PROACTIVE DECISION SUPPORT TOOLKIT FOR DISTRIBUTED COALITION PLANNING

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ABSTRACT

International emergency response requires multinational team members to formulate a plan, know their roles, and be ready to mobilize. Distributed planning in coalition operations such as this is inherently challenging, as individual decision makers are prone to planning fallacies and decision biases, and team members may fail to capitalize on shared knowledge, skills, and experiences when that information is disorganized and difficult to access. In this paper, we present a centralized toolkit comprising three web-based proactive decision support (PDS) tools designed to mitigate these challenges and improve team situation awareness: Task Assistant, Event Scheduler, and Weather Widget.

Keywords: Distributed Planning, Coalition Operations, Decision Support, Transactive Memory System, Team Situation Awareness

Topical Area/Track: Military Applications

INTRODUCTION

To minimize damage and destruction from natural disasters, an emergency response plan must be in place to ensure timely and efficient humanitarian assistance. Planning for such events requires careful coordination among members of large, distributed, multinational teams. Coordinating between culturally and geographically diverse nations is challenging in itself, and to compound this challenge, members of planning teams typically possess different knowledge, skills, access to information, and responsibilities in the decision-making process. Being aware of who knows what, where to go to find what information, and who is responsible for what in collaborative environments is known as team situation awareness (TSA) [24]. Endsley describes TSA as “the degree to which every team member possesses the [situational awareness] (SA) required for his or her responsibility” [1][8]. Planners on the team typically have a trove of relevant information (historic and current), but that information is distributed across different nations, disorganized, and time-consuming to sift through. To mitigate these challenges, planners should utilize a transactive memory system (TMS), which is a centralized system for encoding, storing, and retrieving all pertinent planning information [16].

When presented with vast amounts of information, people tend to be drawn to what is prominent in their field of view [3][12][20]. Search engine optimization (SEO) service providers exploit this bias and allow people to pay to have their information appear higher in search engine results pages [9]. Even when abundant information is available, most decision makers do not look beyond the first page [10]. Suboptimal decisions can thus result from this incomplete and biased information search. Planners who fail to consider additional information, or worse yet, fail to recognize the need to seek out more information, may overlook important details and superior alternatives. The lack of a well-organized system for storing, integrating, and accessing relevant information only exacerbates potential biases in information search, and places the onus on the decision makers to figure out who to talk to and where to go to obtain more information.

Even with complete information, people tend to underestimate the amount of time and resources required to complete future tasks [14]. This planning fallacy can have dire consequences, especially for emergency response planning: Costs may exceed the allotted budget, events may run behind schedule, and entire missions may be compromised. So why don’t people learn from their past experiences and adjust their forecasts accordingly? When making forecasts about future events, people are thought to engage in two distinct modes that draw on different sources of knowledge: An *inside view* that focuses on the details of the plan at hand, and an *outside view* that draws on how the plan at hand compares to other similar plans [4][13]. The key difference between the two is whether the target plan is viewed as a unique case or as an instance of a larger set of similar cases. In most situations, people should incorporate information from both modes, but the planning fallacy implies that people tend to adopt the inside view and largely ignore the outside view.

Forecasting with an inside view is prone to optimism bias and overconfidence [4][13]. An optimism bias describes the tendency to have unduly positive expectations about future events and an illusion of control over the outcomes [25][26]. Overconfidence involves unrealistically high self-evaluations that occur when assigned subjective probability assessments exceed the proportion of cases that turn out to be true [17]. For example, across all instances in which an individual has expressed being 80% confident that a given outcome is true, less than 80% of them are actually true. Both optimism bias and overconfidence inflate the perception that everything will run smoothly and according to plan. As a result, planners may rely on overly specific and narrow plans, and fail to develop alternative contingency plans to adapt to new and changing situations. In summary, engaging in an inside view, with an overreliance on a limited sample of disorganized information, could result in plans taking longer and being more expensive than planned, or worse, failing altogether.

In contrast, forecasting with an outside view is statistical in nature. First, planners define a relevant reference set of similar past plans (i.e., construct a base-rate) [17]. Generally, planners will include cases that are similar on important attributes such as number of personnel, cost, geographic location, and culture. Even though these reference sets may be imperfect, they can still improve forecasts by anchoring them to past outcomes. Second, planners compare the target plan to this reference set to determine its relative position. Importantly, the target and reference set should be compatible in terms of measurement units to allow for meaningful comparisons. Planners can then use the reference set to determine whether components of the target plan are positioned relatively high or low in the distribution and adjust their forecasts accordingly. For example, when forecasting how many days it will take to deliver drinking water to a disaster-stricken region, a reference set of four past plans in the same region shows that it took 10-14 days. From this prior knowledge, planners could anchor their forecasts and are less likely to adopt unrealistic expectations about the required amount of time.

