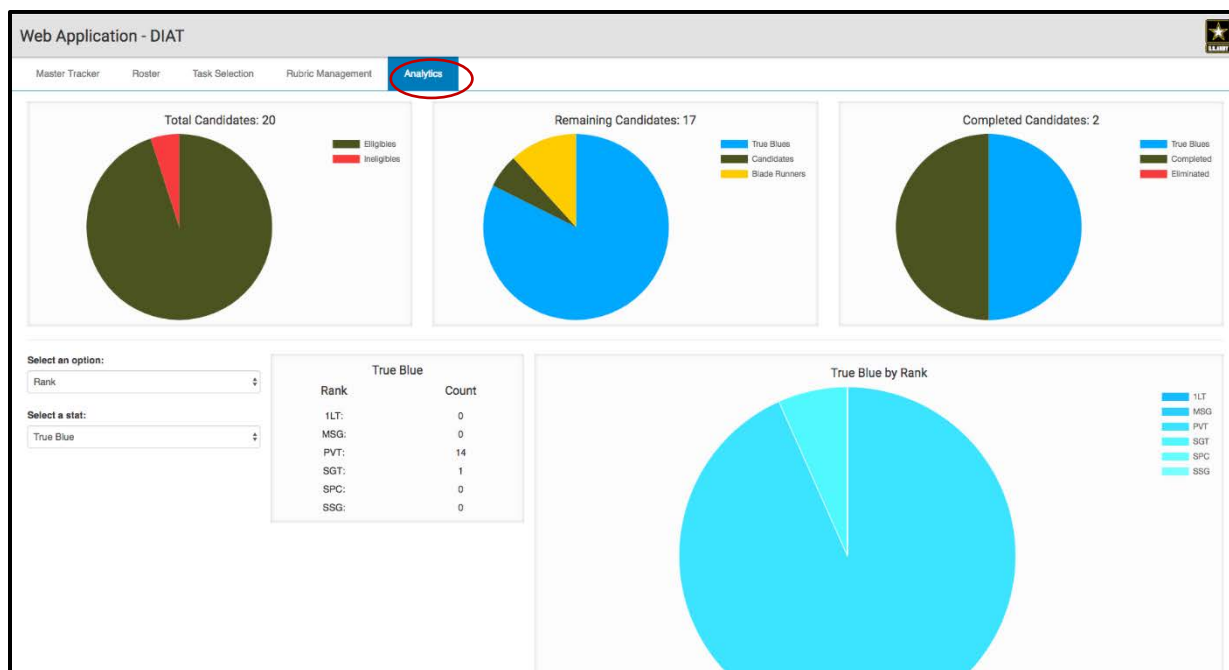


Figure 22. View Results in the Dashboard

Mesh Network Strategy

In order to provide real-time data capture and transfer from the mobile application to the web application (Master Tracker), a UniFi mesh networking system from Ubiquiti networks was deployed and tested. This solution has the lowest cost-per-node and met the goal of being able to deploy remote nodes with little to no configuration in the field.

The solution for the TOC node was comprised of a security gateway device that is used to assign IP addresses to devices on the network and to act as a way to provide a wired connection to the network for the base WAP (Wireless Access Point). The gateway device (Ubiquiti USG) was hard wired to a wireless access point (UAP-AC-M) that was mounted in line of site of the

other nodes, and attached to the field antenna mast for better positioning. The TOC node included a 100 foot Ethernet cable to provide flexibility in positioning the WAP.

The field node's core component, the WAP (UAP-AC-M), was preconfigured to join the wireless network as a mesh node. In order to power this node without a generator or wired power source, it was powered by two small 12 volt batteries wired in series. The batteries are sufficient to provide more than 20 hours of use when fully charged. In order to minimize charging time/overhead, a solar charge controller and two small solar panels were included in the initial field node test. The capacity of the solar panels was sufficient to run the system without a charge in most daylight circumstances (including one day when the sky was overcast). The overall solution is diagrammed in Figure 23. Actual images of the solar panel mast that was used during experimentation is provided in Figure 24. Note that ARI was provided the networking equipment at the conclusion of the project less the solar panels and mast. These items were only used in the experiment.

