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**Integrated DoD/C4ISR Architectures:
It's not *About* the Framework...**

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ABSTRACT

The release of CJCSI 3170.01C, CJCSM 3170.01, CJCSI 6212.01C, and the related DoD Instruction 5000.2 regarding the Joint Capabilities Integration and Development System (JCIDS) and Operation of the Defense Acquisition System have brought DoD/C4ISR Architectures (“integrated architectures” in the respective documents) “to the forefront” of the acquisition process via mandate. However, when discussing “what constitutes an integrated Architecture,” most often the discussion leads directly to the ***DoD Architecture Framework*** and its related products. While the ***Framework*** plays a large part in providing a common lexicon by which the primitives that compose integrated architectures are described, delving directly into “spreadsheets and boxologies” misses the point of why we’re creating integrated architectures. This paper will clarify the overarching purpose of integrated architectures, provide associated implications associated with the enterprise portfolios into which they fit, and describe a methodology by which the architecture community can improve the process of developing and maintaining architectures in order to meet the intent of the *Clinger-Cohen Act* by providing the means for analysis by which one can achieve efficient distribution of limited resources.

FOREWORD

I fully recognize that in recommending to the architecture community: “architectures need to provide information for use in a enterprise-wide Portfolio Management system...” that I’m “preaching to the choir” (for those needing a primer on Portfolio Management as it relates to systems, people, and things, it’s discussed more thoroughly in the paper). However, I’m proceeding with it because I believe the current vision with respect to the creation of the various architecture repositories within the respective commands, services, and agencies is myopic in that they’re only looking for a “correct, from an engineering perspective” description of their respective enterprises. While this is definitely a step in the right direction, and would potentially save the acquisition community from having to recreate architecture artifacts from scratch (thereby saving the DoD millions of dollars each year), it’s only a small part of the equation regarding what’s called for by the Clinger-Cohen act. In fact, the only thing it realistically allows us to do is “more efficiently create more architectures.”

I am not arguing the fact that there are benefits from being able to more efficiently create and integrate disparate architectures. However, I submit that we need to take a more holistic perspective with regard to creating these repositories; the repositories need to be constructed with the following requirements in mind:

- The repositories need to be created for use across communities and across domains; this “strategic information asset base” (i.e., the enterprise portfolio) needs to be designed for use by all the respective stakeholders in the Doctrine, Materiel, Training, Leadership, Personnel, and Facilities (DOTMLPF) equation, to include the financial aspects related to making decisions.
- Each “enterprise” needs to realize it’s a smaller part of a larger enterprise (and potentially multiple enterprises); therefore, these enterprise portfolios need to be designed such that they can feed higher-echelon portfolios in an automated fashion, with considerations made for appropriately protecting information across the different levels (i.e., just because your program’s system is a subset of an even larger portfolio management system, it doesn’t mean you can see the nitty-gritty funding details of another program).

Historically, intentionally or unintentionally, we’ve stovepiped the architecture, engineering, and acquisition process from the other business-related entities. In doing this, we’ve been far too shortsighted -- we need to get all the respective organizations connected and using the same (or at a minimum, “compatible”) portfolio management tools and schema. It is vital to have the vision correct for accomplishing this “in the large,” as it represents the most difficult case of trying to build an agile overall system by which we defend the country. In accomplishing portfolio management “in the large,” we will be accomplishing what the transformation community is trying to do “in the small” (relatively speaking) with Net-Centricity; to build a system-of-systems that keeps us inside our adversaries’ decision cycles via correct distribution of limited resources more quickly than our adversaries can respond.

EXECUTIVE SUMMARY

The release of CJCSI 3170.01C, CJCSM 3170.01, CJCSI 6212.01C, and the related DoD Instruction 5000.2 regarding the Joint Capabilities Integration and Development System (JCIDS) and Operation of the Defense Acquisition System have brought DoD/C4ISR Architectures (“integrated architectures” in the respective documents) “to the forefront” of the acquisition process via mandate. However, when discussing “what constitutes an integrated Architecture,” most often the discussion leads directly to the **DoD Architecture Framework** and its related products. While the **Framework** plays a large part in providing a common lexicon by which the primitives that compose integrated architectures are described, delving directly into “spreadsheets and boxologies” misses the point of why we’re creating integrated architectures. This paper will clarify the overarching purpose of integrated architectures, provide associated implications associated with the enterprise portfolios into which they fit, and describe a methodology by which the architecture community can improve the process of developing and maintaining architectures in order to meet the intent of the *Clinger-Cohen Act* by providing the means for analysis by which one can achieve efficient distribution of limited resources.

The **Framework** defines Architecture as: “...*The structure of components, their relationships, and the principles & guidelines governing their design & evolution over time...*” While the guidance channels are different, I believe the Federal Chief Information Officer (CIO) Council’s definition to be clearer regarding what architectures are, and their intended use: “... *a strategic information asset base, which defines the mission, the information necessary to perform the mission and the technologies necessary to perform the mission, and the transitional processes for implementing new technologies in response to the changing mission needs...*” It goes on further to state: “...*The primary purpose of an Enterprise Architecture is to **inform, guide, and constrain** the decisions for the enterprise, especially those related to IT investments...*”

As such, I believe the primary purpose of Integrated Architecture is to provide the means by which an organization manages the portfolio of resources within its span of control, to include all aspects of doctrine, organization, materiel, personnel, and facilities (DOTMLPF). This “integrated strategic information asset base” must provide the following:

- Multiple, interrelated Operational Views (OVs), for *each* Concept of Operations (CONOPs) accomplished by the enterprise (i.e., desired CONOPs-based capabilities).
 - These CONOPs should form the basis by which doctrine is recorded and analyzed; therefore, those performing the function of creating and updating doctrine are both stewards and users of this “strategic information asset base”
 - Thus, the portfolio needs to provide information to the tools and language familiar to end users from several different domains
- For each CONOPs, the ability to map *multiple* System-of-Systems (SoS) and Family-of-Systems (FoS) solutions (i.e., Systems Views) to each CONOPs. This includes:
 - Current Systems within the Portfolio
 - Programmed Systems within the Portfolio
 - New/Proposed Systems
- The means by which to perform analysis for:
 - Each individual CONOPs and related Operational Views:
 - Available SoS/FoS Solutions

- Optimal SoS/FoS Solutions
- The aggregate of all CONOPs within the scope of the Enterprise
 - Available SoS/FoS Solutions
 - Optimal SoS/FoS Solutions

The vision of this “integrated strategic asset base” is still in its formative stages. There are bodies of work in the Joint Staff and the services moving us towards this vision, but the processes aren’t being *designed, from the start* to feed information into the overall *Joint/DoD Strategic Information Portfolio*. This is absolutely needed to facilitate JCIDS Functional Needs Analyses as well as Functional Solutions Analyses.