To mitigate these aforementioned challenges to effective planning, decision makers should plan proactively instead of reactively. Rather than reacting to disasters after they strike, proactive planners anticipate future problems and prepare in advance. To illustrate this use case, we have threaded throughout this paper a coalition planning narrative based on a multinational planning team involving the United States (US) Pacific Fleet (PACFLT) and members of the Pacific Partnership, which annually deploys forces from PACFLT to work with regional governments, military forces, humanitarian, and non-government organizations. In this paper, we introduce three proactive decision support (PDS) tools: Task Assistant, Event Scheduler, and Weather Widget. This toolkit was developed to facilitate distributed planning and decision making, and together, it provides a centralized TMS for planners to better organize, display, and access past and present planning information. More importantly, it improves TSA across the distributed, coalition planning team and facilitates decision making by providing a streamlined, web-based repository of current and historic planning information that can be accessed and updated in real-time. By using this toolkit, teams will be more prepared, informed, and able to effectively execute their plans.

METHOD

To develop PDS tools that can enhance TSA, we first sought to understand the coalition planning domain and requirements of the key users involved in the decision-making and planning process. To this end, we applied a User-Centered Design (UCD) process, which focused on addressing the goals and needs of the different planning team members across the U.S. PACFLT and Pacific Partnership. This process included activities tailored to support the Discover, Analyze, Design, and Develop phases of PDS tool development (see Figure 1).

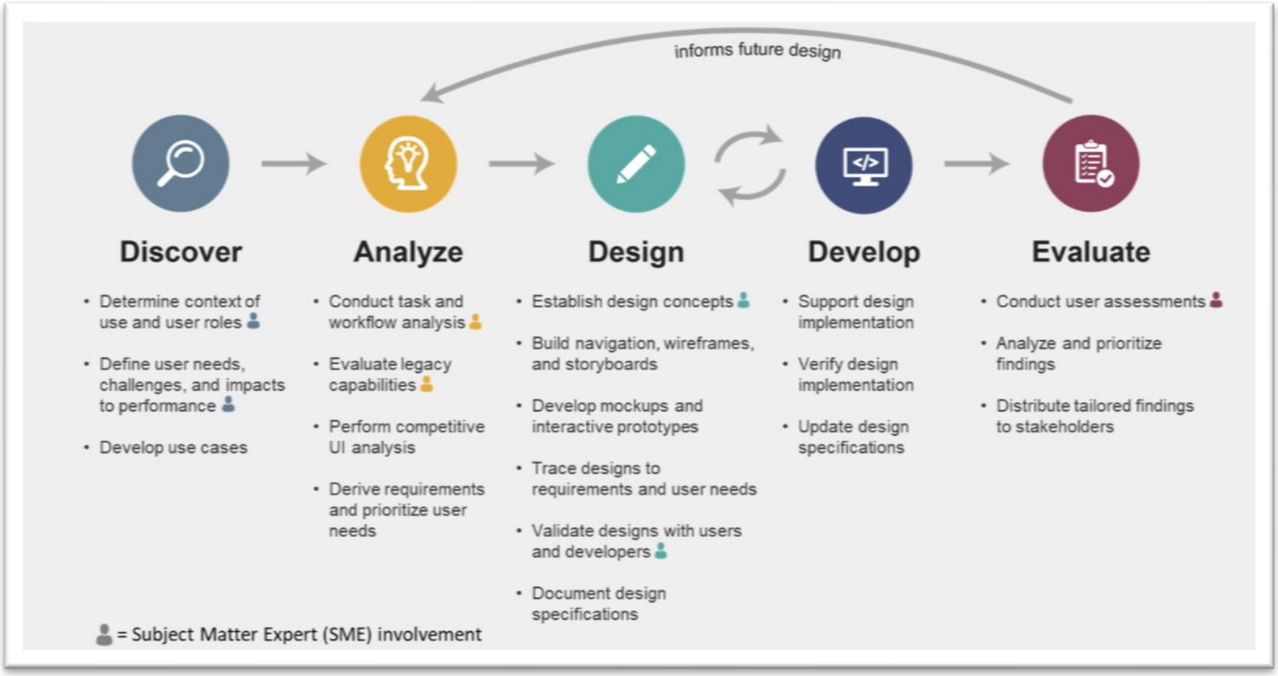

FIGURE 1. Overview of the User-Centered Design process used to understand the goals and needs of the planning team.

During the Discover and Analyze phases, we reviewed Standard Operating Procedures (SOPs) and Tactics, Techniques, and Procedures (TTPs) which reflected the doctrine and best practices for providing structure to missions. We then constructed personas and task flows to capture the goals and tasks performed by Pacific Partnership planners and derived the planning needs and requirements for our PDS tools.