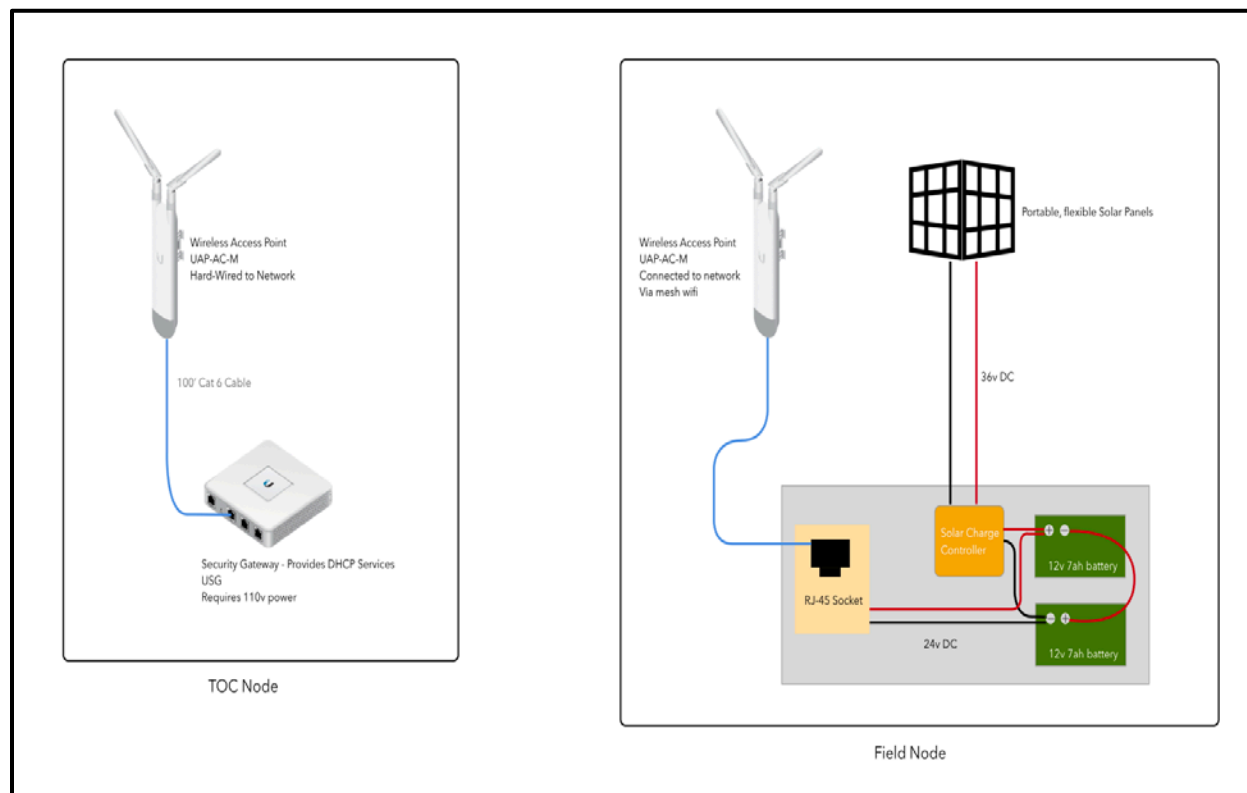


Figure 23. TOC Node and Field Node



Figure 24. Solar Panel Mast and Top View of Field Node

Based on the experimentation of the mesh network, the research team noted several important considerations:

- A UAC-AP-M back-up is required in the event that one ceases to function.
- Two OE-254 pole sets/kits may be included as part of the TOC equipment set-up. However, the mast for the main access point needs to be set up.
- The main access point mast should be set up away from the Army's communications equipment to ensure proper function.

Integrated Assessment System

All of the elements of the digital assessment tool are designed to work together. Individual applications will not work in a standalone capacity; rather these applications must operate as a unit to provide the entire digital solution for field assessment grading and results tracking. Figure 25 depicts how the components of the digital solution are integrated to produce real-time data capture during field assessments, allowing for data redundancy and providing analytics at the point of need. In Figure 25, the orange arrows indicate the flow of communication concerning Candidates and rubrics. For example, the Candidate roster in the web application feeds the Quick Response (QR) code process, allowing EIB Candidate Grade Sheet to be generated containing this QR code. The QR code on the grading sheet is scanned by the Grader using the mobile device.