The architecture community is making strides towards this vision, but there are areas where the community can improve:

- ASD/NII and the Air Force have efforts underway to create an architecture repository called the DoD Architecture Repository System (DARS); this is a step in the right direction, but it DARS at this point is only intended to store architecture information, and not tie to other domain’s information (unless specifically included in an architecture product). This being said, DARS will help the acquisition community by allowing program offices to construct the following query: “SELECT * FROM Systems WHERE My_System (or like systems) is the sender or recipient of information.”
 - This information is absolutely key to the creation and enterprise-wide agreement between OV artifacts in Capability Development Documents (CDDs) and Integrated Support Plans (ISPs).
 - Current efforts, especially with regard to ISPs/C4ISPs are “reinventing the wheel” every time one of these requirements documents is created, thus creating semantic mismatches for the same information, and in the endgame, misusing resources
- Most current architectures have one-and-only-one Systems Architecture to answer the requirement outlined in the Operational Views within their Architecture. This is fine for As-Is/Baseline, and individual program office architectures, but doesn’t allow one to do analysis of optimal SoS/FoS mix for To-Be/Objective architectures.
- Most current architectures’ product views don’t agree across product sets (known as concordance). The products within the OVs should be renderings of information within the same data set, and thus, map to one another; SVs should be renderings of the same data set, and maintain traceability to the requirement outlined in the OVs.

Current concepts and technologies (data mining/warehousing, XML, web portal technologies, various decision management and portfolio management tools, application of net centric warfare concepts, etc.) will potentially enable the realization of integrated architecture-driven enterprise portfolios that are truly “strategic information asset bases.” These technologies will enable the analysis of information collected from different communities (C4ISR Architecture, current system portfolios, Modeling and Simulation, Manpower/Personnel, Doctrine & Training, etc.) leading to substantial productivity gains via economies of scale, thereby meeting the intent of the *Clinger-Cohen Act*. The “ricebowl” implications of such a system are enormous, but these must be surmounted to realize this vision. This is not a short-term process; however, a coherent strategy DoD-wide will be needed to make this happen. This paper provides a strawman for achieving this vision.

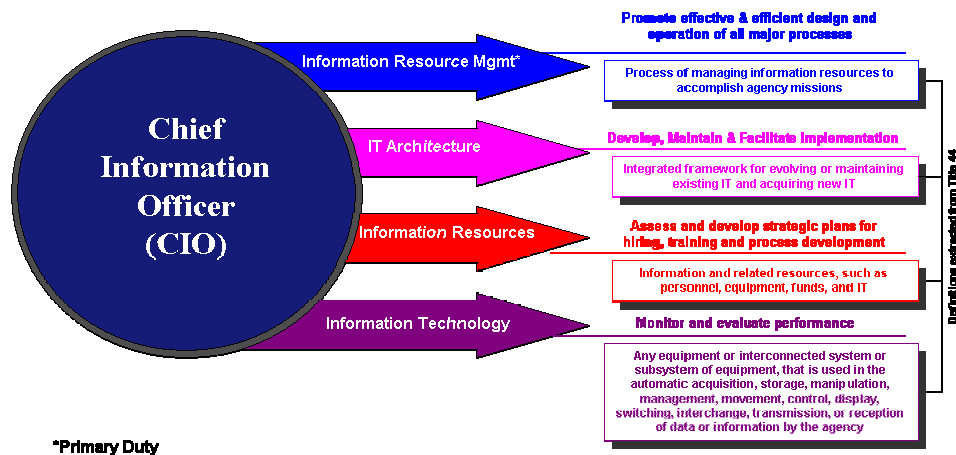
DISCUSSION

Enterprise: an organization (or cross organizational entity) supporting a defined business scope and mission. An enterprise includes interdependent resources (people, organizations, and technology) who must coordinate their functions and share information in support of a common mission (or set of related missions). [A *Practical Guide to Federal Enterprise Architecture*, V 1.0, Federal CIO Council, Feb 01]

The release of CJCSI 3170.01C and CJCSM 3170.01 regarding the Joint Capabilities Integration And Development System (JCIDS), CJCSI 6212.01C Interoperability and Supportability of Information Technology and National Security Systems, as well as the related DoD Instruction 5000.2 regarding Operation of the Defense Acquisition System, have brought DoD/C4ISR Architectures (referred to in the respective documents as “integrated architectures”) “to the forefront” of the acquisition process via mandate. However, when entering into a discussion about “what constitutes an integrated DoD/C4ISR Architecture,” most often the path leads directly to discussions about the *DoD Architecture Framework* and its related products. While the *Framework* plays a large part in providing a common lexicon by which the primitives that compose integrated architectures are described, delving directly into “spreadsheets and boxologies” misses the reason why we’re creating integrated architectures in the first place.

Why are we doing this “Architecture Stuff...?”

Even though there have arguably been “enterprise architecture” efforts for 20 years or more, the genesis of most current architecture efforts is the *Information Technology Reform Act (ITMRA)* of 1996, also known as the *Clinger-Cohen Act*. This legislation required the appointment of a Chief Information Officer (CIO), whose responsibilities included design and implementation an IT Management process for maximizing the value and assessing and managing the risks of IT acquisitions.



Thus, within the U.S. Government, various architecture frameworks have been developed to provide the primitives with which the business enterprise can be captured and explained. Within the DoD, the *C4ISR Architecture Framework*, whose latest incarnation has been renamed the *DoD Architecture Framework* and released as a DoD Instruction, has become the chosen means by which we capture artifacts about our respective organizations within the DoD. However,

information captured by use of the *DoD Architecture Framework* only captures “part of the picture” when it comes to assessing and managing the risks of IT acquisitions. What’s missing? This will be elaborated on in the next sections.

Implications Associated with Enterprise Architectures

The *DoD Architecture Framework* defines Architecture as:

“...The structure of components, their relationships, and the principles & guidelines governing their design & evolution over time...”