The task flows were reviewed and validated through interviews and observations with 13 subject matter experts (SMEs), which included six members of the U.S. PACFLT and seven participating members of Pacific Partnership who served interchangeably as officers-in-charge (OICs) and assistant officers-in-charge (AOICs) from previous planning events in Sri Lanka, Micronesia, Myanmar, Thailand, Vietnam, and Malaysia. Some had little prior experience as planners, while others were expert planners for emergency response events. Through our interviews, these SMEs shared their personal insights on the challenges of coalition planning. This knowledge proved indispensable in our evaluation and refinement of current planning procedures and support systems, and in filling the gaps in our development of recommendations. Finally, we reviewed the scientific literature in the Analyze phase to better understand potential planning and decision-making biases in distributed coalition planning as well as potential solutions.

USER-CENTERED DESIGN PRODUCTS

Personas

We identified three key end user roles involved in the Pacific Partnership's coalition planning process: Senior Planner, OIC, and Commander. For each user role, we developed a persona to capture their key goals, information needs, high-level tasks, tools, and products, as well as their challenges and gaps in support (see Figure 2 for an example).

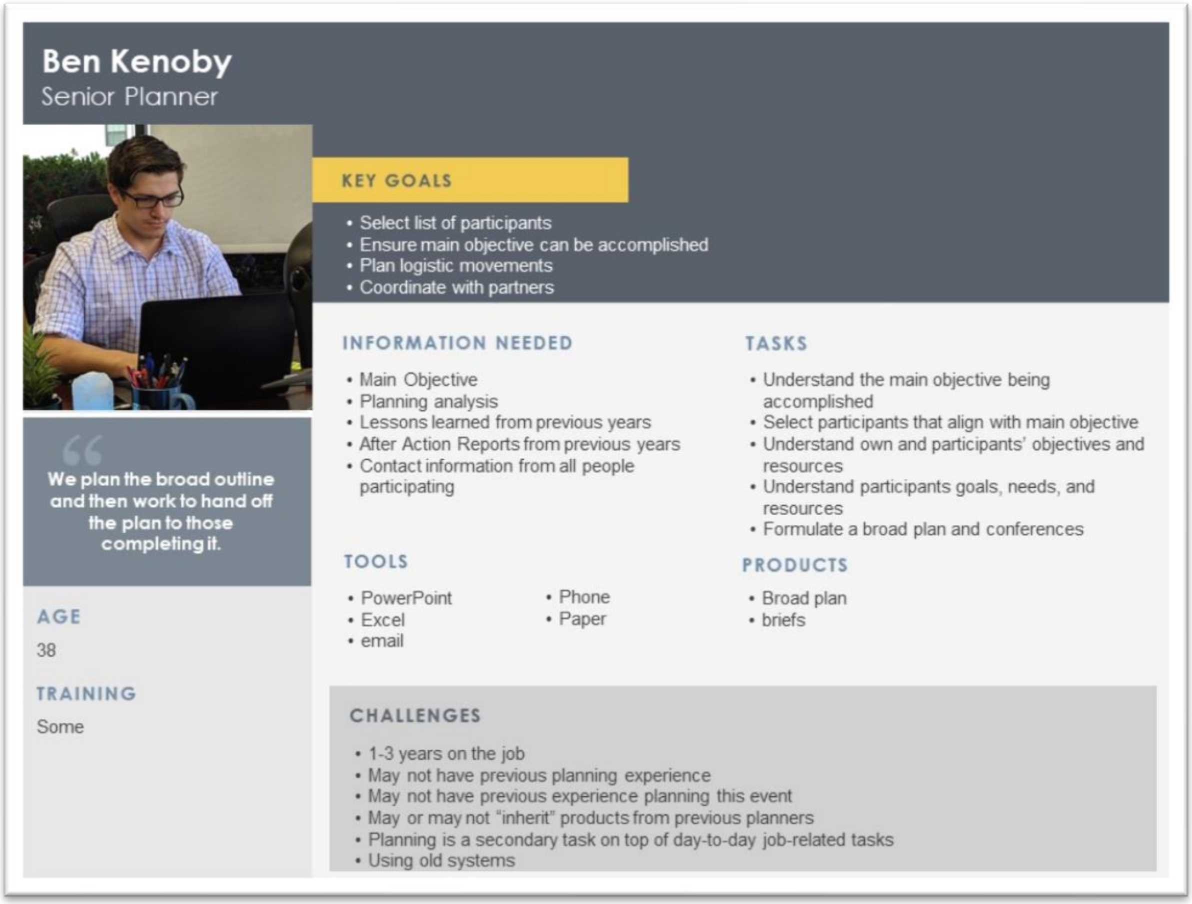

FIGURE 2. Sample persona for the Senior Planner role.

