

Answering the Call for Analytics within the Maritime Patrol Community

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ABSTRACT

Quantitative data is necessary to make sound decisions regarding policy, standards, resource allocation, and areas for innovation. Vice Admiral and Commander of Naval Air Systems Command (NAVAIR) Paul Grosklags has tied NAVAIR strategic imperatives (2016) to "increase readiness, affordability and speed" and a focus on "learning, knowledge management" to the Chief of Naval Operation's goals. Likewise, the Deputy Commander of NAVAIR, has noted that to achieve readiness goals, the U.S. Navy needs to understand the data available "to move from reactive to proactive to predictive." Unfortunately, the current state-of-practice of data analysis is labor intensive, which can lead to delayed and inaccurate reports that lack critical information for detailed analysis and actionable assessments. In 2010, the Command Patrol Reconnaissance Group (CPRG) issued a statement of urgent needs due to the lack of "Navy products that support force-wide Anti-Submarine Warfare (ASW) training assessments." This paper presents a technological solution currently under adoption by the Maritime Patrol Community (P-3C, P-8A) to provide a standardized and centralized repository for the recording, storage, and analysis to provide readiness and effectiveness data. In addition to providing an overview of the current and planned system components, the authors elaborate on the benefits of standardized and accessible data such as enabling efficient data collection and accurate assessment to answer questions about proficiency, readiness and needs. Finally, the authors offer detailed lessons learned for consideration as best practices when implementing such a system in military settings, from development of an appropriate concept of operations (CONOPS) to maintaining relevance.

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INTRODUCTION

Based on statements by the Chief of Naval Operations (CNO) for targeted investments that ensure Anti-Submarine Warfare (ASW) warfare readiness, the Commander, Patrol and Reconnaissance Group (CPRG) issued a statement of urgent need (2010). This memorandum pointed out that addressing tactical and technical proficiency requires adequate knowledge of force-wide trends in training. This paper provides an overview of the on-going efforts to address this need, which resulted in a web-based application and database called the Post Mission Assessment for Tactical Training and Trend Analysis (PMATT-TA). While not the first application to perform advanced performance assessment and trend analysis, it is an early use-case for developing such a tool within military settings. The following discussion is to highlight the importance of implementing these types of systems, the benefits of relying on objectively attained data, and the lessons we learned for consideration by other programs.

In the last decade, the idea of *Big Data* has become ubiquitous in society. Relying on and utilizing objective data to inform unbiased, well-informed, and sound decisions has become the norm in the *age of information*. While the use and reliance on large datasets for making important decisions is nothing new in industry, sports, politics, academics, military and the like, leveraging new technologies to expedite and simplify the process of collecting, storing, analyzing and interpreting expansive sets of data to understand force proficiency remains a challenging undertaking. Historically, within the Navy, minimal command organization staff attempt to track force proficiency and performance based on reviews of antiquated military message traffic and/or data calls to fleet personnel. This is often an insurmountable task, further complicated by the need to safeguard information, given that in many instances the datasets have grown so large that identifying and analyzing the data needed for sound decision-making at each level in the chain-of-command, is practically challenging. By the time communities locate, analyze, interpret and report their findings up the chain, the question(s) have changed and new data/information is sought. Adversaries do not wait for us to analyze and understand our data when they change tactics and present new challenges. Thus, leadership responds based on their best understanding of the issues.

Fortunately, the United States Department of Defense (DoD) has recognized this opportunity. For example, Navy leadership has issued guidance to move from reactive decisions to proactive or predictive solutions leveraging data-driven analytics to aid in decision-making and proficiency tracking. Vice Admiral Dunaway, as part of his Naval Air Systems Command (NAVAIR) Data Strategy (2015) stated “Align[ing] resources to better support today’s readiness” by being “predictive vice reactive, tactical and strategic” and use “ ‘science of learning’ to optimize pilot and aircrew proficiency.” Additionally, Brigadier General Masiello noted that enterprise-wide activities with “The right metrics, tools and skills are leading us to be more predictive and less reactive” and “improving the health of naval aviation” (NAVAIR News, 2016). Consistent with the theme of this paper and the effort outlined throughout, these leaders acknowledge that the next step in the evolution of our military is a proactive or predictive approach that relies on objective data to support real-time interpretation and analyses.

