



Operation Data Storm: Winning the Interoperability War through Data Element Standardization

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Implementing standard data elements is one of the keys toward effective interoperability. Even though the Department of Defense (DoD) has implemented an active data standardization program, barriers continue to impede standard data element use, thus impacting DoD's vision of interoperability and information superiority. This article addresses barriers in implementing data element standards and recommends several actions that can overcome those barriers. The article also proposes an intensively focused initiative, Operation Data Storm, to increase management attention on the importance of data standards and to resuscitate the data element standardization efforts.

The Plight and Recommendation

Sophisticated technology and systems provide today's warfighter with enhanced capabilities designed to perform assigned peace-time and war-time missions. Many, if not all, of these systems rely on software and computer systems to provide and enhance superior performance. Increased interconnections and reliance on data exchanges supporting readiness demand interoperability. Effective interoperability between systems, including weapon, command and control, combat support, messaging, and automated information systems, is an imperative in achieving information superiority [1].

Data element standardization can provide that interoperability. Standard data elements in software intensive systems provide the coordinated means to describe and exchange data, improve communication, minimize the requirement for data translation software and devices, and eliminate redundant data across the battlefield and functional areas. For example, combatants in a joint task force share standardized location and other information to support the overall mission. Sharing of critical location data, made possible through data standardization, enables synchronization of forces. This example shows that interoperability is a key component of readiness and combat effectiveness. We see that data elements define information across a variety of DoD systems supporting readiness. Standard data elements, therefore, have

become as fundamental to readiness as ammunition or fuel [1].

This said, we would think that DoD is well on its way toward implementing standard data elements. True, DoD has been successful in creating standard data elements. For that matter there are 18,000 or more data element standards available for implementation. However, success in implementing those data element standards is less than notable. This is due to both a timid approach in implementing standards, and barriers program and software managers face in using DoD standard data elements. These barriers range from resource availability to commercial-off-the-shelf (COTS) use.

Operation Data Storm is proposed as an initiative that aggressively focuses on implementing data element standards to win the interoperability war and to help deal with the barriers facing program and software managers.

The Resource Barrier

The first barrier impeding data standards use is the availability of adequate resources. Although DoD established an organization to create, manage, and implement standard data¹, most of the resources to date have been focused on policy development and creating data element standards. In other words, the adequacy of resources for policy and creation is sufficient, but the adequacy of resources for implementation is insufficient.

What appears to be missing in this

resource formula is a well-formed data administration structure that supports the implementation of data element standards during software development. There are several reasons for providing direct and independent support to software developers. First, software developers are not necessarily skilled in the acquisition and use of standard data elements. Second, the primary goal of software developers (i.e. writing workable code) often conflicts with the primary goal of data element standardization (i.e. information exchange). To minimize the effects of conflicts, systems data administrators can be added to the resource formula.

The systems data administrator is appointed for a single system or for a family of information systems. In addition, the systems data administrator supports the software developer in the acquisition of data element standards and resolves conflicts that arise in trying to use standards. At the same time, the administrator is accountable to the DoD, functional, and agency data administrators for measuring and reporting usage of data element standards and associated improvements in interoperability.

The Cultural Barrier

The second barrier in implementing data element standards is cultural attitudes that negatively impact decisions to use standard data elements. As an example, software developers may display a "not invented here" syndrome. Because soft-

ware developers traditionally create their own data elements, the idea of using someone else's notion of a data element can be considered intrusive. Additionally, software developers may deem that "it is too hard" to implement standards. The data elements software developers create often are tightly coupled to the application domain, making it easier to code the application. It is not always easy to use DoD standards that are domain independent.

Another attitude that may impact negatively on implementing data standards is the notion of "what is in it for me?" What is in it for program and software managers is their satisfaction in contributing to DoD's quest for achieving their vision of information superiority. But this satisfaction can be elusive in the face of near-term schedule and cost limitations. Program and software managers who face these limitations may consider the implementation of data element standards as one of those costs they can't afford. There are no rewards for missing a schedule or exceeding costs just to implement or propose new standards. Besides, there is likely to be little impact on the manager's future for not implementing standard data elements. After all, there are no strict measures of performance or consistent enforcement for ensuring standard data element use.

Lastly, the notion of institutionalizing a data administration community at the software development level, in an environment of scarce resources and downsizing, guarantees resistance from all levels. Managers may view this as the growth of additional bureaucracy that will add little value and cost additional resources that otherwise could be used more productively in software development.

Although many of these cultural barriers can be mitigated through advanced data administration planning as a part of program planning, additional efforts should be taken to overcome attitudes that impact negatively in using data element standards. These efforts include appropriate education and training, special incentives, and reallocating resources from creating to implementing standards. Resource reallocation minimizes the need for additional funds and personnel.