Task Flows

We constructed detailed task flows across pre-planning, planning, execution, and post-execution phases for the three key planner roles. These task flows were identified using existing documentation and validated with SMEs to ensure accuracy and completeness. A snippet of a high-level task flow is provided in Figure 3. The final, digitized task flows captured the tasks, subtasks, decision points, information sources/formats, and task products for each planning role and phase of an exemplary distributed, coalition planning process (available upon request).

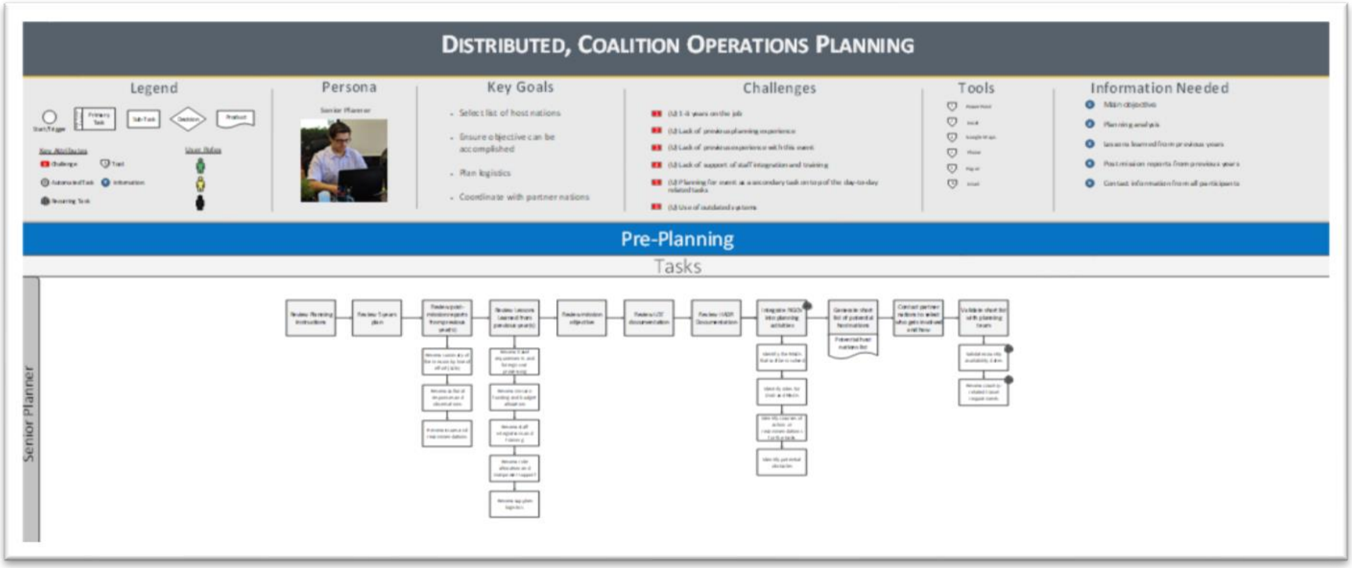

FIGURE 3. Snippet of a domain-specific task flow.

ADDRESSING PLANNING FALLACIES AND COGNITIVE BIASES

Saliency Coding

Given that people's attention is drawn to what is prominent and salient [3], presenting critical information on the first page, at the top of a search page, or in ways that stand out against other information can help direct users to attend and to consider that information.

Project Premortem

One way to mitigate the planning fallacy is to conduct a premortem [15]. Unlike a postmortem, a premortem occurs at the beginning or the pre-planning phase of a project, rather than at the end. When conducting a premortem, the team assumes that the plan has failed and must come up with a list of plausible reasons for what *did* go wrong (and not merely ask what *might* go wrong). This premortem exercise helps overcome the inclination to provide optimistic forecasts by forcing planners to consider reasons for failure and worst-case scenarios. Moreover, it forces planners to come up with contingency plans for when plans go awry. When done well, a premortem can further enable team members to voice reservations they otherwise may not bring up, which helps identify potential problems before execution.

Default Options

Setting default options can alleviate choice overload by reducing the number of active decisions planners must make. Default options refer to options that are implemented when decision makers do nothing. Even though defaults preserve the menu of options, people tend to stick with whichever option is the default. This default effect has been demonstrated in a variety of real-world domains, including organ donation [11], flu vaccination [5], and green energy use [22]. Because defaults can influence behavior while preserving the freedom of choice, setting defaults has become a popular and effective behavioral intervention tool [2] [27]. One rational explanation for default effects is that defaults are perceived as implicit recommendations [18]. That is, decision makers infer that the choice of default reflects the beliefs and attitudes of the default-setter. For instance, people infer that policymakers themselves believe that others ought to be organ donors when "organ donor" is set as the default.