As well, the rubrics are managed in the web application, and the updated rubrics are pushed to the tablet when it is connected to the web application, allowing the grader at any station or EIB event to access the latest rubric. The black arrows indicate the flow of communication concerning the data capture, transfer, storage, and tracking. Data is stored locally on the tablet, and through the mesh network, this data can be transferred to the TOC and appear on the Master Tracker (on the web application).

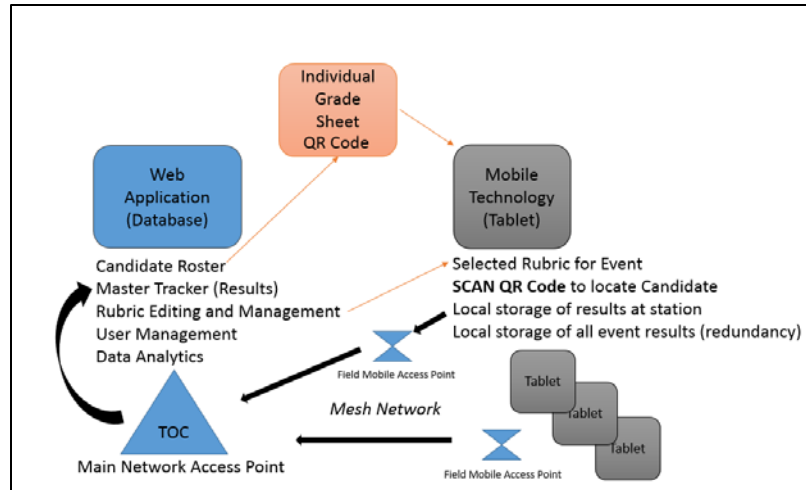


Figure 25. Integrated Solution – Digital Assessment Tool

Appendix B includes instructions for downloading the programming code for the mobile application and the web application. The programming code and all associated equipment is government owned.

Evaluation

The mobile application, web application, and mesh network were evaluated by Soldiers after the research team had a fully working system. The first evaluation was conducted during the train-up week for an EIB. Protocols were developed and used with Soldiers in the field and in the tactical operations center (TOC) to gather data on usability, functionality (of real time data capture, transfer, and tracking), visual and ergonomic experience (two different size iPads were used with testers), and overall efficiency of the system as compared with current paper assessment process. While the sample size (10 Soldiers) was small for the product evaluation, the input of eight Graders/Station NCOICs and two TOC NCOICs proved invaluable. Based on the Soldiers initial input, we made modifications to the research product to streamline its usability and incorporated some additional features. This final version, as presented above, was demonstrated for the EIB Test Manager and several station NCOICs. After final modifications were made, the mobile application and web application code were delivered to ARI as well as the networking equipment and hardware (server laptops and mobile devices).

Based on the evaluation, we found that none of the eight Soldiers we interviewed had used an iPad for assessment purposes. Nonetheless, they reported it was intuitive and user friendly, and were motivated to use the product. Advantages of the digital solution were noted, including less paper and having real-time data. An often noted shortcoming related to the battery life of the iPad (typical battery life is approximately 8 hours and a typical EIB testing day can last up to 12 hours). All participants felt the digital mobile solution was an improvement over paper-and-pencil based assessments, with 88% reporting that it did not increase their current workload, and in fact, it should reduce their workload. An often requested feature was to add an embedded timer/stopwatch (38%). Hardware preferences varied between the iPad mini (due to small size) and the iPad (with the hand-grip). The TOC NCOICs felt the Master Tracker application was very intuitive compared to the current spreadsheet, and that auto-populating the

database alleviated the need for Soldiers to carry papers from the field to the TOC, reducing the number of people in the TOC. A laptop computer was the preferred device to house the Master Tracker application.

Two EIB Test Managers tested the solution and the real-time data capture. Their reactions were very similar to other users. Further, they worked with the research and development team to incorporate the timer/stopwatch feature and a “protest” button. Both EIB Test Managers also agreed that the layout and functionality of the Master Tracker (including filters) was appropriate. Concerning the analytics dashboard, both preferred fractions and associated percentages over pie graph displays.