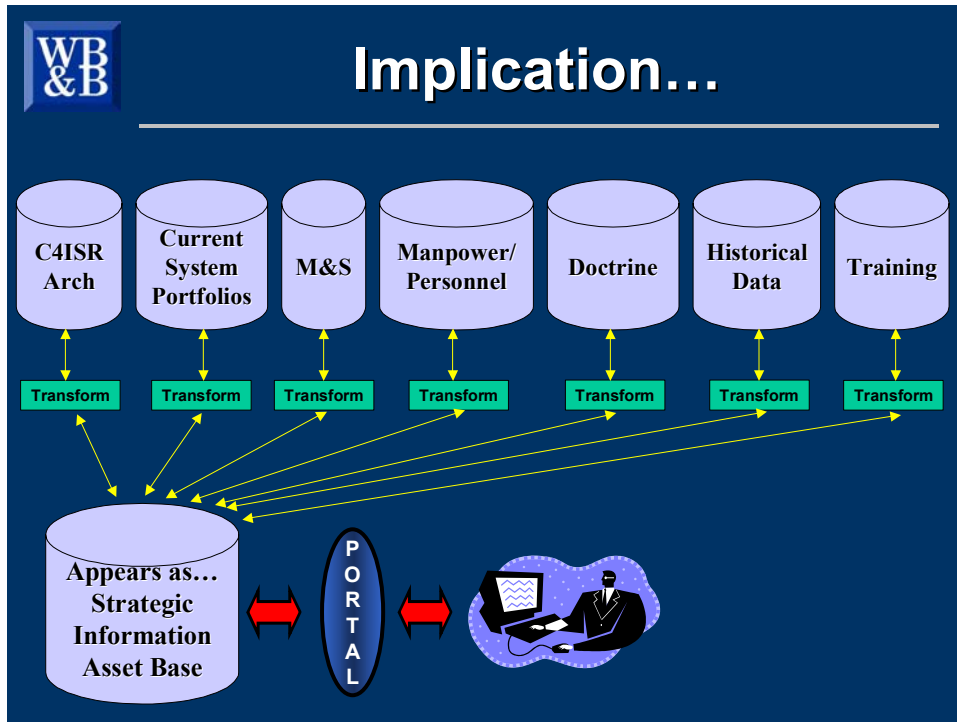
While the guidance channels are different, I believe the Federal Chief Information Officer (CIO) Council’s definitions and philosophy to be clearer with respect to what architectures are, and their intended use. *A Practical Guide to Federal Enterprise Architecture* defines Enterprise Architecture (EA) as:

“... a strategic information asset base, which defines the mission, the information necessary to perform the mission and the technologies necessary to perform the mission, and the transitional processes for implementing new technologies in response to the changing mission needs...”

It goes on further to state:

*“...The primary purpose of an EA is to **inform, guide, and constrain** the decisions for the enterprise, especially those related to IT investments...”*

As such, even though these frameworks were created with the management of IT in mind, I believe the primary purpose of Integrated Architectures is to provide the means by which an organization manages the portfolio of resources within its span of control, to include all aspects of doctrine, organization, materiel, personnel, and facilities (DOTMLPF). The implication of such a statement is that each respective community needs to be able to reach into the “strategic information asset base” (i.e., the Enterprise Portfolio) and get data from the other communities that can be transformed into actionable information from which decisions can be made.



Seems far-fetched, doesn't it? However, several technologies are maturing that can make this integrated architecture-driven strategic information asset base a reality, including several being leveraged for Net-Centric warfare. These include such technologies as data mining/data warehousing, XML, web portal technologies, various decision management and portfolio management tools.

What do you mean when you say portfolio management – that's what we do with stocks, right...?
The concept is very similar; portfolio management, when applied to an enterprise, performs the following functions:


- Tracks the “stuff” in the enterprise: people, materiel, systems, and facilities
- Documents the rules governing their interaction (organization and doctrine)
- Records enterprise evolution over time, including historical information on use of the “stuff” (day-to-day operations, training, exercises, deployments, etc.), current status, and projections for evolution of the individual parts of the enterprise over time:
 - People: manning levels and the respective levels to which they are/have been trained
 - Materiel: when and where consumables have come from, and where they are expected to come from
 - Systems: historical functionality, and expected functionality as new versions are fielded (i.e., fielding schedules across the enterprise)
 - Facilities: historical as well as expected upgrades to facilities
- Tracks financial information related to the “stuff” (historical, current, and projected)
- Provides means to perform “what if” analyses regarding distribution of resources:
 - Diagnostic tools
 - Modeling and Simulation

These technologies can enable the analysis of information collected from different communities (C4ISR Architecture, current system portfolios and their associated readiness data, Modeling and Simulation, Manpower/Personnel, Doctrine & Training, etc.) leading to substantial productivity gains via economies of scale, thereby meeting the intent of the *Clinger-Cohen Act*. The “ricebowl” implications of such a system are enormous, but these must be surmounted to realize this vision. This is not a short-term process; however, a coherent DoD-wide strategy will be needed to make this happen.

A Coherent DoD-wide Strategy - JCIDS

This coherent strategy is the rationale behind the new Joint Capabilities Integration and Development Process (JCIDS). DoD-wide, with the advent of transformation to Net-Centric Warfare, we’re realizing the catch phrase from a computer vendor’s advertisement was, indeed, correct, and “way before its’ time:”

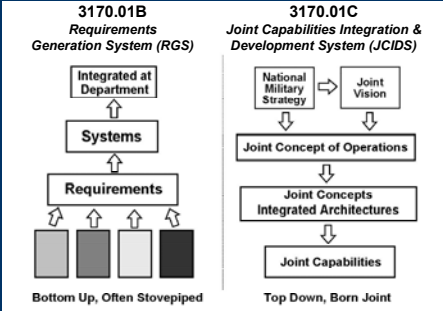
... The Network IS the System...



CJCSI 3170.01C Joint Capabilities Integration and Development Process (JCIDS):

Changes to 3170.01B RGS MNS/ORD Process

- **Transition Period:**
RGS (CRD/MNS/ORD) => JCIDS (Int Arch/ICD/CDD)
- **Why Change:**
 - Historically, RGS process has been good at systems engineering “within the stovepipe”
 - However, RGS has been “not so good” at enterprise-wide requirements management
- **Integrated Architectures:**
 - Provide engineering discipline to design of the Enterprise:
 - Business Processes + Systems + Rules by which systems built...
 - Constraint: that which one has financial control/influence over
 - “Net Centric” transformation enabler: “raises the bar” on what the system is:



The Network IS the System...

(CJCSI 3170.01C, 20 Jan 03 Draft)

However, while the JCIDS process is attempting to drive us to solutions that meet “the big picture,” we’ve still got a long way to go before we reach the vision behind an integrated-architecture-driven “strategic information asset base.” The architecture-supported Enterprise Portfolio Management systems haven’t been coherently implemented; thus we’re in a state of trying to manage our respective portfolios in much the same “system of stovepipes” fashion as we always have, creating yearly drills at each headquarters with a CIO to manually put the information together by which they, and higher echelons make decisions.