In planning, defaults can simplify the process and provide informative recommendations. By setting previously successful courses of action as defaults, planners can integrate knowledge from past experiences. By saving them time and energy, defaults allow planners to devote their cognitive resources to more complex decisions. Furthermore, when defaults are not suitable to the current context, decision makers can simply choose a different option.

Templates

Templates operate similarly to default options by reducing complexity and facilitating process improvement [6]. Templates start with default options that are selected for a specific set of parameters (e.g., host nation, time of year, lines of effort). Like default options, templates reassure planners that the contents have been vetted by experts and previous planners. Additionally, templates can help distinguish between familiar and novel content, allowing new planners to focus their efforts on the novel aspects. Finally, templates provide new planners with insights into the thinking process of their predecessors who may no longer be around and available. In planning, task lists extend the concept of templates from pre-specifying a set of parameters to predefining a set of tasks to be performed. Task lists can be viewed as procedural templates, providing planners with an outline of the number and potential order of tasks to be performed.

Machine Learning

Machine learning uses algorithms and mathematical models to derive patterns and draw inferences from sample data without explicit instructions from users [7][23]. From these derived patterns and inferences, machine learning allows automated systems to make predictions and take actions on behalf of the user. For instance, Google's search completion capability uses machine learning to mine its vast store of historical queries to make suggestions for users as they incrementally type query prefixes. When applied to planning, machine learning can abstract from previously performed actions in support of decision-making to proactively provide relevant information for new tasks.

PROACTIVE DECISION SUPPORT TOOLKIT

The analyses and resultant products from the initial phases of the UCD process were carried forward into the Design phase to inform the design of initial prototypes for the PDS toolkit. These prototypes were iteratively refined for the Develop phase, during which design specifications were generated to facilitate implementation. During the Evaluate phase, high-fidelity, interactive prototypes were presented to the Pacific Partnership SMEs (planners) and evaluated for effectiveness. Finally, with feedback and objective data obtained during evaluation, the prototype PDS toolkit was developed into a fully functioning toolkit that has been fielded through an accessible web server. The PDS toolkit comprises three separate tools that collectively provide a centralized, web based TMS to facilitate distributed coalition planning.

Task Assistant

Task Assistant (TA), developed by SRI International, is a fully collaborative task management tool that has been deployed previously to operational user communities within the U.S. PACFLT, the U.S. Strategic Command (STRATCOM), and the Kansas National Guard [21].

TA mitigates the challenges of planning by providing premortem documentation, templates with default options, and machine learning to automate routine and time-consuming tasks [19]. Within the TA application, planners can access “Lessons Learned” and “After Action Reports” (AARs) documentation from previous events to perform premortems and to share them with current and future teams. Extant manuals, TTPs, and SOPs are transformed into living artifacts populated with default options that enable multiple users to simultaneously edit, build, execute, and track workflows. Planners can monitor their own progress with checklists, assign tasks and responsibilities to other team members, and monitor their progress. Finally, to proactively automate assistive tasks, TA utilizes a set of reasoning and machine learning modules to mine planning data from the activities of personnel on prior missions, from explicit representation of mission activities gleaned from SOPs and TTPs, and from direct user-inputs.

Figure 4 illustrates how users can enable the system to learn to perform relevant subtasks, which include entering survey site information, invoking a map service (such as Google Maps), and opening a weather service. Once the system learns a procedure to automate those tasks, TA can proactively suggest to the user to "get geographic and weather information" whenever the user enters new survey site information (e.g., latitude and longitude). When the user executes the suggested procedure (by pressing the "Play" icon highlighted in Figure 4), TA will automatically integrate and display the map and weather information.