Providing special personal and organizational incentives provides a means to reward individuals and organizations for their standardization efforts. Such incentives are not without precedent. Government organizations have long established these kinds of rewards (e.g. quality management, value engineering, and acquisition streamlining rewards).

Finally, using the budget systems' approval processes can provide other incentives in overcoming cultural barriers. Additional resources can be provided to program and software managers who demonstrate their use of data element standards. On the other hand, program discontinuance or special external assistance is a reward to program and software managers who do not demonstrate appropriate use of data element standards.

The Migration Barrier

A third barrier in implementing data element standards is the existence of legacy data in current mission critical information systems that are likely to survive for some time. It may be too costly, impractical, or impossible to migrate all legacy data to standards.

In these cases, the engineering change proposal system can be used to ensure consideration and use of data element standards. As part of evaluating a change proposal, the systems data administrator completes a thorough data analysis. This includes identifying all legacy data elements that are directly or indirectly impacted by the proposed change, mapping those elements to candidate data element standards, assessing the impact of migrating to standards, and providing a recommendation. In the event that migration of some or all of the legacy elements is not practical, the systems data administrator maintains a record of the mapping in a prominent part of the systems documentation to accommodate the development of potential needed interfaces.

In the case that replacement systems are in the planning, analysis, or implementation stages, migration to data element standards is potentially easier. The unfortunate fact is that many program or software managers do not adequately accommodate for data element standards

in their migration plans.

The Interface Barrier

A fourth barrier in implementing data element standards is the notion that building interfaces is all that is needed. In some cases, building standard interfaces may be the most expedient way in which to map to data element standards for interoperability. However, there is a significant cost in doing so. This includes not only the cost of maintaining interfaces that grow exponentially with the increase in information interchanges but also the cost associated with increased complexity.

Complexity impacts the ability of software managers to make changes quickly and efficiently, thus driving up costs. In addition, costs of maintaining a growing number of interfaces take away the scarce resources needed to implement new software. In an Air Force Data Strategy Paper [2], an analysis of Air Mobility Command's investment in interfaces revealed that "80 percent of annual software costs are interface maintenance costs, and 20 percent of annual software costs are core system software expenses...." Although building interfaces produces short-term schedule and cost reductions, these savings ultimately are erased during interface maintenance.

The Commercial-Off-the-Shelf (COTS) Software Barrier

A fifth barrier is the policy of the federal government to rely on the use of commercial items (including COTS software) to satisfy information technology needs. In the case of COTS software, this includes the use of vendor-created data elements. Unless it is the norm for a COTS software product, mandating that the product be changed to incorporate DoD data element standards may effect the status of the product as a commercial item and may be cost prohibitive as well. One way to handle the issue of commercially designed data elements in COTS software is through a strategy of interface management. The DoD's Office of the Assistant Secretary of Defense for Health Affairs issued a memorandum [3] that provides some insight into such a strate-

“This contract language applies to Commercial Off-The-Shelf (COTS) software purchased to satisfy Military Health Services System (MHSS) functional requirements. It does not apply to development tools such as PowerBuilder, Visual Basic or auxiliary utilities-oriented packages...Congress defined performance measures to assess progress toward information technology goals in the National Defense Authorization Act for Fiscal Year 1995...Section 381 paragraph 1.3.2 of this Act specifically establishes measures for data standardization to include number and percentage of DoD standard data elements that are used in migration systems. This can be done through the actual use of DoD standard data elements or the mapping of nonstandard data to DoD standard data...”

Figure 1. Part of the DoD's Office of the Assistant Secretary of Defense for Health Affairs memorandum.

gy. Part of the content of that memorandum is provided in Figure 1. More specifically, the language recommended for inclusion in solicitations or contracts (Figure 2) provides further insight on how to deal with commercially designed data elements.

Support for Implementation

Two recent activities in DoD provide increased support for implementing standard data elements and overcoming the barriers previously mentioned. One of those activities is in the policy support area and the other is in the software engineering area.

Policy Support

In April 1998, DoD published a manual [4] on data standardization procedures². Chapter 7 of that manual provides guidance on implementing data standards. This chapter provides detail on translating DoD data standards into data elements that can be used in software implementation. Included are descriptions of registering the use of DoD data standards, transforming the logical data model to a physical schema, refining a database schema, and improving DoD data standards during software development.

Software Engineering

For more than a year, DoD has been engineering data standards into reusable reference data sets that can be used in software applications. This initiative is called Shared Data Engineering SHADE³. SHADE is a strategy that identifies how

to share data resources at the application level. It brings together the disciplines of data administration and database administration to identify data requirements and implement database design in a manner that promotes interoperability. To this end, SHADE engineers have transformed the data specified in the DoD Data Architecture (data model and repository) into database components that can be used in DoD systems.