Discussion

This research focused on developing and evaluating a digital assessment system for collecting data and tracking Soldiers’ performance during the EIB. The research product was well received by key EIB personnel during a user evaluation with only a few participants. The evaluation resulted in a number of additional features being added to the research product to enhance its usability. This research product provides exemplar tools to streamline existing Army testing practices in the EIB and other courses and events requiring complex and detailed assessment across a number of critical tasks. As with any emerging technological solution, it will take time for the infrastructure of the Army to catch up. Currently, the research product relies on a network that must be temporarily installed in the field. However, future solutions may be able to rely on existing networks in order to collect and consolidate data. The advantages of handheld technologies are clear when compared to existing paper-and-pencil data collection and consolidation methods. The Army at a higher level needs to begin thinking through how these technologies can be integrated into the existing network, within acceptable risk, in order to better facilitate critical data-centered initiatives enabling the Army to collect and apply the information required to manage and enhance Soldiers’ competencies in a career-long context. This project demonstrates that this assessment system can support data analytics across Leader and Soldier’s careers and the bigger picture of supporting the Army’s Talent Management initiatives. Lastly, this project directly informs future research into many other competitive events, such as the new Expert Soldier Badge, the “Best of” events (Sapper, Ranger, and Sniper), the existing Expert Field Medical Badge, as well as the Armor’s Gainey and Sullivan Cups, all of which are imperative to a Soldier’s ability to advance.

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APPENDIX A
FUTURE CONSIDERATIONS

During the last data collection, two soldiers tested the entire solution (including the real-time data capture with mesh network) and were interviewed, following the same protocol as previous data collections. Several comments were made that merit further exploration. These considerations are listed below followed by a brief commentary.

Instead of having a protest button as an option under the 'GO' or 'NO-GO' button, one Soldier recommended inserting the protest option as a confirmation or validation pop-up dialog box after the Grader/Station NCOIC selects 'NO-GO.' An example of this would be: "Does your Candidate wish to protest?" If the Candidate does not wish to protest, the 'NO-GO' result stands and is sent to the Master Tracker after the user enters the PIN on the validation screen. If the Candidate does wish to protest, the user selects 'YES.' After entering the PIN on the validation screen, the result is sent as a 'protest,' which means the result is pending until the Candidate is scanned again with the resolved final result entered. *Commentary: The risk with this approach is that more Candidates may decide to protest 'NO-GO' results, since the pop-up dialog box may prompt the Grader/ Station NCOIC to ask every Candidate if he or she wishes to protest. Currently, this decision to protest originates from the Candidate, not the Grader/Station NCOIC.*

One Soldier recommended that the performance steps displayed after the Grader/Station NCOIC enters a 'NO-GO' result should actually be shown before a result is input. This would mean that the Grader/Station NCOIC scans the QR Code and is shown the Candidate's information but does not have the option for selecting the result (as in the current design). The Grader/Station NCOIC would need to select a 'Start Task' button that would bring him or her to the scrolling list of performance steps. The Grader/Station NCOIC would then need to scroll down (while watching the Candidate perform) to select which step was missed/performed incorrectly. Selecting a step would automatically result in a 'NO-GO' and the Grader/Station NCOIC would be brought to the validation screen to enter a PIN. When asked about a 'GO' result, the Soldier suggested that there be a stationary large green 'GO' button at the top of the screen (while user is scrolling) that could be selected if no performance steps were missed/performed incorrectly. *Commentary: During various data collections, Soldiers indicated that they have the performance steps memorized and that it made sense that they would select 'NO-GO' and then later select the step that was missed/performed incorrectly. If the tool is redesigned to show the performance steps first, there is a risk that the Graders may not find the exact performance task as quickly.*

One Soldier recommended that after a result has been entered/confirmed, the tablet should not be automatically set to scan the next Candidate. The reason for this suggestion is that the Grader/Station NCOIC might accidentally scan a different paper. This would require an additional button to select after each Candidate, such as 'Start New Candidate.' *Commentary: During various data collections, this did not seem to be an issue since the Grader/Station NCOICs were not demonstrating any fumbling or mishandling of the tablets and scanning papers appropriately. However, data collection protocol allowed for testing out only a few EIB Candidate Grade Sheets for the experiment. It is possible that during an actual EIB event, this could become more of an issue if EIB Candidate Grade Sheets are not physically controlled by the Candidate. In any case, if the wrong Candidate is scanned, the Grader/Station NCOIC can*

back out and re-scan. There is little likelihood this extra procedural step (selecting ‘Start Candidate’) would be needed and may ultimately add time to the process.

