

Web-Based Acquisition Coordination Tools with Embedded Expertise

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PROBLEM STATEMENT

The U.S. Navy, in its POM 10 “Naval Science and Technology Focus Areas,” lists a need to improve “Platform and System Cost” as its first item. Studies of fleet readiness based on POM 10 have identified a \$20B unfunded shortfall just in OMN in the Future Year Defense Plan (from 2010-2015) [Fleet Readiness POM-10 and Beyond, Fleet Readiness Division, N43].

Modernizing warships is an extremely complicated undertaking that must be planned years in advance. Systems Integration Program Managers (SIPMs) must ensure that compatible versions of constantly evolving systems and software are designed, tested, approved, integrated, and procured for deployment during the limited windows when ships, usually at sea, are available for complex upgrades. Slips affecting one system's development, as well as late changes in funding, ship availability schedules, and fleet priorities, can ripple through to affect other system upgrades. SIPMs responsible for overall systems integration must monitor the status of individual systems programs, track system inter-relationships, and cope with risks and problems as they materialize.

The community of U.S. Navy warfare systems SIPMs, Major Program Managers (MPMs), Participating Managers (PARMs), and other interested parties has used a constantly evolving set of processes to develop and field warfare systems. The burden of “data calls” on PARMs is high. The timeliness and completeness of information reaching decision-makers is variable. The ability for SIPMs and MPMs to see the big picture and anticipate problems is limited. The community needs a way to access and manipulate multiple large legacy (existing) web-based data sources to allow real-time decision support via modeling and simulation, multi-layered analysis and prioritization, collaborative scheduling and deconfliction, highly tailorable reports, and automated coordination within and across SIPMs, MPMs, and PARMs.

Stottler Henke's ADEPT will offer collaborative web-based, expert decision-support technology to help SIPMs and MPMs plan, coordinate, model, track, and manage modernization of warfare systems on surface ships. In time, the same approach should be expanded in several ways: (1) to support forward-fit as part of new ship construction, (2) to support Hull, Mechanical and Electrical (HM&E) systems as well as warfare systems, and (3) to support procurement beyond the surface fleet.

WHO CAN BENEFIT?

Any complex, long-term, multi-system, multi-party acquisition activity can benefit from ADEPT's ability to track dependencies, explore "what-ifs" (including shifts in budget, slips in schedule, changes in scope or capabilities, etc), generate high-quality schedules that take into account a wide range of domain-specific constraints and heuristics, identify potential risks and actual problems, issue notifications, and suggest potential mitigations or solutions. Most immediately, Northrop Grumman—the developer of PEO-IWS's WISE system with which ADEPT is expected to be integrated—and the Navy will benefit from this technology's help in fielding more capable ships more quickly, reliably, and at lower cost.

Our initial work is focused on NAVSEA requirements for surface ship warfare system upgrades as managed by PEO-IWS. Support for integration of warfare system components managed by PEO-C4I and SPAWAR is a logical next step. As noted, the same techniques can usefully be applied beyond warfare systems to HM&E, beyond backward fit to include original ship construction, and beyond surface warfare to include sub-surface and aviation platforms. Ultimately, most NAVSEA-affiliated PEOs (i.e. PEO-Ships, PEO-Carriers, PEO-Subs, PEO-Space, and PEO-LMW) can benefit from ADEPT. The other services also maintain fleets of long-lived platforms that require extensive systems-integration both in support of original procurement, and for upgrade over their often extended service lives—e.g. the Air Force's long-lived fleets of fighter (F-14, F-15, F-16), bomber (B-52), AWACS (E-3) transport (C-130) aircraft, or the Army's comparable fleets of aircraft, helicopters, boats, tanks, artillery, etc.

