A Strategy for Improving Interoperability of Weapon System Electronics

Volume 2. Strategy

Iris Kameny, Jean Gebman, Douglas McIver

February 1997

DRR-1579/2-OSD

Prepared for the Office of the Secretary of Defense

National Defense Research Institute

PREFACE

Improving the ability to reuse hardware and software in different types of weapon systems, and improving the ability of weapon systems to operate jointly, are two dimensions of improving the interoperability of weapon system electronics that are of high interest to the Department of Defense because such improvements (A) accelerate upgrading through the insertion of new technology, (B) reduce the acquisition and support costs for weapon systems, and (C) strengthen effective execution of joint operations. To achieve these three strategic goals, the DoD has separately employed three related tactics: (1) reduce the use of military specifications, (2) increase the reuse of hardware and software, and (3) improve the interoperation among weapon and C4I systems. Because the separate efforts to employ these tactics seems to be leaving some significant room for further improvement, this research is attempting to develop a unified strategy that might help improve the implementation of this set of related tactics.

Regarding the third tactic, the DoD has made recent progress by developing a Joint Technical Architecture (JTA) for C4I information management systems. This research is exploring the hypothesis that the C4I technical architecture work might be extended and applied broadly to improve the three tactics that DoD is using to improve the interoperability of weapon system electronics. This work is reported in this volume and two companion volumes.[1]

This research was conducted for the Open Systems Joint Task Force established by the Undersecretary of Defense for Acquisition and Technology. It was conducted within the Acquisition and Technology Policy Center of RAND's National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies.

This draft report should be of interest to people with general interests in the acquisition process as well as those interested in the interoperability of weapon system electronics. This draft is being circulated to share the initial research results and to acquire comments and suggestions regarding this continuing work.

---

[1] Vol. 1, *Executive Summary,* and Vol. 3, *Appendixes (forthcoming)*.

SUMMARY

To better sustain the superior warfighting effectiveness of the nation's weapons systems, the DoD is exploring new methods for improving the interoperability of weapon system electronics. By interoperability we mean both the interoperation among weapon and C4I systems and the interchangeable use of hardware and software across many different kinds of military and commercial systems. The DoD is using three tactics to improve interoperability: (1) reduce the use of military-unique specifications, (2) increase the reuse of hardware and software, and (3) improve interoperation among weapon and C4I systems. This research aims to help the DoD strengthen its employment of these tactics in order to produce better outcomes in terms of three strategic goals:

- Quick insertion of new technology
- Lower costs for weapon system electronics (hardware and software)
- More effective joint operations

To help the DoD realize such outcomes, the research is exploring the idea of developing and implementing a methodology that the Services and the defense agencies could use to construct technical architectures for their weapon systems electronics.

BACKGROUND

The DoD has recently developed a technical architecture for C4I systems. The matter of migrating existing systems to conform to this Joint Technical Architecture (JTA) for C4I, however, has been left to the Services and defense agencies to address through their acquisition executives. This research addresses how the Services and defense agencies might cooperate to minimize their joint costs.

APPROACH

Building upon DoD's progress in developing a technical architecture for C4I, this research is extending the C4I technical architecture work to improve interoperability of weapon system electronics.

FINDINGS

A number of challenges arose in extending the technical architecture concept beyond C4I to include improving the interoperability of weapon system electronics, for example:.

- Weapon systems, in general, have form, fit and function needs affecting hardware reuse that are not required for information systems and are not covered in the current JTA for C4I.

- To achieve common use of hardware across a domain, the Services/agencies responsible for a domain must reach agreements about the architectural style for the equipment in that domain and they must agree to interface definitions for the form, fit, and function of those equipments that will be used in common. Reaching such agreements about reuse of hardware requires investments in research and tradeoff studies to arrive at the most suitable arrangements for both architectural style and interfaces. It also requires a high degree of cooperation and commitment across institutions.
- The response time requirements on information processing for a weapon system are more demanding than those for information systems and C4I.

To address these challenges and others we extended the technical architecture concept to include coverage of issues such as hardware interfaces, resource needs, and institutional factors.

STRATEGY

Our strategy for improving interoperability of weapon system electronics has four steps:

Step 1. Design a prospective methodology for developing technical architectures for weapon system electronics.

Step 2. Conduct pilot tests and refine the methodology.

Step 3. Conduct further demonstration applications and further refine the methodology.

Step 4. Implement the methodology across all weapon system electronics and to the extent appropriate, integrate the technical architectures.

Integral to each of these steps is a need to manage the extent and pace of change in a way that recognizes the uncertain nature of outcomes and the great difficulty in estimating the life cycle costs and benefits of change. Difficult as it may be, though, such analysis is crucial to sorting through alternative course of action and gauging the nature, extent, and pace of investments in change.