One Soldier recommended that any result that is selected should be followed by a confirmation or validation pop-up dialog box (e.g. Are you sure you want to give this Candidate a ‘NO-GO’?). The reasoning behind this was that he envisioned a lot of accidental button pressing (i.e., fat-fingered; which would not be the case with a paper system). *Commentary: Every result that is entered is followed by a validation screen with a PIN entry. If the result is incorrectly entered, the Grader can back out and re-scan the Candidate and then enter the correct result. There is little likelihood this extra step would need to occur and may add time to the process. It would also be redundant since there is a validation screen already displayed.*

Both Soldiers felt that using pie graphs on the analytics dashboard were not as effective as having statistics. They would rather see ratios and percentages (e.g. ‘NO-GO’s at the W1 station are 10/100 or 10% ‘NO-GO’s). *Commentary: The data is there, so this type of display could be easily created in future research.*

One Soldier recommended that a display on the tablet could indicate whether or not the device was in a connected or disconnected state. The reasoning behind this is that when a device is in the disconnected state, there is no data redundancy (i.e. data is not being held on all of the other connected devices). There is a risk that data collected in the disconnected state would be lost if that particular device were destroyed before it could be brought into the network range. *Commentary: The device has an indicator of wireless/network connection bars. If the user sees the bars, the device is connected to the network. Adding a more visible display of connected versus disconnected state might create distrust with the technology. Although the likelihood exists, it would be rare that the device would be destroyed at the same time it is not in range of the network.*

APPENDIX B

ACCESSING PROGRAMMING CODE

Equipment List

All of the hardware (4 mini iPads, 4 regular iPads, and 2 standalone laptops) used for this project is government owned.

Instructions for Downloading Programming Code

The government owned laptops contain a “readme” file. The instructions in this file are:

- The credentials.txt file on the desktop contains the credentials for the laptop, the Unifi Control Panel and the Linksys router (this is for the mesh network setup).
- The documents folder on the desktop contains detailed readme documents on the various solutions and applications.
- The CouchDB Solution Source Code folder on the desktop contains the source code for the initial Couchdb-based solution.
- The .Net-SignalR Solution Source Code folder on the desktop contains the source code for the final .Net/SignalR/SQL Server solution.

Mobile Application Instructions

Overview:

- * React Native application for ARI DIAT
- * Run on iOS device after obtaining a team certification

Dependencies:

- Node.js (Node 6 LTS)
- XCode for iOS
- Physical hardware for QR code camera access

Summary of set up:

1. Do an npm install of react-native-cli in the project root and mobile-client directory
`npm install -g react-native-cli`
2. Project source is located in the mobile-client folder.
3. Change into the project folder
`cd ari-diat/mobile-client`
4. Run npm install
`npm install`
5. Test on iOS Device
 - open XCode project in iOS folder
6. To test on iOS simulated device run the following command on the mobile-client folder
`react-native run-ios --simulator 'iPad Air 2'`

Local Simulator Debug Tips

- R = Refresh Simulated device
- ctrl Z = Shake Gesture which brings up the React Native Development Window

Settings.js Notes

- Update the settings.js with the appropriate ip addresses
- When testing with the simulator, use the localhost ip address
- When testing on an iPad change the ip to the internal ip address (ifconfig)

CouchDB Solution Instructions

ARI DIAT

Prerequisites / Assumptions

This project is set up for a developer workstation that has the following prerequisite technologies:

- Current Docker Community Edition
- Current version of NPM (Node 6LTS)

It is also helpful to have `./node_modules/.bin`` in your path for easy execution of cli components provided by NPM modules.