Prior to this Navy wide push, CPRG recognized they had a data problem of their own, issuing a memo highlighting that there are “no existing Navy products that support force-wide Anti-Submarine Warfare (ASW) training assessments & the lack of centralized performance data is the key limiting factor” (Commander, Patrol & Reconnaissance Group, 2010). The statement of urgent needs also noted, “Objective, outcome-based assessments of aircrew performance are critical to operational mission success by enabling the measurement of force-wide tactical proficiency & the subsequent implementation of focused training solutions in a resource constrained environment.” This memo called for a targeted solution with a focused problem – centralized tracking of performance-based data for understanding ASW proficiency. This is by no means the limits of the technology solution needed for this community or others, but this call and the community utilizing any resulting technology represented a narrowly

scoped but complex domain for attention from research and development (R&D) sponsors. While targeting a specific domain, the resulting technology aligns with the recent Strategic Guidance outlined by Rear Admiral Morley pertaining to open architecture systems that are modular, scalable and interoperable across platforms (NAVAIR Blog, April 25, 2016). That is, the technology and process of implementation, resulting from this R&D effort, could be scaled for use by any platform or community concerned with improving their use of data. In this paper, the authors present a case study for answering the call for better analytics in the Navy. In the following sections, the authors outline the solution (i.e., Post-Mission Assessment for Tactical Training and Trend Analysis - PMATT-TA) resulting from our research and development efforts, lists its specific components and their benefits, and update the status of the effort and discuss lessons learned.

A TECHNOLOGY SOLUTION

The program management office's (i.e., PMA-205) Aviation Warfare Training Division (AWTD) Integrated Project Team (IPT) set out to align the goals of on-going research and development efforts focused on providing Automated Performance Measure (APM) technologies through the implementation of system-based performance measures with the aforementioned CPRG statement of urgent needs. The resulting technology (i.e., PMATT-TA) sought to address those needs. The desired end state Concept of Operations (CONOPS) for the patrol community will include logging mission event details for operational flights, live training events or exercises, and simulation-based training scenarios conducted in aircrew system trainers with manual and semi-automated event data capture and reporting (see Figure 1). Additionally, while initial goals focused on supporting event capture and reporting for ASW as the primary mission for the community platforms, P-3 and P-8, the final system will include provisions for capture of Anti-Surface Warfare (ASuW) and Intelligence, Surveillance and Reconnaissance (ISR) missions.

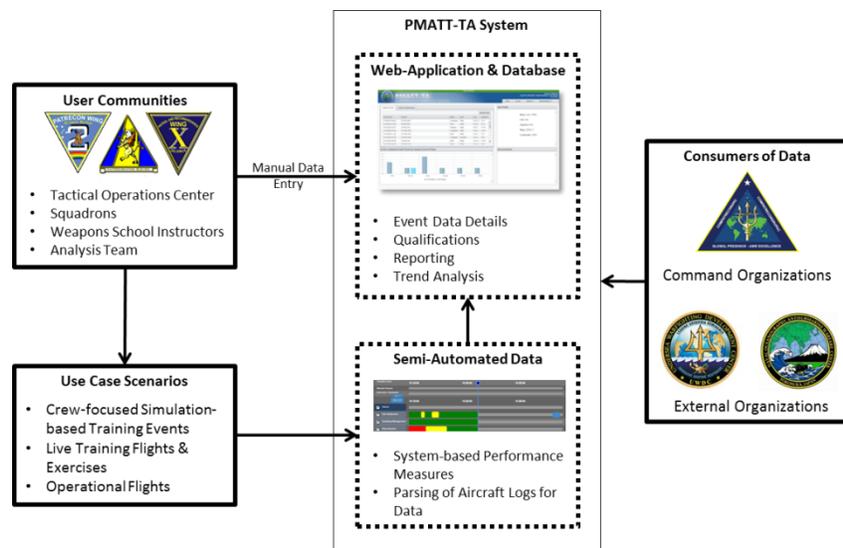


Figure 1. Notional PMATT-TA End State CONOPS for Maritime Patrol

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PMATT-TA: Incremental and Modular Development

Due to the complexity of the system and requests to field a capability as early as possible, the IPT took an incremental approach to develop component technologies. The PMATT-TA Increment 1 focus was to deliver a manual data entry system for maritime patrol aircrews that supported collection of post event (i.e., training or operational) data and qualification gradesheets. The development focus was heavily on the underlying architecture, resulting in minimal automation and limited reporting capabilities. In parallel, the IPT coordinated development of the PMATT-TA Increment 2, which leveraged on-going APM efforts. The use case for the Increment 2 transition was the P-8A simulation-based training environment. In addition to APMs, the technology solution seeks to increase the overall automated capabilities within the system (i.e., populating event data, determining measures of difficulty and providing measures of performance data for gradesheets).

The modular functionality of the PMATT-TA technology includes several components, which each yield benefits for the community (see Table 1). At a high level, the key components include a *centralized capability* for recording and displaying post-mission data, *APMs* for providing diagnostic feedback during debriefs, and *trend analysis reporting* to provide longitudinal brief/debrief feedback, training effectiveness analysis, and performance-based tracking of force proficiencies.

