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Final Copy of Case Study

Status:
WINNER

Year:
2013

Organization Name:
Naval Meteorology and Oceanography Command (NAVMETOCCOM)

Organization URL:
http://www.navy.mil/local/cnmoc/

Project Name:
Piracy Attack Risk Surface (PARS)

Please select the category in which you are submitting your entry:
Safety & Security

Please provide an overview of the nominated project. Describe the problem it was intended to solve, the technology or approach used, how it was innovative and any technical or other challenges that had to be overcome for successful implementation and adoption. (In 300 words or less.)

The instability and lack of government in Somalia have caused a rapid increase in pirate activity within the Somali Basin Region and the Gulf of Aden. Due to this increase, maritime security and stability in these regions are severely threatened. Somali pirate attacks have taken the lives of innocent people, held sea-going persons hostage, and cost the world's economy billions of dollars annually. President Obama has stated that piracy and armed robbery on the high seas are a threat to the United States' national security and foreign policy of the United States. A few short months before the MV Maersk Alabama, a U.S.-flagged ship, was hijacked by Somali pirates in the Indian Ocean on April 8, 2009, NAVMETOCCOM personnel were tasked by the Oceanographer of the Navy to assist in the fight against piracy. Within two weeks, NAVMETOCCOM developed

the framework for the first-generation Piracy Performance Surface (PPS) model, which produced maps of probability of attack based on how environmental conditions affected pirate small boat operations. The success of the PPS model led NAVMETOCCOM leadership to pursue a more advanced anti-piracy model, the Pirate Attack Risk Surface (PARS). The PARS model is a Monte Carlo probabilistic forecasting tool that integrates environmental conditions, pirate concept of operations, commercial shipping information and all relevant piracy information to produce a probability forecast of shipping vulnerability to piracy as a function of latitude, longitude, and time. The PARS outputs a forecast of relative pirate presence probability over a 72-hour time period with a forecast probability surface generated at 12-hour time steps. The PARS model is the only known Navy product that attempts to fuse multi-discipline shipping information, environmental data, pirate locations, pirate operating procedures, and predicted pirate behaviors into a cohesive forecast environment.

When was this project implemented or last updated? (Please specify month and year.) Has it incorporated new technologies and/or other innovations since its initial deployment? (In 300 words or less.)

This project was last updated October 2012. To mitigate the difficulties imposed by large volume stochastic processes, NAVMETOCCOM chartered an Integrated Product Team (IPT) to characterize a suitable computational architecture for PARS and future performance surfaces. In order to select an architecture for the general class of performance surfaces, the engineering approach led the group through processes of clarifying stakeholder needs to technical requirements, thus illuminating the technical gaps between the existing architecture and the required "objective" architecture. Analysis of the requirements identified significant gaps in performance. The requirement to produce a final end-product within 30 minutes of product initiation (desired) or 2 hours (maximum) was not achievable with the existing PARS architecture. PARS production requires numerous inputs to generate a probabilistic surface using numerically intensive Monte Carlo algorithm techniques. An average PARS run was taking between 150 to 600 minutes, well outside the time limit of 2 hours. The IPT conducted an Analysis of Alternatives (AoA) to determine a production architecture that would meet the PARS technical requirements, within existing technical capabilities, and be used as guidance for future performance surfaces. The IPT conducted a prototype demonstration with the most promising prediction alternative. This alternative proposed splitting out the Probability of Pirates (Pp) code that was currently running in the Naval Oceanographic Office (NAVOCEANO) dissemination environment and running it on the Fleet Numerical Meteorology and Oceanography Center (FNMOC) High Performance Computing (HPC) environment. The objectives of the test were to determine the performance improvement of running the Pp code on the FNMOC HPC, and determine the data latency impacts of the file transfers. The test resulted in a significant

improvement in the time to process Pp with minimal data latency effects. The run time for Pp went from 563 minutes to 12 minutes, well within the functional requirement.

Is implementation of the project complete? If no, please describe the project's phases and which phase the project is now in. (In 300 words or less.)

As described previously, in 2009, the Naval Oceanographic Office implemented the prototype Piracy Performance Surface (PPS), which modeled pirate operating capability on environmental conditions; i.e. significant wave height, wave/current interaction, wind speed, plus a record of historical and recent attacks. Between 2009 and 2012, NAVMETOCCOM implemented a second generation model, the Piracy Attack Risk Surface (PARS), which added the factors of Probability of Shipping (Are there vessels in the area to be attacked?), Probability of Pirates (A pirate behavior model indicating the best guess of what the pirates are doing), Probability of Suitable Environment (similar to PPS), and Historical Probability of Attack. The PARS is in operational use, configured in the architecture described in question 6. (See Appendix 1 and Appendix 2.)

Please provide at least one example of how the technology project has benefited a specific individual or organization. Feel free to include personal quotes from individuals who have directly benefited from the work. (In 300 words or less.)

There were approximately 60 piracy events off the east coast of Africa in 2007. In a short two years, the number of yearly piracy events off of east Africa quadrupled. The shipping lines were increasing transit speeds and altering their shipping routes further to the east, entailing billions of dollars in extra fuel costs. Insurance premiums were spiraling for ships transiting the waters near east Africa, Red Sea, Arabian Sea, and the Indian Ocean. Shipping companies were begging for help. In April of 2009, NAVMETOCCOM personnel briefed the Horn of Africa Piracy Conference on a brand new product, less than a month old, of fusing weather, oceanographic, and piracy information into a forecast product that will delineate areas where shipping was susceptible to piracy. Afterwards, Rear Admiral Ann Gilbride of the National Maritime Intelligence Center stood up and told the 280 representatives from 20 nations, 24 U.S. Agencies, and an equal number of U.S. military commands that this product (the piracy performance surface) was a game changer. The Office of Naval Intelligence immediately incorporated the product into its Piracy Analysis Weekly Warning that was distributed to the naval forces of the United States, NATO, European Union, and other naval forces as well as to the maritime industry representatives and ships at sea. These products are briefed daily to Naval Commanders in the U.S. Central Command, Naval Forces in European Theater of operations, and to

the NATO commander in charge of the Horn of Africa counter piracy operations. In just the Horn of Africa, the numbers of piracy events have decreased from a high of 181 events in 2009 to 32 events in 2012, representing an 83% reduction in piracy events.

Would this project be considered an innovation, a best practice or other notable advancement that could be adopted by or tailored for other organizations and uses? If yes, please describe that here. (In 300 words or less.)

A spike in piracy near Somalia in 2009 and 2010 dramatically impacted worldwide commercial shipping. As good practices are implemented by mariners to minimize the piracy threat, the pirates' tactics, techniques, and procedures (TTPs) are evolving. In the past there has been anecdotal evidence of how and when pirates would attack. The PARS applies the much-needed scientific rigor in attempting to predict where and when pirates are most likely to attack. These results are huge as Navy moves forward in building a forecast model for areas of highest probability of attacks. Task Force Commanders use this product to determine where to allocate limited assets in a vast area to deter and/or interdict pirates. So successful has this product series been, the same techniques have been migrated to conduct counter drug operations off of Central and South America, counter smuggling operations in the Red Sea, counter criminal operations in the Gulf of Guinea, and small boat operations in the Persian Gulf.