So, with the understanding that architectures are supposed to inform, guide, and constrain decisions, what's missing? Asked a different way, what aren't we doing right? In a nutshell, the architectures are not being created for use such that all the various organizations within the enterprise rely on them to formulate their decisions – we've not even begun to scratch the surface for creation of architecture-driven enterprise portfolios that are "strategic information asset bases." We're thinking entirely too small – instead of viewing architecture as providing the structural input to "how the enterprise works" to the "strategic asset base," we've historically thought of it as "someone else's problem."

Historical Perspective: Architectures 1996 - Present

Since the creation and maintenance of DoD/C4ISR Architectures was aligned under the CIO, most organizations thought of architecture as "an IT problem." This being said, in the creation of their respective enterprise architectures, most CIOs were not adequately funded to set up anything approaching the vision of a "strategic information asset base." Knowing this, the community attempted to create a levy on new systems within the acquisition process, mandating that they create architectural artifacts for their respective programs that could be aggregated by the CIO to build the enterprise architecture with successively more current information as time went on. However, this never happened. My opinions on this are derived from having worked both in support of a CIO-related organizations, as well as in support of program offices; my impressions of the respective community views:

- CIO: all acquisition documents have to come through my front door for approval. Therefore, I'm in the best position to ensure that the information provided by the programs fits into the overall "big picture" of what the enterprise is doing. However, as far as integrating all the information in the requirements documents into one cohesive whole, I'm still not funded for that. Additionally, since many of the systems are not under my funding purview, I haven't got the "hammer" to modify aspects of individual programs.
- Acquisition: What's this "architecture stuff?" Hmm... ***C4ISR Architecture Framework...*** OK – I can create something that looks like that. Most of this our prime contractor has, but they'll want us to pay for it if we ask them to do it, and that could affect our schedule; we'll get together our in-house graybeards and lock them in a room, and they'll be able to knock it out in a couple of weeks. What do you mean contact the CIO? What does the CIO have to do with this? This is the requirement for my contractor? We've already got them under contract using... (pick any applicable requirements document) ... as the requirement; they're already building the system to those specifications, and anything else that comes out of architecture would cause us to have to modify the contract, which we're not inclined to do because that would cause a new contract to have to be created, with the associated schedule adjustments, increased costs in getting the contract approved, etc.

This process put the architectures at the wrong end of the acquisition chain; the architectures didn't drive the requirements to create the respective systems – they ended up being the product of the system being built (and often, an afterthought, after the system had already been built). As such, there was no integrated methodology by which program offices were told: "build down

from here;” i.e., they weren’t given the operational requirement (obtained by a structured engineering driven gap analysis) to elaborate upon using engineering techniques, and build the system to match those specifications.

With no overarching process by which the individual program offices built their respective architectures, in the endgame, aggregation of the information provided in the program offices’ architectures proved impossible. Even if the respective CIOs tried to incorporate the architectural information into some sort of centralized repository, the “Acquisition graybeards” made it difficult, especially regarding information exchanges (which were most times aggregated to such a level as to be meaningless to any systems engineer trying to decipher them), operational nomenclature (think of how fast names of organizations change, and you’ll get the picture), and systems nomenclature. That’s not to say that the products that came out of the program offices were “wrong” – their creators just weren’t aware of the larger scale into which they fit, and that other resources should have been available to them such that they didn’t have to create the information relating to “every icon on the page” from scratch. Therefore, what was created was a series of “PowerPoint engineering” renderings of systems, whose information exchanges didn’t match up semantically or otherwise with the documentation relating to the systems to which they were connecting, nor to the doctrine within which these systems were supposed to operate.

Therefore, without an overarching structure into which the individual program offices’ architectures were to fit, the acquisition document approval process never included a step that utilized an enterprise portfolio to perform the following checks and balances:

- Ensure agreement regarding information exchanges (semantic, timeliness, and amount of information exchanged) across the spectrum of all programs to which the system is connected
- Ensure the schedule regarding releases, block cycles, and versions being released, matches up with the dependencies of other systems to which the system is connected

Most of this work, if done at all, was personality-driven (i.e., if the person reading the document knew other programs being affected by the system whose documentation they were reading, maybe they could catch an error; if not, the rigor of the check was along the lines of the following: ... lets see... they’re supposed to have an OV-1, and OV-3, and an SV-1... let me get my copy of the *C4ISR Architecture Framework* out... yep, these look like them... they look OK regarding agreement within the document, so they must be OK... next!).

Several initiatives in the architecture community (DoD Architecture Repository System [DARS], Army Architecture Repository Management System [AARMS], Department of the Navy Integrated Architecture Database [DIAD], among others) have sought to remedy parts of this equation, but in trying to solve the smaller problem of having a reference database for “architecture stuff” that provides vetted, reusable primitives, we’ve had trouble achieving these small steps towards the larger vision of an “integrated strategic asset base” due to the following:

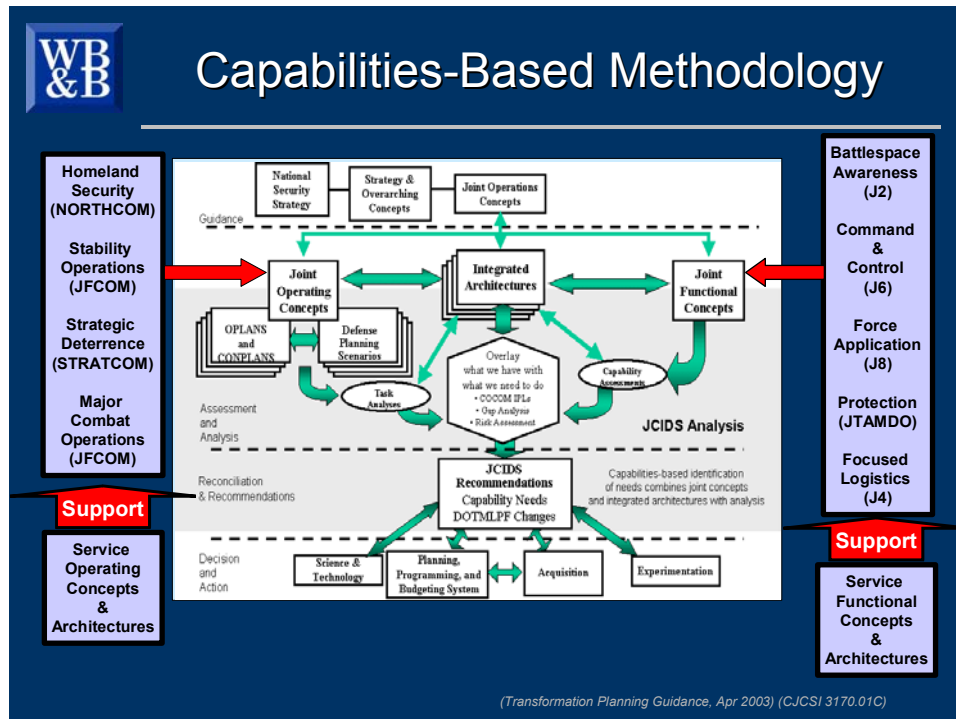
- The architecture databases haven’t reached the level of maturity by which the acquisition community can get the answer to the following query: “SELECT * FROM Systems WHERE My_System (or like systems) is the sender or recipient of information.”