Table 1. PMATT-TA Component Function Descriptions and Benefits

Component & Description	Benefits
Administrative Controls: User account, drop-down menu management, qualification, announcements.	<ul style="list-style-type: none"> • Allow appropriate personnel to maintain system relevance as personnel and tactics shift • A mechanism for leadership to disseminate relevant information to the user base • Higher permission levels can approve, unlock and update permissions based on individual's roles
Permission Structures: Administrative rights based on roles and responsibilities.	<ul style="list-style-type: none"> • Restrict access of performance data through permission structure • Prevent qualifications from being logged without instructor input • Restrict outside organizations to read-only access to pertinent tactical data
Web-based Events Access: SIPR hosted website enables stakeholders to view events and relevant data.	<ul style="list-style-type: none"> • Streamlined interface and/or automation increase aircrew availability by reducing time spent completing post-mission administrative tasks • Improve TacMobile¹ personnel's integration into tactical mission execution • Direct access to event details promotes distribution of tactically relevant information
Automated Performance Measures: Supports objective assessment of capabilities-based performance with increased standardization.	<ul style="list-style-type: none"> • Improve ability to conduct aircrew performance reviews/evaluations. • Standardized longitudinal data aids in identification of targeted remediation requirements • Reduces workload and manual data entry requirements, thereby reducing human error due to fatigue/delays and reduces requirements for contract support instructors
Qualifications: Gradesheets are provided by mission that enable instructors to enter, track and grade trainees on various tactics relevant to readiness and proficiency.	<ul style="list-style-type: none"> • Balance of system-based and observer-based measures provide cross-validation of assessed performance • Directly links event data with qualifications claimed to provide all relevant data • Provide capability to automate aspects of qualifications based on event data and/or make recommendations of qualifications to claim based on tactics and experiences included in event
Centralized database: SIPR hosted server provides access to logged events, qualifications, and reports derived from those events.	<ul style="list-style-type: none"> • Centralize all post-mission data collection from both aircraft and the simulators • Improve the ability for other organizations (e.g., Undersea Warfighting Development Center, UWDC; Commander, Naval Meteorology and Oceanography Command, CNMOC) to access post-flight data and/or conduct performance assessments • Provides data to stakeholders in real-time
Reporting: Outputs per event, exercise or other parameters allow stakeholders to generate visual or quantitative interpretations of data.	<ul style="list-style-type: none"> • Understanding readiness gains and losses to balance flight and simulation training • Improve mission performance of fleet aircrews by identifying deficiencies and proficiencies at the individual, squad, wing and fleet level • Capability to pull longitudinal performance data provides quick access to current readiness state data in a format that is easy to interpret

Event Data

The data collected as part of each event includes the type of event, aircrew, environmental data, sonobuoy patterns, contacts (e.g., submarine, merchant ships, aircraft), target of interest details, expendables deployed (i.e., weapons, sonobuoys), link communication capabilities leveraged, and equipment malfunctions. Following completion of appropriate datasets based on the tactics used during an event, the aircrew focuses on narrative remarks that provide additional context about the event, outcomes and performance of the aircrew. As part of Increment 2 and beyond, the goal will be to leverage the automated data capture capabilities to generate default information for event data fields, reducing the need for manual data entry to the maximum extent possible.

Performance Measurement and Assessment

The APM component of the system represents another evolution in effective and efficient use of data. While not advocating removing the human from-the-loop for trainee observation and assessment, P-8 training instructors' demonstrate high workload (Atkinson, Findlay & Tindall, 2016). Past research clearly demonstrates the potential high workload has to negatively impact the accuracy and effectiveness of subjective performance ratings and the subsequent feedback provided to trainees (i.e., Bretz, Milkovich, & Read 1992; Kahneman, 1973). The inclusion of APMs in Increment 2, therefore, will result in real-time data for instructors to gain diagnostic feedback on outcomes to supplement observer-based performance assessments (see Figure 2).

¹ TacMobile, an ACAT III program, provides the Maritime Patrol and Reconnaissance Force (MPRF) with capabilities to plan, direct and control the tactical execution of operations for P-3 and P-8 aircrews.