BASELINE TECHNOLOGY

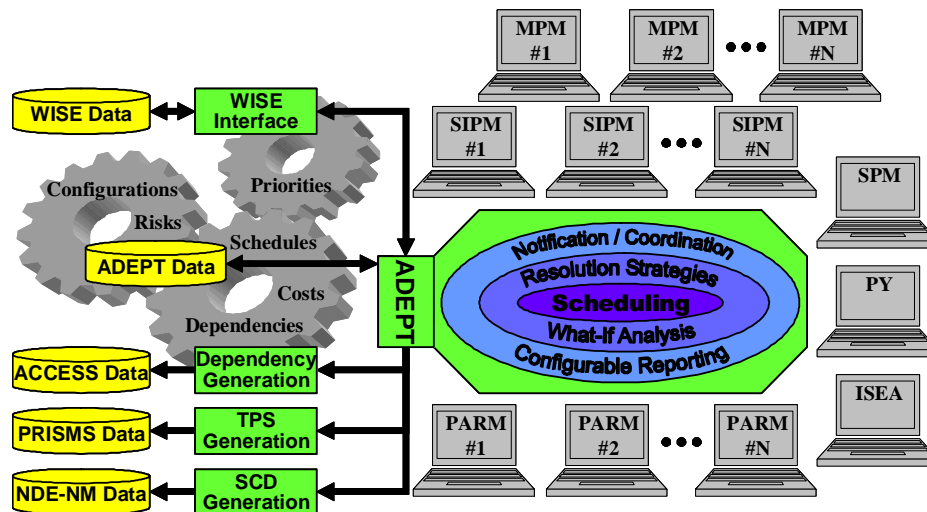
Development and procurement of each major warfare system is managed by a PARM office, with the help of engineering support agencies and OEMs. The planning and tracking tools used may vary from PARM to PARM, and among the supporting organizations. MPMs and SIPMs often require data from many PARMs so they can review and manage a suite of system programs or ship configurations. The organizations that control and fund PARMs introduce shifting sets of tasks, reports, and deadlines as they continually refine their management processes.

Transmission and sharing of rolled-up data is often accomplished by "data calls" (for scheduled or ad-hoc meetings and reviews) satisfied by generation of PowerPoint charts or Excel spreadsheets (typically based on an explicit or implicit template). A growing suite of IT systems has been introduced by different involved organizations to manage

selected pieces of data in a more formal way: NDE, WISE, ACCESS, PRISMS, etc. NDE-NM for instance, helps manage the fleet's decisions about which warfare system upgrades are under consideration or have been approved. WISE manages PEO-IWS's SIPMs' vision of upgrades being planned. ACCESS manages technical information about the inter-dependencies among many warfare systems. PRISMS manages financial planning data related to some systems development and acquisition.

TECHNOLOGY DESCRIPTION

The Acquisition Decision Expert Planning Tool (ADEPT) system incorporates Stottler Henke's proprietary Aurora™ scheduling engine, along with knowledge representation, case, and rule processing technologies to embed and apply expertise that helps system engineers integrate new warfare systems onto U.S. naval vessels efficiently. ADEPT is an evolving client/server software application whose purpose is to improve coordination and decision-making in large-scale, long-term, multi-system, multi-party acquisition processes such as those used to manage U.S. Navy ship modernization. Stottler Henke is building the SIPM (and MPM) support module of this system.



When compared to the current baseline approach, ADEPT supports the Navy's process, but improves integration—of both data systems and decision participants. Repeated data entry will be reduced, as ADEPT provides a central generation and exploitation point for data currently in at least four different systems. At the same time ADEPT will ensure consistent versions of data are available where needed as early as possible; PARM-generated planning data will be available to ADEPT users potentially months before it appears in (and is approved by) NDE, and weeks before entry into WISE. Likewise, results of analyses (reports to satisfy “data calls”) will be produced more easily, in more consistent and informative formats, and routed more quickly to those who need to see them; important status updates will be generated and propagated automatically on-line without yet another round of slide-editing, teleconferences, and face-to-face meeting.

Most importantly from a SIPM's perspective, *integration* planning will be able to (1) make use of the most up-to-date information from PARMs, (2) consistently take more information into account, (3) consider and evaluate more options; as a result the system will produce earlier, more complete, and more detailed notifications of impending

problems, as well as possible solutions. For instance, when budget cuts come down from sponsors, instead of receiving a quick back-of-the-envelope estimate of impacts and one rough adjusted plan from each PARM, MPMs and SIPMs will receive a range of more fully analyzed plans from multiple PARMs, and be able to perform unified evaluation of the potential interactions inherent in different combinations of responses. When dealing with multi-billion-dollar platforms, and multi-million-dollar systems, great savings can be achieved by avoiding rushed crisis-driven commitment to weakly-analyzed plans that interact with other commitments. For example, just minimizing needless configuration variation can save millions of dollars and weeks of effort on systems integration testing.