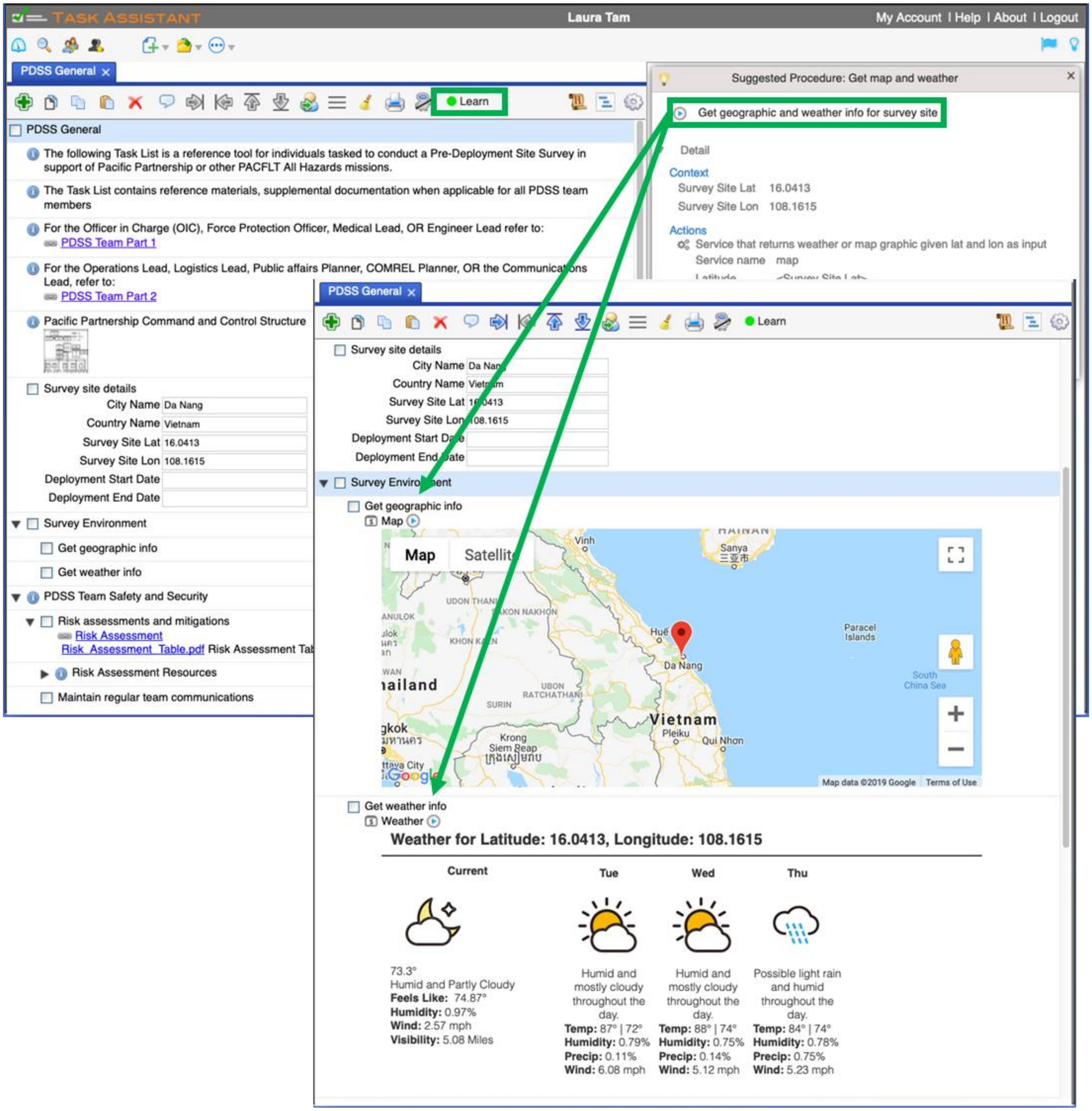

FIGURE 4. Illustration of TA making a proactive recommendation based on a learned procedure.

Event Scheduler

Event Scheduler (ES), developed by Pacific Science & Engineering (PSE), is a planning tool that facilitates proactive event scheduling and coordination among team members across different organizations (see Figure 5). ES features elements of common calendar-based planners but it is additionally optimized for the specific distributed coalition operations needs of Pacific Partnership. ES draws on information from the Internet to automatically populate its calendar and provides a visual timeframe of known schedule conflicts such as holidays, elections, and sporting events (e.g., Manny Paquiao boxing matches in the Philippines are so popular that businesses close early and people's availability and responsiveness may be affected). In addition, planners can manually input scheduling conflicts based on personal knowledge and change the status of plans during the course of planning. Planners can initially set tentative plans to “soft,” and as details emerge and plans become more concrete, planners can change them to “firm.” Importantly, ES allows individuals from different organizations (with different institutional email addresses) to collaborate and update the schedule concurrently by providing read-write access based on their needs.

ES employs saliency coding by highlighting scheduling conflicts in red and further distinguishes the severity of those conflicts in saturation (solid red for problematic conflicts and pink for unproblematic). By storing previously vetted and executed plans, ES also helps new planners perform premortems and provides them with templates for new plans.