The initial analysis work to address this capability focused on defining performance measures and assessments² that aligned with the community's Wing Training Manual (WTM) and qualifications. The results of this analysis provided a range of cross-mission metrics³ for implementation; however, technical challenges limit the number implemented in initial software releases (see Wiese, Atkinson, Roberts, Ayers, & Ramoutar, 2012). For initial delivery, the IPT identified *timely attack criteria*, *actual attack placement*, *standoffs maintained*, *attack positioning*, *re-attack*, and *timely attack*, *proper weapon envelope*, *coordinated time on target*, *water space management*, *recognition of lost contact*, *EMCON tactics*, *harpoon impact or miss*, *environmental update*, and *attack authorization* as suitable for automation. Qualitative feedback from fleet instructors indicated the benefit of automating these dimensions of performance because removing the calculation of these performance dimensions from their instruction duties would enable them to focus their feedback on what specific behaviors led to success or failure. In addition to APMs with performance assessments, this aspect of the technology also provides summary data to further aid instructors and aircrews in interpreting the outcomes of an event. For example, while rules exist for *sonobuoy management* it is an aspect of tactics that depends on a number of contextual factors and the skill level of the aircrew. Therefore, these measures will output raw data in a format that allows instructors to interpret the strengths and weaknesses of the tactical approach implemented by the aircrew. Additional raw outputs include *closest point of approach*, *release angle*, and *torpedo presets*. In combination, this data yields more accurate and effective debriefs than the former system. Further, by providing access to historical performance data, instructors throughout the training pipeline can identify valuable briefing points and opportunities to focus training on areas where the aircrew needs the most attention. In addition to providing more quality training opportunities, the combination of performance data provides the potential to make training far more efficient, especially as flight hours are reduced and time in simulators is increased.

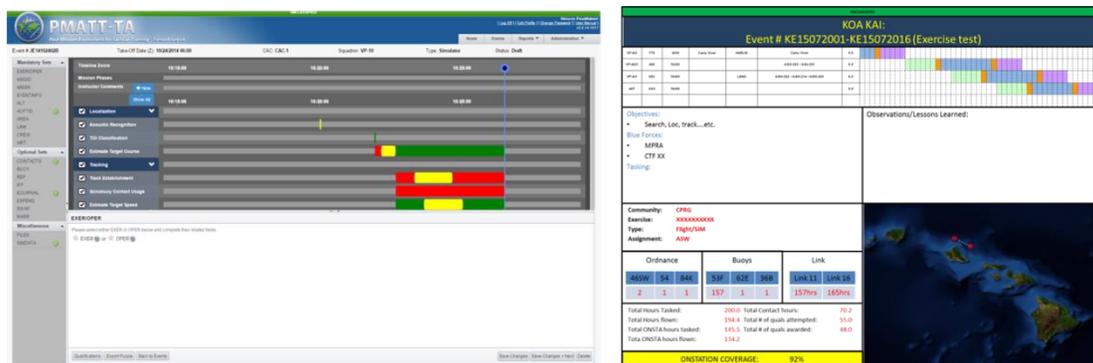


Figure 2. Event Interface with APM Timeline & Notional Quad Reporting Output

Qualifications

Based on event outcomes, aircrews complete gradesheets for appropriate qualifications. The desired functionality is a *wizard* type functionality that steps training officers, debrief officers and/or weapons tactics instructors through a series of questions focused on the tactically relevant sections of qualifications outlined within the community's WTM. Following the completion of this wizard, the system outputs a Measure of Readiness (MOR) based on Measures of Performance and Measures of Difficulty (MOD). By storing event data and qualifications in the same system, the community will realize additional long-term benefits to effective and efficient use of data. For example, when using event data, business rules can be coded within the software to automate MOD (e.g., weather conditions make the implementation for certain tactics more or less difficult) and identify qualifications that an aircrew could consider claiming (e.g., identification of subsurface and surface contacts may meet the requirements for ASW and ASuW qualifications).

Reporting

The reporting aspect of the system provides visual representations of data trends across aircrews, squadrons or wing. The initial capabilities developed included charts tailored by parameters to provide graphs such as average time of

² Performance measure refers to what was defined as the measurement of outcomes and results based on the raw data output that provides a basis for understanding effectiveness and efficiency, whereas assessment refers to the linking of various levels of performance to pre-defined acceptable standards (e.g., expert, average, below average).

³ Metrics refers to a group of measures and/or assessments that provide data on the organization's behavior or performance.

lost contact, average time to attack/re-attack, and average measure of readiness vs measure of difficulty. In later iterations, the focus will be on developing event or exercise based reports (see Figure 3), such as a quad charts, that provide a summary of information. In general, the reporting capability will revolutionize the way the community shares data about events and exercises. For instance, in large-scale exercises, aircrews historically release message traffic after each flight returns from an event; however, in the 2016 Undersea Warfare Exercise (USWEX), the participating squadrons entered data in PMATT-TA, which UWDC personnel could directly access for event recreation and debriefings. From an aircrew perspective, the future capabilities to generate quad chart post-mission debrief products automatically from event data represents efficiencies that directly affect their ability to meet leadership and crew rest requirements⁴.