Overview

This project includes the following components to support development of the ARI DIAT solution:

Web Application (React.js): Core web-based user interface to the solution. Primarily used for roster management and data display. Source can be located in `/code/webapp`.
[More](code/webapp)

Mobile Application (React Native): Native mobile (iOS) application with a core function of supporting data collection in a field application. [More](code/mobile-client)

Database (CouchDB): Distributed document-oriented database system.

Docker: Container-based development environment.

Initial Setup

From a fresh copy of the repo, run ``npm install`` in the following folders:

- / (project root)
- /code/webapp
- /code/mobile-client

Then complete a build of the web application by running ``npm run build`` from within the ``/code/webapp`` folder.

Once the web application build completes successfully, build the docker images by running ``docker-compose build`` from the `/docker/` folder.

Once the docker build completes, start the environment by running ``docker-compose up -d`` from the `/docker/` folder.

Data Restore

Run the following to restore / populate the initial database, replacing USERNAME and PASSWORD with the appropriate couchdb credentials.

```
`./utils/couchdb-backup.sh -rc -H 127.0.0.1 -f ./data/couchdb/stations.json -d aridiat -u  
diat_db_admin -p pigsfly2`
```

Install Without Using Docker

If you decide to setup dedicated servers instead of using Docker, you will need to setup both a CouchDB and Web Server installation.

CouchDB

- Install CouchDB 2.x on your server (<http://docs.couchdb.org/en/2.1.1/install/>)
- Run Project Fauxton (http://localhost:5984/_utils/) and create an Admin Account
- Run the provided couchdb-backup.sh script with the provided files to create the aridiat database (``./utils/couchdb-backup.sh -rc -H SERVERIP -f ./data/couchdb/stations.json -d aridiat -u USERNAME -p PASSWORD``)
- Update the webapp configuration script to match your server settings (`/code/webapp/src/settings.js`)
- Rebuild the webapp using NPM (instructions for that are in the webapp readme.md)

Web Server

- Setup a Web Server (IIS, Apache, etc)
- Copy the latest webapp build (`/code/webapp/build`) to the web server site html root folder
- Update the mobile-client configuration script to match your server settings (`/code/mobile-client/js/settings.js`)

SignalR Server Set-up Instructions

This project can be setup on Windows 7, 8, 10, Server 2012, or Server 2016. From your selected OS platform, perform the following steps:

1. Turn the following Windows features on:
 - Internet Information Services (IIS)
 - o The default features are good, except under **World Wide Web Services -> Application Development Features**, ensure **ASP.NET** is selected
2. Open IIS and edit the Advanced Settings of the **DefaultAppPool**. Ensure that the:
 - **.NET Framework Version** is **v4.0**
 - **Identity** is **LocalSystem**
3. Install **URL Rewrite** (this will also install **Web Platform Installer**) for IIS
4. From the Home section (upper most option in the connection panel), select **Mime Types** from the IIS section. Ensure that both **.woff** and **.woff2** types are listed. If not, add them using the following settings:
 - Extension: **.woff** and Mime type: **application/font-woff**
 - Extension: **.woff2** and Mime type: **application/font-woff2**
5. Open **Windows Firewall with Advanced Security** and ensure to enable the **World Wide Web Services (Http Traffic-In)** rule in **Inbound Rules**.
6. Install the following applications if not already on the machine (ensure versions are compatible with current OS, you may have to use previous versions for Windows 7 and Server 2012):
 - MS SQL Server (Express works too)
 - MS SQL Server Management Studio (SSMS)
7. Open SSMS and make note of the Server name you connect to (you will need this to edit your configuration file later). After connecting, in the Object Explorer for your database server:
 - Select **Security -> Logins -> NT AUTHORITY\SYSTEM**
 - o In the window that opens, select **Server Roles**
 - In Server roles, ensure that **sysadmin** is checked and select **Ok**
8. Create the .NET package for deployment from the ARI-DIAT-NET source files (**NOTE: this step does not need to take place on the same machine)
 - Using Visual Studio, open the ARI-DIAT-NET solution
 - Allow Visual Studio to restore the missing NuGet packages
 - Open and edit line 12 of the **Web.config** file, which should be the **<add>** node in the **<connectionStrings>** node:
 - o Edit the **DataSource** section of the **connectionString** attribute so that it is equal to the Server/MS SQL Server DB name (you noted this earlier when opening SMSS)
 - Publish the project using the following settings:
 - o Under **Connection**:
 - **Publish method: File System**