- This information is absolutely key to the creation and enterprise-wide agreement between OV artifacts in Capability Development Documents (CDDs) and Integrated Support Plans (ISPs – the follow-on to C4ISPs)
- Current efforts, especially with regard to ISPs/C4ISPs are “reinventing the wheel” every time one of these requirements documents is created, thus creating semantic mismatches for the same information, and in the endgame, misusing resources
- Most current architectures have one-and-only-one Systems Architecture to answer the requirement outlined in the Operational views within their architecture. This is fine for As-Is/Baseline architectures, but doesn’t allow one to do analysis of optimal SoS/FoS mix for To-Be/Objective architectures. These analyses should be done prior to new program office inception, and should be handed to the program office as the “up front” requirement by which the new system is to be created.
- Many current architectures’ product views don’t agree across product sets (known as concordance). The products within the OVs should be renderings of information within the same data set, and thus, map to one another; SVs should be renderings of the same data set, and maintain traceability to the requirement outlined in the OVs. Since the guidance for creating the architectures wasn’t clear on this point, in most cases, the architecture products were created separately by different teams with no interaction. The lack of understanding of this key point led to the vast majority of architectures created to become “shelfware,” rather than creating information that can be subsequently leveraged by other activities (program offices, doctrine creators, financial management, etc.) within the enterprise.

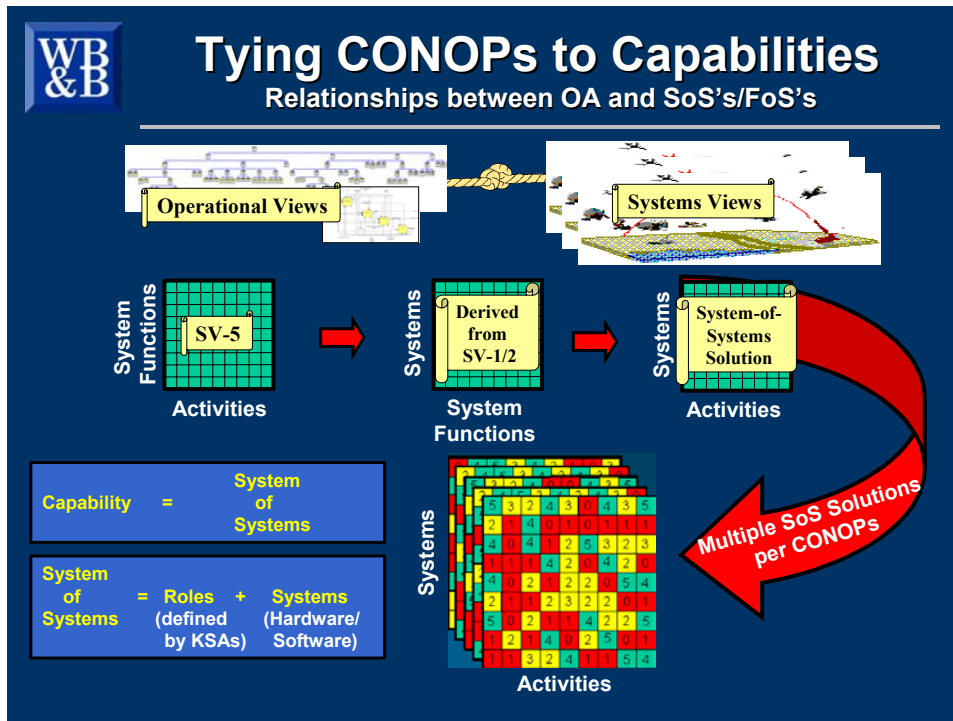
Since the CIO and the program offices weren’t on same page regarding an overarching process by which architectures were being created, any thought of having this architecture-driven “strategic information asset base” from which we could pull information enterprise-wide to manage the enterprise portfolio has simply been beyond our grasp. Thus, the vision of having the organizations responsible for provision of Doctrine, Organization, Training, Materiel, Personnel, and Facilities, to include the financial aspects of all, using the same set of core information has never come to fruition.

So... What Does this “Strategic Information Asset Base” Need to Do?

In order to provide the means by which analyses of alternatives can be conducted for the JCIDS process (at the command, service, agency, or the JROC level), the integrated architecture-driven “strategic information asset base” must provide the means by which the following are documented:



- Doctrine:** The enterprise is defined by the mission areas for which it is responsible. Within the JCIDS process, these mission areas are described via Concepts of Operations (CONOPs). The CONOPs, in turn, are described by multiple, interrelated sets of Operational Views (OVs), for *each* Concept of Operations (CONOPs) to be accomplished by the enterprise. These CONOPs should form the basis by which doctrine is recorded and analyzed; therefore, those performing the function of creating and updating doctrine are both stewards and users of this “strategic information asset base.”



- FoS/SoS's Matching the Respective CONOPs: For each CONOPs, the ability to map *multiple* System-of-Systems (SoS) and Family-of-Systems (FoS) solutions (i.e., Systems Views) to each CONOPs. These include:
 - Current Systems within the Portfolio
 - Programmed Systems within the Portfolio
 - New/Proposed Systems

Capabilities

		Capability 1			Capability 2			Capability 3				
		Operational Activity A	Operational Activity B	Operational Activity C	Operational Activity D	Operational Activity E	Operational Activity F	Operational Activity A	Operational Activity E	Operational Activity G	Operational Activity H	
Systems	System 1	System Function A	●		●				●		●	
		System Function B					●		●			
		System Function C		●								●
	System 2	System Function B				●						
		System Function D						●			●	
		System Function E				●						
		System Function F										●
	System 3	System Function G			●							
		System Function H		●				●				
System Function I				●								

Capability to Systems/Programs Traceability Matrix
(SV-5 derivative)

Of note in making this match FoS/SoS match to CONOPs, the *DoD Architecture Framework* provides a new product, which attempts to frame this analysis. The **Capability to Systems/Programs Traceability** matrix product attempts to do this by creating mappings between an operational activities and system functions, described by a stoplight colored circle to indicate the status of the system support. Red indicates functionality planned but not developed. Yellow indicates either partial or full functionality provided, but the system has not been fielded. Green indicates full functionality provided and system fielded. A blank cell indicates that there is no system support planned for an operational activity, or that a relationship does not exist between the operational activity and the system function. While this answers the “first order” question of “is there a system being developed that answers the requirements of the capability,” it does not answer the question of “how effective” the FoS/SoS is in accomplishing this capability. Thus, this only provides the “first step” towards the analysis that the decision-maker will need to make acquisition decisions.