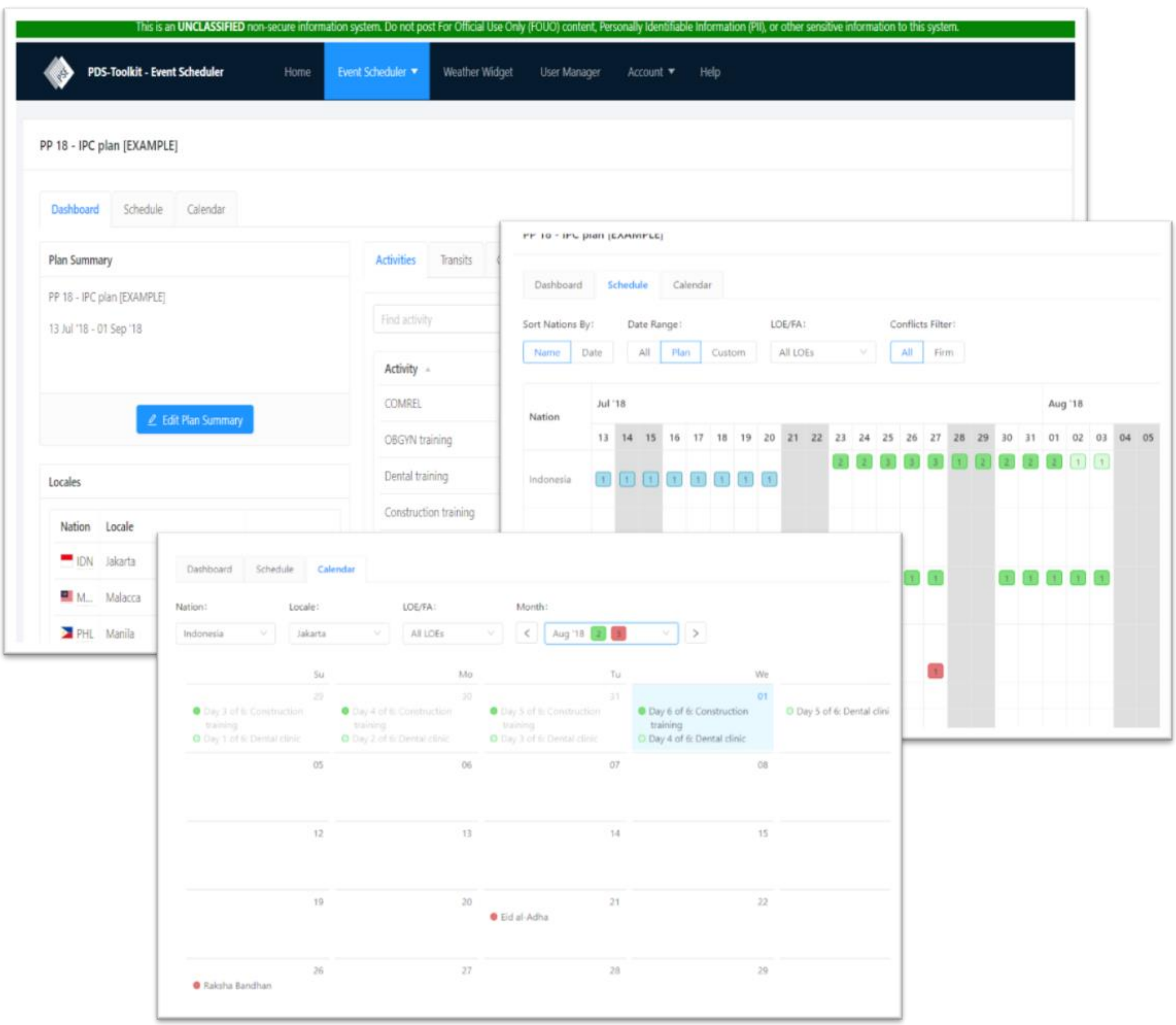

FIGURE 5. Screenshots of Event Scheduler.

Weather Widget

The Weather Widget (WW), developed by PSE, is a forecasting tool that helps planners determine how weather may impact their mission months in advance (see Figure 6). It allows planners to plan not only for a single activity in a particular location, but for a mission that spans across multiple countries and regions. WW presents historical weather data for a selected country and allows planners to specify the desired weather thresholds. After setting these thresholds, planners can see on the updated weather grid the months that fall outside the desired range. In addition, WW prominently displays recommendations for the months best suited for planned activities based on key parameters. The information provided by WW is intended to be used in combination with available timelines provided by the ES described above.