Current Status

Since initial fielding in June 2015, the team has continued to make improvements to the front end of the application. These modifications have included removing data entry requirements that were antiquated and increasing collection of tactically relevant data (e.g., gathering both briefed and observed datasets for comparison of deltas, appending events with operationally relevant attachments). Further, through multiple efforts to assess system usability, the team identified opportunities to increase users' effectiveness and efficiency through the elimination of data redundancies, increased use of defaults to streamline data entry, and interface reorganization to increase access to related information on a single page. Due to these efforts, the benefits include:

- 1) Reduced aircrew time spent completing post-mission administrative tasks,
- 2) Improved TacMobile integration into tactical mission execution,
- 3) Improved and centralized post-mission data collection for aircraft and simulator events,
- 4) Improved ability for external organization to access post-flight data,
- 5) Intuitive nature of the system reduces training for system use to near zero,
- 6) Supports P-8 planned shift toward heavy simulation versus live flight training, and
- 7) Provide a capability to reach across communities to make the most efficient use of resources and tactics.

Moreover, the initial Wing used for beta testing has not had to release the former post-mission report since the introduction of PMATT-TA, which represents a significant change in how the community conducts business during post-flight. Based on their experience, the other Wings and Commander Task Forces (CTFs) have actively pushed to get PMATT-TA introduced as soon as possible. At this time, it is anticipated that CPRG will transition the full P-3/P-8 fleet to adoption of the technology shortly. While the team has realized several successes in the last year, there have been numerous challenges to overcome or that remain in the implementation of analytical technology for centralized reporting of aircrew performance and proficiency. For this reason, the remainder of the paper will address lessons learned and recommendations based on our progress to date on transitioning this technology.

LESSONS LEARNED, CHALLENGES AND RECOMMENDATIONS

A Culture of Change with a Guiding Concept of Operations (CONOPS)

Relying on event data for decision making in military contexts will require more than simply leveraging the technologies capable of handling the storage, analysis and interpretation of information. Reliance on data requires a cultural shift that emphasizes not only the careful collection, analysis, and interpretation of data but the actual implementation of decisions based on that information. That is, all stakeholders from CPRG down to the individual squadrons need to acknowledge required changes in the way things are done. In this instance, stakeholders must have an understanding and belief that reliance on objective information plays a crucial role in the continual evolution and sustainment of warfighter capabilities. Further, stakeholder coordination is necessary to identify responsibilities in the process to move beyond the status quo. Currently much reporting in the Navy relies on standard but antiquated military messages. A successful transition from this status quo, particularly in highly bureaucratic organizations such as the military, require the buy-in, active participation and input from every person and entity that has a stake in the new way of doing things.

⁴ Historical process of completing post mission reporting took a range of 1-4 hours to complete based on subjective reporting, while the new process has been reduced to 15-30 minutes based on feedback from Wing 2 aircrews.

The consensus of the community regarding the *new way of doing business* provided the beginnings of the CONOPS for PMATT-TA. While PMATT-TA was a top-down driven effort, convincing the end-users (i.e., fleet and instructors) that it would also benefit them was imperative for its survival and success. CPRG carefully selected the community for the initial rollout, beta testing and CONOPS outlining for PMATT-TA. They selected a group with whom they had a healthy rapport. CPRG informed the community that use of PMATT-TA, in place of the former system for post mission reporting, was not a choice. However, CPRG also afforded them the opportunity to help shape the characteristics of the system and its CONOPS. The goal was not to add work or to inconvenience the fleet but to improve existing processes and as a result, help them do their jobs more efficiently. For this reason, the success of the resulting system was, at least partially, in the user community's hands. This was critical to the transition of the product. It resulted in a group of individuals that were especially well suited to inform a new and improved way of doing things. Further, this dynamic provided a situation where the development team had nearly immediate end user buy-in and, based on early successes, yielded champions for the solution at the *grass roots* level.

After the initial rollout workshop, a series of meetings with CPRG, the wings, the squadrons and former fleet SMEs were conducted to outline how the system would be operated. Together the IPT developed official documentation that outlined administrative roles, account and user profile set-up processes, qualification structure, data entry responsibilities, the process for submitting system change and deficiency requests, and points of contact. In the end, the CONOPS outlines a new process by which post-mission and training event data are entered, tracked and reported up the chain-of-command and to outside organizations. The new process, which represents an improvement and time reduction compared to the former system, has resulted in requests by communities to shift to the new system as soon as possible.