WB & B Analysis

Scenario #1 Scenario #2 Scenario #3... Scenario #n

SoS Measures of Merit (Relative...)

System of System (SoS) #1
SoS #2
SoS #3

Decision Analysis/ Portfolio Management
Operations Analysis

Analysis

Chosen SoS Solutions

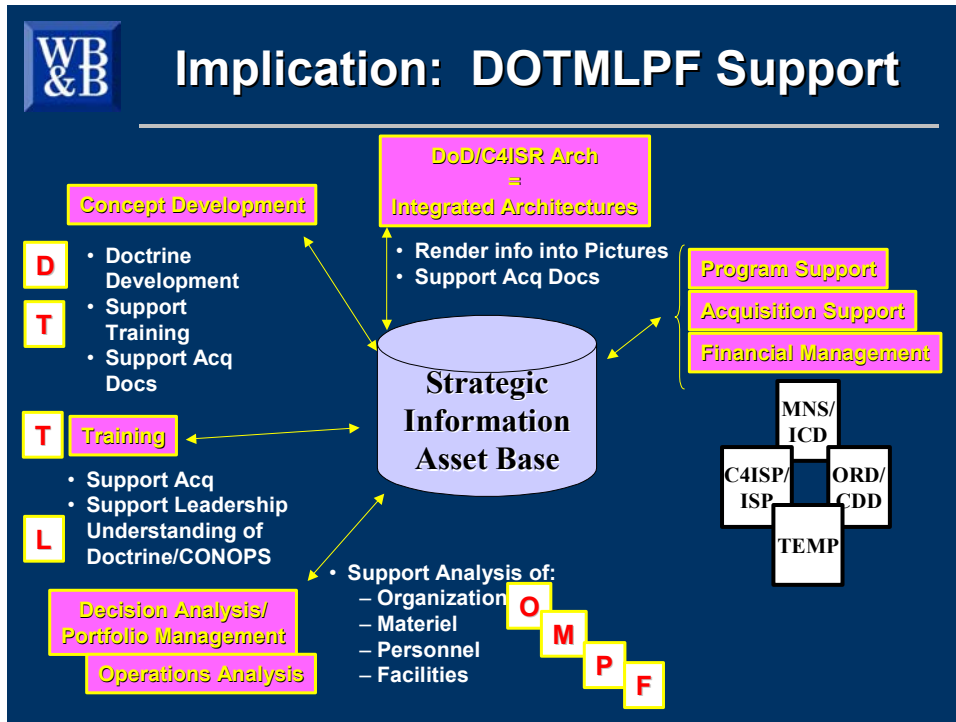
Acquisition

MNS/ICD
C4ISP/ISP
ORD/CDD
TEMP

- Analyze SoS's across ALL applicable scenarios within the Enterprise
- Enterprise Examples:
 - ✓ Navy: Mission Capability Packages
 - ✓ AF: AF CONOPs (Global Strike, Global Response, etc.)
 - ✓ Joint: Joint Operational Concepts/ Joint Functional Concepts
- Potential Analysis Threads:
 - ✓ Systems coverage across scope of Activities
 - ✓ Min acceptable solutions

- Analyze Capabilities: the means by which to perform analysis for:
 - Each individual CONOPs/related Operational Views
 - Available SoS/FoS Solutions
 - Optimal SoS/FoS Solutions
 - The aggregate of all CONOPs within the scope of the Enterprise
 - Available SoS/FoS Solutions
 - Optimal SoS/FoS Solutions

The key point here is that in order to perform a viable analysis of the different SoS/FoS solutions across all CONOPs for which an enterprise is responsible, the asset base must not only contain “architecture data,” but information that can be of use to such communities as modeling and simulation, doctrine development, training and leadership development, acquisition support, financial support, scheduling information (including dependencies between individual systems/programs), and analytical tools providing decision-makers the information by which the enterprise portfolio can be managed.



Examples of these analyses run across the “total cost of ownership” DOTMLPF equation:

- Doctrine, Training, Leadership: need to use this strategic information to provide the documentation, simulations, etc. with which the Warfighter is trained
- Organization, Materiel, Personnel, Facilities: need to use the strategic information to answer key questions about their respective areas such as “how,” “who,” “where,” “how much (training required, materiel required),” “how many (facilities required, personnel required),” etc.
- Acquisition: the acquisition community needs to be able to perform the following query: “SELECT * FROM Systems WHERE My_System (or like systems) is the sender or recipient of information.”
 - This information is absolutely key to the creation and enterprise-wide agreement between OV artifacts in Capability Development Documents (CDDs) and Integrated Support Plans (ISPs – with the release of CJCSI 6212.01C, these replace C4ISPs in the acquisition process)
 - Current efforts, especially with regard to C4ISPs/ISPs are “reinventing the wheel” every time one of these requirements documents is created, thus creating semantic mismatches for the same information, and in the endgame, misusing resources
 - Net-Ready Key Performance Parameters (NR KPP’s) won’t answer this question either; even if we get to the point of “everything runs via publish and subscribe,” you need to be able to document what information your system requires, what information it provides, what services it requires, what services it provides, etc. Without the ability to ask the “What’s out there already?” question, we’re back to the “endless architecture do loop” of creating the information in each program office from scratch.

- Schedule analysis: the ability to determine the interrelationships of individual systems (to include the subsystems included in each system, block, or version upgrade) is key to overall management of the enterprise.