- **Target location:** you decide where you want to publish the project to, but make note of where these files go
 - o Under **Settings:**
 - **Configuration: Release**
 - **File Publish Options** selected:
 - **Delete all existing files prior to publish**
 - **Exclude files from the App_Data folder**
 - If this package was created on a different machine, copy the published output to the Server machine (make note of the copy location)
9. In IIS, right click the **Default Web Site** under **Sites** and select **Add Application:**
- Enter **diat-net** in the **Alias** field
 - Ensure that **DefaultAppPool** is the selected **Application pool**
 - In the **Physical path** field, enter the location of the published output
 - Select **Ok**
10. Give IIS_IUSRS user Group read/execute/list rights to the location of the published output.

Your server is now setup and ready for use. The first time the site is accessed is when the MS SQL DB **DiatNet** will be created. You can test this by using a browser on your server and navigating to <http://localhost/diat-net/api/documents/>. The query will return an xml document with a single **ArrayOfDocument** node without any children nodes (there are no documents in the database yet). This also means that the server is listening for the SignalR requests that come from the DIAT web and iOS applications.

You can now open SSMS and **DiatNet** will be visible under **Databases** in the **Object Explorer**.

Web Application Deployment to IIS (SignalR) Instructions

This project can be built from most platforms (OS X, Linux, or Windows) using the following steps:

1. Install NodeJS (use the LTS v6.12.0).
2. From a command line and in the **webapp** project root folder, run **`npm install`**
3. Using a text editor of your choice, open the **webapp** project and edit the **src\settings.js** file:
 - Ensure that **SIGNALR_HOST** is set to the server's hostname or IP address
 - If you chose to host the SignalR Server from a location different than **/diat-net**, then change **SIGNALR_LOC** to the location that you specified
 - Ensure that **HOME PAGE** is set to **/diat/**
4. While still using the text editor, open and edit the **package.json** file in the project root folder:

- Ensure that “**homepage**” is set to “/**diat**”
- 5. While still using the text editor, open and edit the **src\scss_diat-variables.scss** file:
 - Ensure that \$homepage is set to **/diat/** (on line 41)
- 6. From a command line and in the **webapp** project root folder, run **`npm run build`**
- 7. The content of **build** folder is what will be moved/copied to be served statically from IIS.

NOTE: The following steps occur on the Server running Windows and IIS

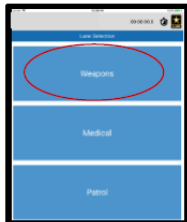
- 8. Create a folder named **diat** in **C:\inetpub\wwwroot**.
- 9. Recursively move/copy the content of the **build** folder from step 4 into **C:\inetpub\wwwroot\diat**.
- 10. Go back to IIS to setup a redirect rule using **URL Rewrite**:
 - Select the **diat** folder under **Default Web Site**
 - Open **URL Rewrite** from the IIS section
 - Select **Add Rule(s)...** and choose **Blank Rule**
 - Name the rule **DIAT redirect**
 - In the Match URL section, ensure the following settings:
 - o Requested URL: **Matches the Pattern**
 - o Using: **Regular Expressions**
 - o Pattern: **(rubric|tracker|Candidates|events|analytics).***
 - o Ignore Case: checked
 - Skip the Conditions and Server Variables sections
 - In the Action section, ensure the following settings:
 - o Action Type: **Redirect**
 - o Redirect URL: **/diat/**
 - o Append query string: unchecked
 - o Redirect type: **Found (302)**
 - Now select **Apply** to save the rule
- 11. From a browser, navigate to <http://{your-server-ip}/diat/> and the web application will run with a connection to the Server via SignalR

APPENDIX C

GRADER/STATION NCOIC QUICK REFERENCE GUIDE

EIB Assessment Digital Application

Quick Reference Guide

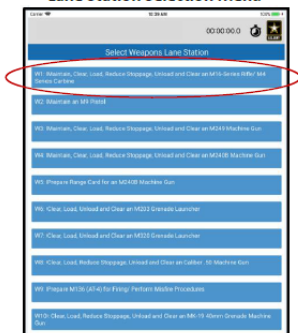


Upon opening the Application, you will see the Lane Selection menu. e.g. *Weapons*

Lane Selection Menu

Use the touch screen to select the appropriate lane:
Weapons
Medical
Patrol

Lane Station Selection Menu



Next, select the appropriate station (e.g. *W1- M16/M4*), or select the **back** button in the top left corner of the screen to return to the Lane Selection Menu. You are now ready to scan candidates and enter results.