These database components, which include implemented data standards, are called reference data sets. The data element standards included in reference data sets are primarily the elements that can be

represented by static data values⁴. The use of these reference data sets supports data interoperability in that they provide uniform representations of standard data elements for use in mission critical systems. In addition, these reference data sets are designed for use under the Defense Information Infrastructure (DII) Common Operating Environment (COE)⁵.

There are several hundred reference data sets that can be downloaded from the SHADE Web site and moved into a software application for immediate reuse. This also is an example of software code reuse in that both the data definition language and the table values can be ported directly into most software databases. This eliminates the need to re-enter hundreds of data values, minimizing data input errors.

Operation Data Storm – Last Thoughts

The DoD procedures and SHADE are the tip of the iceberg. Current results appear to be sporadic, at best, and do not deal with most of the implementation barriers. If DoD is to win the interoperability war, more aggressive steps need to be taken to deal with the barriers to implementing standard data elements. In

Figure 2. Specific language to be used in solicitations and contracts.

“Prior to final agreement and purchase, the government requires the vendor to provide a data dictionary, which includes the following information for each functional data element in the software: the logical data element name, its definition that describes the meaning and the context of the data element in the system, the domain of the data element (the allowable values), the data type, length and a unit of measure if applicable. The vendor is required to submit this data dictionary using the MHSS Health Import Tool (HITool) which can be obtained from www.hirs.af.mil/mhss/. In addition, the vendor will be required to provide additional information for clarification of the individual data element meaning and context to assist Health Affairs in reporting the National Defense Authorization Act data standardization metric.

The vendor shall describe in its proposal to the government and be able to demonstrate within ___ days of final award the applications capability and flexibility to import and export applicable standard MHSS data defined in the task order to or from external sources directly or through standardized interfaces, front-end or back-end translators or utilities.”

implementing standard data elements. In addition, a return on investment for implementing data standards needs to be demonstrated and this return can only be confirmed after implementation of standard data elements.

Operation Data Storm is proposed as an initiative that would focus more aggressively on implementation.

Operation Data Storm is a focused and concentrated management initiative. The initiative would require DoD Chief Information Officer support, as well as the support of the DoD Acquisition Executive. The first part of the initiative would cover approximately a six- to-eight month period where selected software intensive systems intensively focus on using data standards. The selected software intensive systems should include a wide variety of systems at various stages in the acquisition lifecycle. Selecting systems at various stages will reveal the different kinds of management issues that arise at each stage. At the end of this first part, an assessment would be made to determine any change in direction.

Resources for this initiative can be reallocated from the resources currently used to create data standards; DoD data administrators could refocus their planning efforts to participate in implementation. Getting their "hands dirty," so to speak, will increase understanding of the barriers and problems program and software managers face in implementing the standards policy makers created. An intensively focused effort can provide lessons learned on overcoming barriers that would benefit both the policy makers and developers, and provide an example for future software developers in using standard data elements.

Lastly, any additional standards that are needed during this implementation effort can be created during software development. This will promote a process of creating standards when they are needed for a just-in-time inventory of standards.

The bottom line is a need for proof — proof that implementing data stan-

dards decreases cost and proof that implementing data standards promotes information superiority. Unless a return on investment and improvements in interoperability can be demonstrated by using standard data, software development efforts will continue to avoid using data element standards. Operation Data Storm can help provide that proof. ♦

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2. U.S. Air Force, Corporate Information Division, "Data Strategy Paper," April 24, 1998.
3. Office of the Assistant Secretary of Defense Health Affairs memorandum, "Data Standardization Contract Language for Commercial-Off-the-Shelf Solutions," December 15, 1997, <http://hirs.brooks.af.mil/mhss/cots.html>
4. DoD 8320.1-M-1, Data Standardization Procedures, April 1998, <http://www-datadmn.itsi.disa.mil>.

Notes

1. The data administration organization consists of a DoD Data Administrator, Functional Data Administrators (at the secretarial level and often the principal staff assistants), and component data administrators (for separate agencies and military services). This is supplemented by a central organization providing services, such as central policy development, maintenance of the data models, and maintenance of data element standards contained in data repositories.
2. Other DoD data administration policies and procedures include: DoD Directive 8320.1, DoD Data Administration and DoD 8320.1-M, Data Administration Procedures.
3. Shared Data Engineering (SHADE). SHADE can be accessed through <http://dii-sw.ncr.disa.mil>.
4. Static data values include such things as country names, state names and abbreviations (codes) (i.e., Virginia, VA, Alabama, AL, etc.), postal zip codes, security classification codes, and the like.
5. Defense Information Infrastructure (DII) Common Operating Environment (COE).