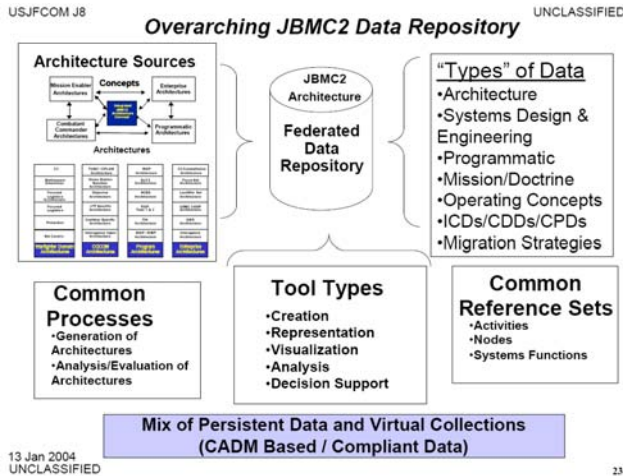
And... due to new technologies being able to provide for many disparate systems to be interconnected and provide each other information, it doesn't necessarily have to be centrally located. The "devil in the details" are in the transforms of information; how much information are other communities allowed to see? Who has access? These are important issues, but all surmountable.

Several initiatives are underway in each of the services to move us along towards this vision. Among these are the Air Force's Capabilities Review and Risk Assessment (CRRA) process, the Army's LandWarNet (formerly Army Knowledge Management), Navy Mission Capability Packages/FORCEnet/GEMINII Assessment Process and Toolset, as well as the Joint Staff's JCIDS Analysis process by which Functional Solutions Analyses (FSA), and Post Independent Analyses are conducted. Each of these presents logical constructs for achieving architecture-based analyses, but each of these, due to the architectures not having complete financial, scheduling, etc. information, requires lots of manual processes to put together. Additionally, the following statement from the *DoD Architecture Framework Deskbook (V1.0)* regarding "Techniques for Using Architectures" is very telling:

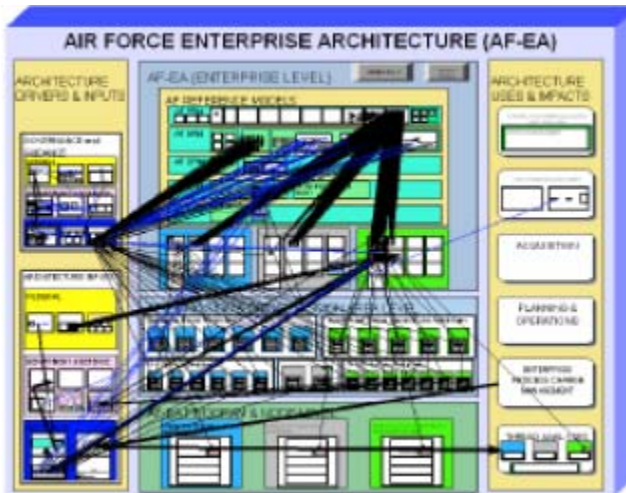
...These analytic techniques have been developed within different segments of the DoD community and do not reflect coordinated community positions ...

In the endgame, how is the JCIDS process supposed to manage the DoD enterprise if the respective processes aren't *designed, from the start* to feed information into the overall *Joint/DoD* "strategic information asset base" portfolio?

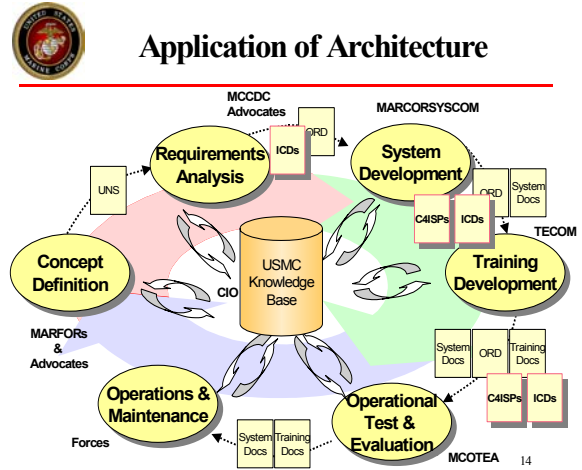
RECOMMENDATIONS



USJFCOM

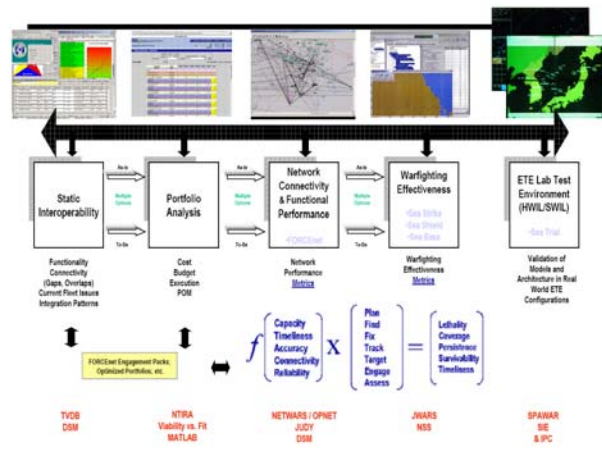


USAF



USMC (MCCDC)

GEMINII Assessment Process and Toolset



USN (SPAWAR)

The examples above document selected services' and Joint Forces Command's (JFCOM) efforts with respect to achieving this vision. However, during a recent architecture symposium, one of the most telling slides came from the Army (TRADOC), who had overlaid the Joint Forces Command slide above with the statement "Where is the Virtual Overarching Data Repository?"

Therefore, I believe to achieve the vision of a "Virtual Overarching Data Repository" (i.e., the "strategic information asset base" – the Enterprise Portfolio), we need a comprehensive, well-thought-out solution to bringing the enterprise information together. Current systems and methodologies are only scratching the surface of being able to accomplish this vision. While they are beginning to solve problems within their respective realms, they don't appear to be moving towards the vision of a "strategic information asset base" enabling portfolio management all the way up to the Joint/DoD level. It is absolutely imperative that we delineate and move with haste towards this vision in order to make best use of our limited resources.

