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NAVY SBIR TRANSITION PROGRAM

SPOTLIGHT

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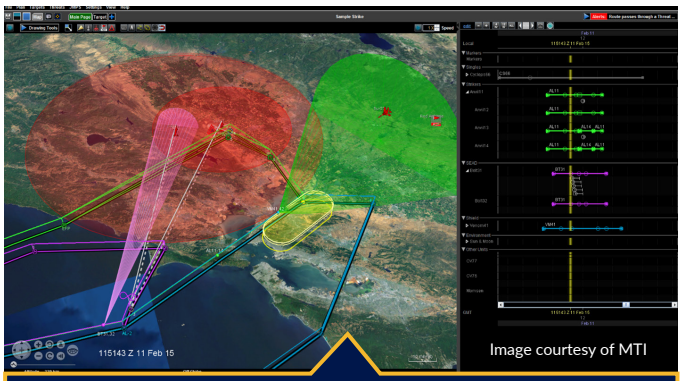
ViPER mission planning tool streamlines complex Navy planning tasks across air and sea domains

By Amie Alscheff

Monterey Technologies, Inc. (MTI) and Stottler Henke Associates, Inc. (Stottler Henke) leveraged Navy SBIR funding to develop the Visualization, Planning, Execution & Review (ViPER) mission planning tool. Having successfully transitioned to the fleet in two versions, ViPER enables planners to gather information from distributed sources and integrate them in a single application, allowing collaborative multi-asset planning. ViPER can also automatically generate map and timeline graphics and create plan animations, letting planners spend less time creating briefing slides and more time developing effective plans. The ViPER system for carrier air wings (ViPER-CVW) is incorporated into the Joint Mission Planning System (JMPS) program of record and is operational on U.S. Navy (USN) and Royal Australian Air Force (RAAF) F/A-18s. A separate system, the ViPER Mission Planning Application (ViPER-MPA), is deployed as part of the AN/BYG-1 Tactical Control System (TCS) used on all USN and Royal Australian Navy (RAN) submarines.

"In some way, shape or form, we've been working this concept since 2007, and just branching it out and growing it," says Todd Cloutier, MTI's director of Mission Management Systems.

In 2007, MTI approached the Naval Air Systems Command (NAVAIR) to propose doing analysis and building a tool to automate the complex manual multi-aircraft strike planning process. NAVAIR awarded a Phase II SBIR award to a previous Phase I SBIR that MTI had completed for the Army related to helicopter flight planning.



A screenshot from the ViPER-CVW planning application.

MTI's proposal to NAVAIR was a joint venture with Stottler Henke, a fellow California company at the time: MTI was founded in Monterey, California, and moved to Park City, Utah, in 2014. Stottler Henke is located in San Mateo, California. "We were looking for an artificial intelligence company that did Department of Defense work, and that was Stottler Henke," says Cloutier. "They are AI and modeling experts. They speak our design language; they were OK with us doing all the software design and with them doing the software architecture to implement the designs."

Sponsored by NAVAIR's PMA-281, the Strike

Planning and Execution Systems program office, MTI and Stottler Henke began work on what eventually became ViPER.

While the original iteration of ViPER was focused on aviation strike planning, once MTI and Stottler Henke engineers began their analysis, they found they needed to widen the scope of the project. "Once they got to the carrier," says Cloutier, "they realized that the hard part was planning at the carrier strike group staff level, one echelon higher than just the Carrier Air Wing, integrating the considerations of aviation plus the defense of the carrier, anti-submarine warfare, surface warfare, logistics, all the moving parts for the entire strike group, not just the air wing embarked on the carrier." The team began developing a tool that would provide a common planning environment for all domains. "If you're talking air defense, anti-submarine warfare and logistics, you would all go to the same user interface to enter your constraints and your tasks, so you could see what everybody else has put in there."

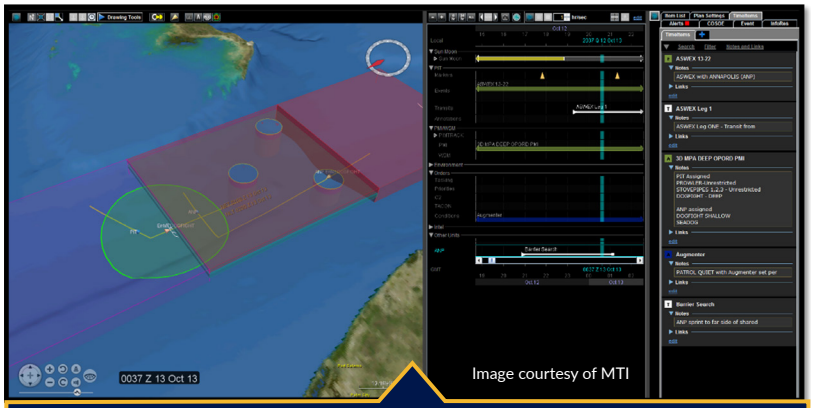


Image courtesy of MTI

A screenshot from ViPER-MPA.

The team followed a user-centered design process focused on the tasks users would need to perform, and on optimizing user capabilities. First, MTI brought in human factors engineers to study how carrier strike group planners worked, including workflow analysis and cognitive task flow analysis. This informed the requirements for the software design. Stottler Henke created data models for each task and MTI generated software designs that were tested repeatedly by operators to identify any gaps. According to Cloutier, "Once the operators agreed that the design did what it was supposed to do and helped them get their job done, that became the basis for building software." Based on user feedback over many iterations of software design, developers at Stottler Henke and MTI built the user interface and connected it to the task database.