Validity Checking of Data & Increasing Quality of Data

All data has limitations. When attempting to measure a specific phenomenon, variability of the data is not always the result of what researchers intended to measure and instead could be the result of error – variance in the measurement not related to the phenomena of interest (Siedler, 1974). One potential source of systematic error could occur if the instrument used for measurement (e.g., observation, computer sensors, and scales) was flawed. This can be the result of calibration issues, human limitations in perception or human bias. Random errors occur when there is unexplained inconsistency between two or more measurements. As an illustration, when measuring an aircrew's *submarine tracking*, if the instructor rating this dimension of performance is greatly distracted with other tasking, their observations of the aircrew's performance will contain systematic error. On the other hand, if technical issues arise with the simulator the aircrew is using for training, the rating of their performance will contain random error. In both cases the degree of systematic and random error present in the measurement, will negatively influence the accuracy, and therefore validity, of the performance rating.

While social scientists accept that a certain degree of error is inevitable when measuring human related phenomena, there are several ways error in data can be limited or reduced. The most common approach to limiting random error is to increase the number of instances of measurement. That is, a larger sample size provides a researcher confidence that their finding is the result of expected hypotheses/relationships and not something else (i.e., error). PMATT-TA deals with random error in much the same way. By providing wings and squadrons with a conveniently accessible and easy to use system for data entry, the sample CPRG has to determine proficiency trends across communities has been exponentially increased (i.e., roughly 600 events entered in less than a year of implementation compared to a fraction of that over the history of the past system). Not only can CPRG be more confident in the assertions and decisions they make based on the large sample PMATT-TA provides, the system affords them the ability to see if successful approaches to training and tactical shifts will generalize from one wing to another (e.g., CPRW-10 vs. CPRW-1). If there is generalizability, they can be that much more confident in the validity of their data and the decisions they are making. If not, it affords them an opportunity to diagnose and remedy any potential issue(s) in the system (e.g., systematic error caused by faulty instruments or inaccurate human rating) or in the communities themselves (e.g., differences in the way they approach training).

Moreover, PMATT-TA enables stakeholders of the data to account for confounding variables that could affect the accuracy of measurements. Many data fields and sets in the system allow users to provide free-response information that provides context or supplemental information. Using an earlier example, if an aircrew is training in a simulator that has technical issues, their performance scores as rated by the APM system might be low. However, the instructor could provide free-response details outlining that their scores were the result of technical issues, not

performance. This allows CPRG to control for this contaminated data when integrating it into a larger sample. In addition, it minimizes the potential for faulty decisions made about the proficiency, and the community as a whole can understand technical issues that may be influencing aircrew training effectiveness.

For early implementation of the PMATT-TA technology, the CONOPS has outlined better interaction and communication with tactically involved watch standards to increase data entry during flight. This is a first step toward more valid data entries. Additionally, the design of the system has included interface features that allow users to quality check data during entry (e.g., map display allows quick identification of errors in locations). In later iterations, the move toward automated collection of data from the aircraft and simulator will provide increased data reliability by reducing error for those measurements due to human errors or biases. While these systems may not be flawless, the previously mentioned free-response fields enable instructors to specify if something other than trainee performance affected the measurement whether that is due to system error or even a change in tactics.

Another way in which PMATT-TA ensures the quality of the data is by providing consistency in the data entered across communities. While the past system for post event reporting was standard across communities, emphasis on specific data fields and qualification types varied across communities. Additionally, depending on an individual's familiarity with the reporting nomenclature, some data may have been assumed *defaults* (i.e., never changed) if the meaning behind the coded data fields was not understood. This was partly due to CPRG's limitations to efficiently organize, analyze and interpret the vast sums of data solicited from the communities and return feedback to them. As a result, communities formed subcultures set forth by their local command. Those subcultures affect focus areas in training and valued data points. If there are differences in the data collected between communities, there is no way for CPRG to make comparisons or investigate trends across the fleet. PMATT-TA enables CPRG to set precedents across communities for the type of training and data that is most important to the command. In fact, during the initial beta testing phase of PMATT-TA, the datasets and fields were narrowed down to the information that was most important and relevant to current and future threats. The results were greatly reduced sets and fields from the original post mission reporting. This not only improved the quality of the data, it reduced the overall time and workload of filling out post mission reports. This later feature has the potential to improve the accuracy of the data by itself.

Lastly, the centralized, *cloud-like* aspect of PMATT-TA allows different users of data output to quickly and efficiently find and analyze the data they need to do their jobs. Instructors have access to the APM system and performance timeline during a training session. As a result, they can provide immediate specific feedback to trainees and be better prepared to provide a detailed debrief. CPRG can access the system at any time to get data they need to support data *calls*, in addition to running both pre-established reports and create custom reports to view the data however they choose. While this last point does not ensure the data input into the system is valid, it does ensure that stakeholders are able to access the data most important for their purposes. This is an improvement on the old system where vast sums of data collected made it practically impossible to retrieve only the data needed given other responsibilities.