Table 1: Features, Advantages, and Benefits

Features	Advantages	Benefits
Large-scale multi-system, multi-ship schedules	Quickly catch inconsistent installation proposals	Ensure compatibility of any independent proposals
Incorporation of detailed user and domain specific constraints and heuristics	Produces higher quality and more easily understood schedules	Quality schedules save time and money, or show ways to achieve difficult goals
Sensitivity to inter-system dependencies	Highlight effects of changes in on system on another	Quickly determine need to notify other stakeholders
Flexible “what if” schedule explorations	Facilitate exploring space of options for better solutions	End up with higher quality solution overall
Schedule space exploration and sensitivity analyses	Fast automated exploration of related alternatives	Rapid identification of key break points to watch for
Risk and problem identification	Early and reliable notice of actual or impending failures	Keep problems from slipping through the cracks
Mitigation and solution recommendation	Rapid review/evaluation of courses of action	Minimize problem impacts by fast accurate response

ADEPT requires a commodity (or open source) Java web server, and Java-capable clients with standard web browsers or Java Web Start installed. Standard Navy/Marine Corps Intranet (NMCI) workstations meet the client requirements. ADEPT will interface with PEO-IWS’s WISE system, and modules within ADEPT will likely collect and format data for eventual input to other Navy systems such as NDE-NM, ACCESS, and PRISMS.

CURRENT STATE OF DEVELOPMENT

Stottler Henke has demonstrated an ability to generate multi-system, multi-ship schedules that include the essential tasks and milestones of interest to SIPMs, and to produce a variety of reports and interactive visualizations that highlight issues of interest in those schedules. ADEPT is able to take into account *conjunctivities* among systems and planned upgrades. It is able to support a wide variety of “what if” studies. The system’s client/server architecture enables access over the web from any NMCI machine. These existing capabilities fall roughly at Technology Readiness Level (TRL) 4.

Pending development tasks include:

- (1) integrating with legacy data sources such as the WISE system;
- (2) integrating with the companion PARM support module;
- (3) adding a more complete range of user-desired analyses, reports and notifications;
- (4) including more user-specified domain-specific scheduling constraints and heuristics;
- (5) developing more sophisticated risk and problem recognizers;
- (6) implementing an initial response generation capability and library; and
- (7) developing more capable tools for end-user maintenance and extension of system capabilities.

The Phase II project is scheduled to conclude with a 6-month period of refinement and trial deployment for evaluation by members of the PEO-IWS community. Our target is to achieve TRL 6 for major system capabilities by the end of that trial in January 2010. A major hurdle for transition to operational status will be acquiring all necessary certifications and approvals to enable deployment on the NMCI with live data—e.g. from NAVSEA and Department of Navy Chief Information Officer (DONCIO), Defense Automated Document Management System / DoD Information Technology Portfolio Repository - Department of the Navy (DADMS/DITPR-DON).

We expect to be in beta test on a government server by January 2011 (at TRL 7), and fully operational by January 2012 (at TRL 9). Meanwhile, we are seeking contracts through Navy program managers and primes, to apply this technology to a broader range of acquisition management problems.

REFERENCES

The following references represent a selection of Stottler Henke customers for whom we have successfully applied the Aurora™ scheduling engine and related technologies:

NASA: Dick Thornburg (407) 867-3374

NASA: Mark Jernigan (713) 483-9528

Camcar: Tim McGuire (815) 961-5395 [division of Acument™ Global Technologies]

ABOUT THE COMPANY

Founded in 1988, Stottler Henke Associates, Inc. applies Artificial Intelligence (AI) and other advanced software technologies to solve problems that defy solution using traditional approaches. Our diverse staff's expert command of a broad range of AI techniques insures an appropriate selection and application of specific technologies to each problem. The company delivers intelligent software solutions for education and training, planning and scheduling, knowledge management and discovery, decision support, and computer security and reliability. Stottler Henke's clients include manufacturers, retailers, educational media companies and government agencies. Seven Stottler Henke systems have been designated as Small Business Innovation Research (SBIR) success stories. Four Stottler Henke systems have been included in Spinoff, NASA's showcase of successful spinoff technologies. In 2006, NASA released a Hallmarks of Success video that showcases innovative scheduling and training technologies Stottler Henke developed for NASA. The Aurora™ scheduling engine at the heart of ADEPT descends from a long line of successfully fielded R&D for NASA, and is currently in use by Boeing for scheduling 787 production.