PROSPECTIVE METHODOLOGY FOR DEVELOPING TECHNICAL ARCHITECTURES FOR WEAPON SYSTEM ELECTRONICS

The strategy's methodology is built upon four basic ideas.

- **Domains.** Divide weapon system electronics into domains comprised of similar equipment and develop a technical architecture for each domain.
- **Separate Method for Each Tactic.** Divide the methodology for developing technical architectures for weapon system electronics into three parts, with one part dedicated to

each of DoD's three tactics for improving weapon system interoperability: (1) reduce military specifications, (2) increase reuse, and (3) improve interoperation.

- **Tailor Each Domain's Technical Architecture to Best Address Needs.** Focus a domain's technical architecture on the tactics that will best address the domain's needs for improved interoperability of weapon system electronics.
- **Integrate Technical Architectures.** To the extent that it proves beneficial, integrate technical architectures, or aspects of the technical architectures, across Services/agencies and across domains.

Methodology for a Technical Architecture with Multiple Tactics

For domains that require a technical architecture that addresses more than one tactic, the domains will need to blend the foregoing methods in developing their technical architecture.

Methodology for Coordinating Technical Architectures Across Weapon Systems

To coordinate the development, evolution, maintenance, and application of a technical architecture for weapon systems electronics in a domain, five things are necessary:

- **Coordination.** A Domain Technical Architecture Committee (DTAC) could be formed to oversee coordination. It should include representatives from weapon system program offices and the Services'/defense agencies' acquisition organizations.
- **Technical Support.** Research, analysis (e.g., tradeoff studies), and facilitation efforts would need to be provided to support the DTAC. Such technical support could be provided by what we call a Defense Systems Technical Support Contractor.
- **Investment.** Front end investments would be needed for technical support, as well as for the development of common architectures and associated specifications and standards for the domain. Additional funding and management for such funding would need to be arranged.
- **Tactic Selection.** Because the development and application of a technical architecture requires investment of resources, it is important to select the most worthwhile tactics for each domain's technical architecture. The Combatant CINCs and the Joint Staff should prioritize needed improvements. A committee or group such as a Defense Systems Interoperability Board (DSIB) could serve as an intermediary between the DTACs and the Combatant CINCs and the Joint Staff.
- **Oversight.** Funding of the research and tradeoff studies required to support the devlopment of technical architectures will require management oversight, as will the development and application of the technical architecture for the domain's weapon system electronics. A DSIB could provide such oversight.

Methodology for Coordinating Technical Architectures Across Services and Defense Agencies

For weapon system electronics, the coordination of technical architectures across Services and defense agencies may require DoD assistance to help organizations overcome parochial interests. The DoD could provide such assistance in several ways.

Use a DSIB to Help Review Acquisition Programs. Involving the DSIB in milestone reviews for acquisition programs would provide an opportunity to assess the suitability of progress in achieving the three aspects of DoD's interoperability goal (insert new technology, reduce costs, and improve interoperation).

Use a DSIB to Assess Interoperability Performance. To provide the DoD an assessment of current interoperability performance, a DSIB could produce a periodic assessment that would be provided to the Combatant CINCs and the Joint Staff to facilitate their assessment of needed improvements and priorities for improvement.

Require DSIB Approval of Domain Technical Architectures for Weapon System Electronics. To assure quality, consistency, and timeliness in the development of these technical architectures, the DoD could require DSIB approval of these domain architectures. The DoD could also make the DSIB responsible for the DoD's methodology for developing technical architectures for weapon system electronics.

Provide Technical Support for a DSIB. To enable a DSIB to carry out the aforementioned functions, the DoD would need to provide long-term technical support for the DSIB. Mitre and Aerospace are examples of existing FFRDCs that might provide a good match for such support.

Methodology for Integrating Technical Architectures Across Domains

As weapon systems electronics is divided into domains, and as technical architectures are developed for each domain, certain similarities in the architectures may become apparent. In some instances there may be value added from integrating certain aspects of the architectures. A DSIB and its technical support organization -- perhaps an FFRDC -- could facilitate the identification of such opportunities and the development of an appropriate technical approach.

PLAN FOR A PILOT TEST

A pilot test could be divided into four phases: prepare for the pilot test, execute the test, analyze the test results, and refine the method for developing technical architectures for weapon system electronics. Preparing for such a test includes developing support within DoD, developing specific concepts for the test, developing a test plan with the participants, and arranging for test support. To help facilitate the test, the Under Secretary for Acquisition and Technology would approve the test concept and the test plan and review progress.

CONCLUSIONS

Improving interoperability of weapon system electronics requires significant effort to coordinate and integrate the actions required of numerous DoD organizations. Extending the C4I JTA concept to weapon systems electronics appears to offer promise. A pilot test seems warranted. It needs preparation and high level support within OSD.