"The idea of ViPER was to expose all the mission planning as data and services, which can then be shared by everybody who's involved in the planning. Before, in order to share data, you would often have to wait for somebody to produce something like a PowerPoint brief or an Excel file, and then you'd have to ask them the right question to get the answer you wanted. Now, all the planning is stored as data and all the machines can work on that same data at the same time."

A classic example, says Cloutier, is scheduling deck landing qualifications (DLQ) for helicopter pilots. "They have to practice landing, and they have to get so many landings in daylight and so many in the dark. The most efficient way to do that

is to schedule the event to start an hour before sunset. But if the ship is moving, what time is sunset three days from now? It seems like a very simple question, but it's really complicated." ViPER can automatically calculate sunrise and sunset in local time along the ship's planned route, whereas formerly the planner would have needed to place calls or emails and wait for a response. ViPER saves both time and mental labor, according to Cloutier. "If the person who's trying to schedule that DLQ event is waiting for communications, that person's brain is tied up on minutiae and not on the tactics and the efficiencies of how to make things go better and faster. They're just worried about getting on the schedule at all."

Over the course of the NAVAIR SBIR Phase II, MTI built a prototype tool for the carrier strike group and took it to the fleet for testing, which it passed with flying colors. Although NAVAIR was delighted with the product, a roadblock appeared. NAVAIR had no single program office responsible for carrier strike group planning, and therefore, no office was prepared to field the product. With the end of their Phase II.5 contract in 2011, MTI entered the transition "valley of death." Over the next three years, the company would continue working with the Navy to keep ViPER alive.

"We were in contact with them constantly about it. But we also got a different transition through NAVSEA PEO IWS. We used ViPER as the basis for a response to a broad area announcement (BAA) to build a mission planning tool for submarines. The submarine force asked for a mission planning tool without knowing us and we responded to that BAA with a white paper, along with a prime contractor, General Dynamics Mission Systems, because they own the integration. We proposed with them to integrate ViPER and modify it to become a submarine mission planner."

By the end of 2011, MTI had pivoted to creating ViPER-MPA. "We basically did the same thing again. We did a task analysis with submarine operators and we already had a lot of the parts in ViPER that would do what we needed them to do. We just had to reskin it to support a different set of operators. Their tasks were just a little bit different here and there, so we made some adjustments and added some submarine-specific capabilities."

ViPER-MPA provides decision aids and interfaces to data sources that accelerate route planning and other planning tasks that submarine planners formerly had to execute manually. For example, when MTI performed its task analysis with submarine crews, they found one particular tactical task that was extraordinarily painful. In order to determine the safe navigation envelope (SNE) for a given area of water, planners need to determine the shallowest depth the submarine might encounter. This required cycling through images of several different nautical charts and scanning for the smallest number on each. "But what we found," says Cloutier, "was that those images the operators were looking at came from a database that we could query. We created queries that would search all the depth data on all the available charts and return the shallowest point. It seems like a very simple thing, but that alone saved many person hours of work." Freed from the tedious mental labor of trying to find the smallest number on a screen full of

numbers, operators were able to devote more time to optimizing their tactical position and creating different scenarios to give the submarine tactical flexibility. "Before, they were spending so much time doing that shallow point search that you couldn't ask them to redivide the water space in different ways. It was too hard."

While MTI worked on the submarine application of ViPER for NAVSEA, NAVAIR circled back to their original vision for ViPER in aviation. In 2014, seeking a strike planning optimization tool for its F/A-18 aircraft, NAVAIR decided to extend work on the technology it had already funded through the SBIR program. They issued MTI a new Phase II award to retool the ViPER user interface and task flows for carrier air wing planning, creating ViPER-CVW. After surviving the valley of death, MTI emerged with not one but two versions of ViPER to field to the fleet.

ViPER-MPA was the first to gain a SBIR Phase III transition contract. In 2017, NAVSEA awarded MTI a Phase III so that the company could prototype further innovations beyond what the BAA could fund. MTI continues to perform work under the BAA as well, says Cloutier, because PEO IWS updates its software builds with new capabilities every two years. "We've been adding incremental capabilities to ViPER-MPA since that initial build in 2012."

ViPER-CVW received its own Phase III contract in 2019, in the form of a five-year basic ordering agreement (BOA) with NAVAIR-PMA-281, the office that had sponsored the original SBIR Phase II back in 2007. MTI continues to work with NAVAIR PMA-281 as they upgrade the software architecture for JMPS. "Everything that we brought in ViPER is being incorporated into that new architecture. We're working with them on that, as well as dozens of other teams working at the same time on the same project."

MTI applies human-centered systems engineering to the design and development of complex critical systems. In addition to mission planning, the company's capability areas include human factors engineering, human-systems integration, user experience research and design, and model-based systems engineering. For further information, see www.montereytechnologies.com.

Founded in 1988, Stottler Henke applies cognitive modeling, artificial intelligence, machine learning, and other advanced technologies to develop solutions for planning and scheduling, decision support, education and training, knowledge management and discovery, and autonomous systems. For further information on the company, see www.stottlerhenke.com.

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