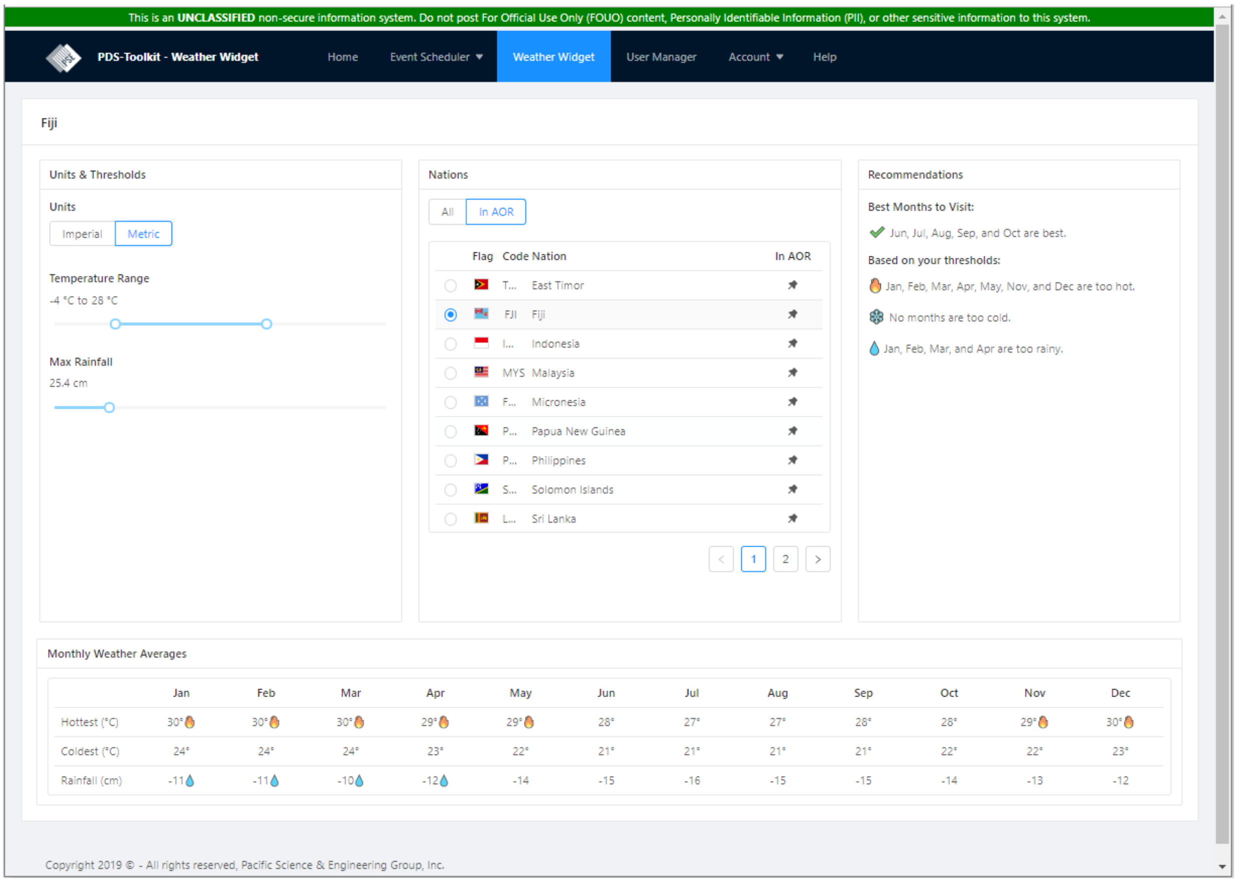

FIGURE 6. Screenshot of the Weather Widget.

CONCLUSION

Many challenges arise in the process of coordinating a multinational emergency response plan. One of these challenges is that members of the planning team, with their knowledge, access to information, and responsibilities, vary drastically from year to year. Another is that even when relevant information is available, that information may be disorganized and time-consuming to thoroughly examine. Finally, planners may not be cognizant of what information is available and how to obtain it, and they may fall prey to a number of decision-making biases and fallacies. As a result, when disaster strikes, planning teams often find themselves taking a reactive stance and responding to needs as they come.

In this paper, we presented a set of decision support tools (the PDS toolkit) that allow distributed coalition team members of Pacific Partnership to proactively plan for disasters. The PDS toolkit, which consists of Task Assistant, Event Scheduler, and Weather Widget, forms an effective TMS by allowing planners to maintain TSA across the distributed, coalition planning team. This web-based, real-time toolkit streamlines the planning and decision-making processes and provides a mechanism for team members to collectively encode, store, and retrieve pertinent planning information. This toolkit effectively addresses the challenges that have traditionally plagued planning teams: 1) It presents critical information prominently and saliently, 2) it allows planners to review past plans and perform premortems, 3) it provides default options and templates, and 4) it employs built-in machine learning to streamline the decision-making and planning process. By being proactive rather than reactive, planners could thus "plan in calm to respond in crisis." While even the best-laid plans can go awry, our suite of tools drastically improves the rate of success.

APPENDIX

ACRONYMS

AOIC	Assistant Officer-In-Charge
ES	Event Scheduler
OIC	Officer-In-Charge
PACFLT	Pacific Fleet
PDS	Proactive Decision Support
PSE	Pacific Science & Engineering
SA	Situation Awareness
SEO	Search Engine Optimization
SME	Subject Matter Expert
SOP	Standard Operating Procedure
STRATCOM	Strategic Command
TA	Task Assistant
TMS	Transactive Memory System
TSA	Team Situation Awareness
TTP	Tactics, Techniques, and Procedures
UCD	User-Centered Design
WW	Weather Widget

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