Personal Identification Information (PII) Issues

The primary entry point into records that are part of PMATT-TA is through the events themselves. For each event, Combat Aircrew (CAC) is designated to identify who was assigned to crew positions for qualification purposes. However, since the data records are not accessed or sortable through an individual name or other personal identifier, they are not covered by the regulations outlined in the DoD Privacy Program (DOD5400.11-R). Some precautions and/or system design aspects provide protection of the information stored in the system. First, PMATT-TA is hosted on a DoD approved data center server system. This system undergoes periodic patches that address any new security concerns, and administrators assure the configuration and processes adhere to DoD Information Assurance (IA) policies. Second, the system runs on the Secret Internet Protocol Router Network (SIPRNet), which limits those who can reach the application to those who have proper credentials. Further, as part of the SIPRNet IA regulations, the web-based application itself requires a SIPR Token. Finally, while anyone with SIPRNet access and a SIPR Token can reach the web-based application and request an account, each account request undergoes a review by an individual with administrative level permissions who can delete or approve the user account request. This individual also assigns permissions based on their role, with default permissions at the *squadron crewmember* level (limited event access, no administrative privileges).

In addition to these safeguards, the PMATT-TA database contains limited information at the individual level. First, *User Accounts* include name (not rank), affiliation (i.e., wing, squadron and CAC), email, and a DoD assigned identification number. Second, *Crew Management* provides designated officers with the means to add crewmembers first and last name, assigned squadron/CAC, position, and if that individual is part of the core crew (for qualification purposes). User accounts provide access and permissions structures and remain separate from crewmember listings associated with events. This is the extent of the individual information affiliated with an event record. A CAC, not individuals, receive qualification scores based on aircrew performance and grades. The current design of the system also limits access to qualifications; users must either access grade sheets through the relevant event or be one of the last 25 qualifications earned by their assigned CAC/squadron. With the introduction of APMs into the system, as well as suggested revisions to support tracking of individual Air Combat Training Continuum (ACTC) levels and associated performance on an event, there will likely need to be continued review and potential revisions to permission structures and storage of individual performance data.

Data Trends as Tactics Shift

History demonstrates that addressing threats requires shifts in submarine warfare tactics (Geroux, 2016); this need to change remains true today, for any tactics or strategies our warfighters implement in order to maintain superiority and best address differing threats. Systems such as PMATT-TA will enable leadership to determine quickly the strengths and areas where the fleet would benefit from improvement. These web-enabled database applications provide important data for determining the quantity and types of resources needed to combat the most common threats. To enable naval superiority now and in the future, advanced data management systems, as well as systems that allow communities to quickly update APMs associated with new tactics, will be integral to achieving this aim.

CONCLUSIONS AND FUTURE DIRECTIONS

The successful implementation of Increment 1 and progress on Increment 2 lays the groundwork for further adoption of the PMATT-TA system. Coordination is already underway with the P-8 program office (PMA-290) to test the feasibility of using the system on-board the aircraft. This would not only enable the easy capture of performance data for training and operational events, it would also automate the majority of the post mission reporting duties. The latter has the benefit of allowing aircrew to focus more heavily on the mission at hand, as opposed to administrative tasks, and afford aircrews an opportunity to conduct beneficial debriefs. Furthermore, post-event data and status can quickly move up the chain-of-command, which implies understanding what the fleet needs when they need it to answer the Navy-wide call for *readiness*.

Currently, the PMA-205 PMATT-TA roadmap includes a secondary transition to the Helicopter Maritime Strike Community (HSM) to kick off in FY17. This comes as a response to recommendations from the HSM community leadership (Commodores of the Helicopter Maritime Strike Wing U.S. Pacific and Atlantic Fleet; June 2015) that OPNAV N98 (Air Warfare, Office of the Chief of Naval Operations) consider integrating the MH-60R into the PMATT-TA program. The letter notes that the lack of “a comprehensive analytical tool to bridge the gap between instructor evaluation of post mission data and quantifiable metrics for ASW performance.” Further, it states, “detailed trend analysis [is] needed to make ASW investment decisions or provide essential, readily accessible force-wide ASW metrics to Fleet Commanding Officers, Commodores, and Carrier Air Wing Commanders.” The Commander, Naval Air Force, Pacific and the Commander, Naval Mine and Anti-Submarine Warfare Command confirmed the support for a fleet-wide ASW analytic tool through signed endorsements of the recommendation. The unique challenge of this transition will be similar to the final transition target for the patrol community – “automated performance measures that interface with the MH-60R’s onboard and desktop mission systems.”