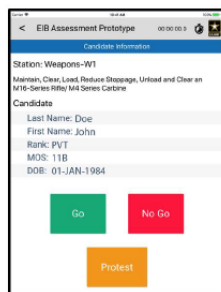
QR Scanner

The candidate will present you with his or her grading sheet after completing the station. This sheet will contain a QR Code. Scan the candidate's QR code (example pictured below) by placing the mobile device in position to scan.



Scanning the QR code will load the candidate's information into the application. You will be presented with the Candidate Information screen.

Candidate Information Screen



Station Title: Identifies the station name.

Station assessment task description: Provides the sequence of steps required for this task at this station.

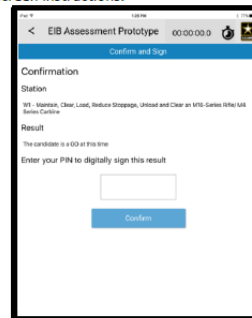
Candidate Information: Displays information that is populated from the Master Roster.

Go/No Go buttons: Select "Go" if the candidate has passed the station. Select "No Go" if the candidate has failed the station.

Protest: Select "Protest" if candidate indicates they protest the "No Go" result. The candidate will be logged as a "Protest" until the final result is entered in the tablet.

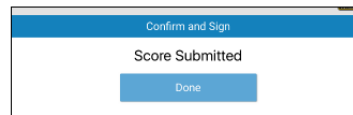
Go Confirm and Sign Screen

After selecting Go for this candidate, you will review the information on the Confirm and Sign screen. Enter your PIN to acknowledge accuracy of data, and select **Confirm**. If the candidate was a No Go, proceed to the No Go screen instructions.

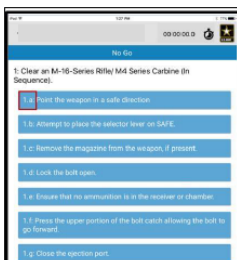


Go Score Submitted

After entering your PIN and confirming, you will see that your score has been submitted. Once you click **Done**, you are ready to scan the next candidate.

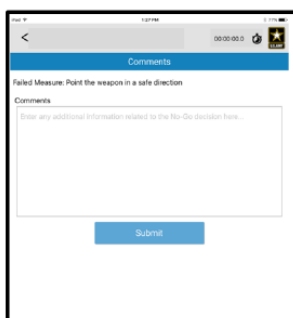


No Go Screen



If you selected No Go for this candidate, you will be brought to the No Go Screen. Select the performance measure that resulted in the No Go decision (e.g. *failed to point weapon in safe direction*). Scroll down for "Safety Violation."

No Go Comments Screen



Comments: For the performance measure selected, you can add any specific comments in the comment box using the mobile device keypad and click **Submit**.

No Go Confirm and Sign Screen



After selecting No Go for this candidate and indicating the reason for the No Go, you will review the information on the Confirm and Sign screen. Enter your PIN to acknowledge accuracy of data, and select **Confirm**.

No Go Score Submitted

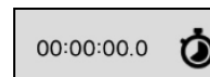
After entering your PIN and confirming, you will see that your score has been submitted. Once you click **Done**, you are ready to scan the next candidate.



Stop Watch Function

You are able to use the digital application to record the time of your candidate's task (as opposed to using a

separate timer or stop watch). The stop watch feature can be accessed from any screen on the application by selecting the "stopwatch" icon located next to the Army logo.



Note that the time is not recorded or tracked within the application. The stop watch only serves as an option for you to record your candidate's time.

After selecting the stopwatch icon, you will see the stopwatch feature appear. Select "Start" to start timer and "Stop" to stop timer. Select "Reset" to reset the timer to 0. Select "Close timer" to close the timer application.

