

# NRAC Software Intensive Systems Study

## Executive Summary

### **Purpose of study**

The consistent production of quality, affordable software has become enormously important, because information dominance has become a cornerstone of national defense. Unfortunately, abundant examples demonstrate that DON and DOD software programs are often late, over budget, and under performing.

All this is especially worrisome in light of the globalizing of competence in information technology. Other countries have surpassed the United States in computer manufacturing and much software production is now outsourced abroad.

On the other hand, emerging technologies and processes such as model-driven design and software product lines, offer promise, inviting development and selected deployment. Our overall purpose was to assess the state of the art, offer deployment suggestions, and identify S&T needs and opportunities.

### **Findings and general recommendations**

Overall, we saw great benefits emerging from emerging practices, including lower cost, greater security, more reliability, increased interoperability, easier maintenance, better match to requirements, more agile evolution, and more openness.

Such benefits led us to several suggestions focused on Naval acquisition management, systems engineering, training, education, and business practices. In the small, we recommend that the DON create a software acquisition specialty, that the DON mandate basic schooling for software acquisition specialists, that the DON close certain acquisition loopholes that permit poor development practice, and that the DON promote the careful use of existing technology and the development of gap-filling technology.

We also recommend investment in software engineering, particularly as it complements industrial developments and promotes the application of systems engineering methodology. Such investment is needed, even though there is a great deal of commercial investment, because much of commercial practice requires adaptation before it is useful to DON problems. For example, the practice of the nightly build, commonplace in industry, is relatively rare in the DON because the real-world exercise of a current prototype, all the way out to firing, say, a missile, is impractical.

As for emerging tools for specifying, bidding, and engineering software-intensive systems, we found promise, but not full maturity. Specifying and bidding tools are emerging but none are

mature enough to seriously evaluate. On the other hand, some software engineering tools are ready for use in selected applications as long as matched to problems. Caveat emptor, however, as there is much zealotry out there, as well as misleading claims, such as “no coding is done.” In reality, tools associated with such claims have so-called action languages in which the users certainly specify procedures. Worse yet, users often find themselves forced to escape to a traditional programming language such as C or C++.

### **The key recommendation: a three-step plan**

In the large, our central recommendation is a three step mobilize-transform-consolidate process, starting with project-directed RESET teams (rapid evolution of software engineering technology) inserted on-site at contractor locations, continuing with a Naval Software System Center, and evolving into a larger organization. These steps will help suffuse the DON with the best of today’s best tools and practices and those tools and practices that emerge going forward.

Missions of the RESET teams are:

- Complete user-requirements loop
- Promote use of system engineering tools, policies, and practices
- Champion best-practice software methodology emphasizing commonality, evolution, adaptation, reuse, reliability, interoperability, security and rapid response to changing defense needs
- Identify open systems needs and ensure compliance
- Recommend contract incentives
- Monitor progress and sustain support

Missions of the Naval Software System Center are:

- Institutionalize and staff RESET teams
- Build models and assist in building models.
- Ensure maximum Naval commonality
- Manage and staff Independent Expert Reviews
- Recommend acquisition policy
- Manage innovation through programs, such as SBIRs.

Embarking on this three step plan involves risks and challenges, but because the DON spends on the order of 1.7B/year on software rework, there is ample opportunity for a huge return on investment. If by step two of the plan, the Navy saves just 10% of that rework cost, the plan will have paid for itself 1000 times over.