While the authors presented a targeted use case and experiences, this is not a specific platform or Navy only challenge and need. For example, Major David Blair of the U.S. Air Force wrote an article entitled *MoneyJet* (2015) — a reference to the popular book and movie *Moneyball* — where he challenges the military to better utilize data for both training and decision making purposes. Agreement across the DoD that quantitative, data-driven decisions is an important first step; however, implementing systems capable of collecting, storing, analyzing, interpreting and safeguarding that information is a difficult challenge. Additionally, work remains even within this use case for ensuring that performance data and trend analysis remain relevant and valid as tactics shift and circumstances change. It is important to ensure decisions made are based on comparisons that are *apples to apples* and not

something else. This applies to trending as the data being compared changes. For instance, new weapons emerge that provide variations in tactics for timing or distance. Comparing weapon utilization trends may no longer be a meaningful trend when legacy and new technology intertwine. These types of issues may require mechanisms in the system itself to provide adjustments or human-in-the-loop decisions when pulling trends. Additionally, while the DoD as a whole moves toward providing these type of systems that output quantitative performance data, further investigation for cross-platform definitions of performance constructs and facets of mission reporting will also help ensure consistency in comparisons. As a fabricated illustration, let us examine a construct like *sonobuoy management* for an ASW mission for the MH-60R and P-8A. If MH-60R defines this construct with heavy emphasis on decision making associated with buoy location, but P-8A emphasizes number of buoys, when we look at cross-platform trends we are no longer comparing the same information. The way performance constructs and metrics are defined need to be consistent if comparisons are to be meaningful, but this requires stepping away from traditional stove-piped acquisition and training solution definitions. The benefit of this shift will be providing leadership with data that helps identify the best-suited platform and/or aircrew to solve a specific problem.

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REFERENCES

- Atkinson, B., Findlay, R., & Tindall, M. (2016). Performance measurement & post mission reporting for performance assessment & trend tracking. *87th Annual ASMA Proceedings*.
- Bretz, R. D., Milkovich, G. T., & Read, W. (1992). The current state of performance appraisal research and practice: Concerns, directions, and implications. *Journal of management*, *18*(2), 321-352.
- Blair, D. (2015). Moneyjet. *United States Naval Institute Proceedings*. *141*, 68-70.
- U.S. Department of Defense. (2007). *Department of Defense Privacy Program* (Report No. DoD 5400-11-R). Arlington, VA: U.S. Department of Defense.
- Geroux, W. (2016). World War II shows why we need the merchant marine. *TIME Magazine*. Retrieved from <http://time.com/4303121/world-war-ii-merchant-marine/>.
- Grosklags, Adm. (2016) Readiness, affordability, speed will win future for the Navy. NAVAIR News Release: COMFRC Public Affairs. 1-4.
- Kahneman, D. (1973). *Attention and effort* (p. 246). Englewood Cliffs, NJ: Prentice-Hall.
- Naval Air Systems Command. (2016). Open architecture strategy for naval aviation. *NAVAIR Blog*. [Navy Specific Blog]. Retrieved from <https://myteam.navair.navy.mil/corpapps/NAVAIRComm/NAVAIRBlog/default.aspx>.
- Naval Air Systems Command. (2015). *NAVAIR Data Strategy*. [Navy Correspondence]. Retrieved from <http://www.navair.navy.mil/index.cfm?fuseaction=home.download&key=BB7FC94D-87CB-4DA4AA39AFD5D3A8193F>
- Naval Air Systems Command. (2016). Readiness, affordability, speed will win future for Navy. *NAVAIR News*. [Navy Online Periodical]. Retrieved from <http://www.navair.navy.mil>.
- Naval Air Systems Command. (2010). Command Patrol Reconnaissance Group [Statement of Urgent Need].
- Pifer, S. (2013). U.S. strategic nuclear triad: The challenge of tight budgets. *Brookings*. Retrieved from <http://www.brookings.edu/blogs/up-front/posts/2013/11/19-strategic-triad-tight-budget-challenges-pifer>.
- Seidler, J. (1974). On using informants: A technique for collecting quantitative data and controlling measurement error in organization analysis. *American Sociological Review*, 816-831.
- Wiese, E., Atkinson, B. F., Roberts, M., Ayers, J., & Ramoutar, D. M. (2012). Automated human performance measurement: Data availability and standards. *Proceedings of the 34th Interservice/Industry Training Simulation & Education Conference*, Orlando, FL.