Some suggested requirements:

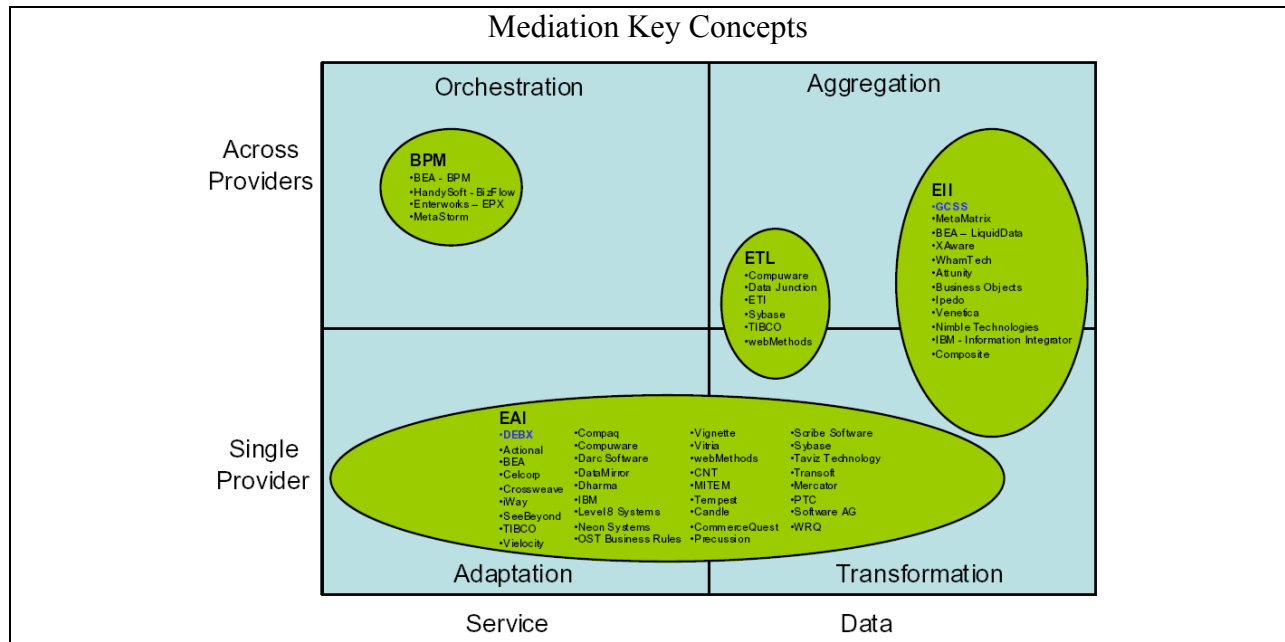
- Web-based Access to Disparate Data Sources: across the services, the organizations responsible for the creation of doctrine, the acquisition of systems and materiel to match that doctrine, human resources to man the systems, leadership and organizations who implement the doctrine, training of personnel, and the facilities at which all these functions reside are geographically scattered. Therefore, point solutions are not a player; I believe this can access can be achieved using web-based enterprise knowledge portal technologies that leverage mediation services (elaborated upon below).
- Portfolio Analysis and Management Tools: including the ability to track and analyze schedule, finances, dependencies, efficacy, are needed at each level of abstraction to include program offices, major commands, warfighting commands, services, agencies, and the joint level. Additionally, information within this portfolio will potentially be tied to “multiple masters.” Some examples of the “multiple masters” relationship:
 - Air Force Special Operations Command (AFSOC) is an Air Force major command, but is also a component of and force provider for US Special Operations Command (SOCOM); the same relationship holds true for Air Mobility Command (AMC) in regards to US Transportation Command (TRANSCOM). Similar relationships exist between components of other services and these commands.
 - Multi-service and multi-national programs will derive funding from multiple sources. Each funding source will want access to program information.
- Profile-based Access Control: profile-based access will be needed to keep access to information at a level commensurate with the function of the person or organizational function accessing the information.

A **portal** is site featuring a suite of commonly used services, serving as a starting point and frequent gateway to the Web (Web portal) or a niche topic (vertical portal). Civilian web portal services (Yahoo, MSN, etc.) often include a search engine or directory, news, email, stock quotes, maps, forums, chat, shopping, and options for customization. An **Enterprise Knowledge Portal** is an enhanced Portal that:

- Is goal-directed toward knowledge production, knowledge integration, and knowledge management
- Focuses upon, provides, produces and manages information about the validity of the information it supplies
- Provides information about your business and meta-information about the degree to which you can rely on that information
- Distinguishes knowledge from mere information
- Provides a facility for producing knowledge from information
- Orients one toward producing and integrating knowledge rather than information

Mediation Services: in a large enterprise of autonomous systems, the definition of a single set of data standards that are suitable for everyone is nearly impossible. Individual systems were built using differing standards, data models, and technologies that best address their individual requirements. To participate in the greater enterprise, there must be a way to bridge the

incompatibilities between these individual IT environments. Mediation services provide the means for translation of data between different systems and services. Efforts associated with the Global Information Grid (GIG) Net-Centric Enterprise Services Core Enterprise Services (NCES CES) program can be leveraged in this regard. The following graphic from the Association for Enterprise Integration (AFEI) NCES Workshop's Mediation and Discovery Working Group diagrams the solution space, as well as potential vendors and/or systems in the solution space:



Further information regarding the diagram above:

- Axes of Mediation:
 - Data Mediation - integrating dissimilar information
 - Service Mediation - integrating dissimilar services (i.e., integration of web-based services available for use network wide into a new, larger information service)
 - Across Providers - mediation involving many sources/actors
 - Single Provider - mediation involving a single provider/consumer pair
- Types of Mediation:
 - Adaptation: Used when an invoking application cannot communicate directly with an outside service. Adaptors provide service mediation when systems need to communicate point to point.
 - Orchestration: When a service request triggers a whole chain of events, orchestration services assemble and manage the integrated services (workflow).
 - Transformation: When an application requests information that is not available in the fashion that the requestor desires, transformation services convert the information into the desired format.
 - Aggregation: Provides a central point of interaction when requesting information. There are usually multiple information sources points being integrated into the single point of interaction.

Mediation Services will provide the information required to be gathered and transformed in order for a Portfolio Management suite to be used (in the above diagram, the Mediation services provided are Data Mediation – Transformation and/or Data Mediation - Aggregation). This of course, assumes the Portfolio Management suite doesn't already come with some degree of Mediation Services already bundled with it (the possibility of which is indicated in the diagram above by the ability to orchestrate processes requiring information that is transformed between different sources available to the web portal).

Regarding Portfolio Management software, the top vendors within this sector include ProSight, Niku, Kintana, Business Engine, Pacific Edge, and Primavera. Of these, only Pacific Edge, Business Engine, and ProSight were evaluated by the META Group in a recent market study. From this study, ProSight appeared to be the best across-the-board choice; ProSight has worked with the Veteran's Administration, Hershey, as well as many other large corporations, and has a product for use with the Federal Enterprise Architecture Framework in beta. Regardless of the vendor picked to implement the portfolio management, it needs to incorporate the aforementioned features in order to work across all echelons, and across all services of the DoD.

The obvious question regarding the marriage of a Portfolio Management system with some degree of Mediation Services, to include access controls on specific information, is "where do we start?" I recommend a pilot program be started at JFCOM, SOCOM, or TRANSCOM in order to provide the multi-service view with multi-service ownership of assets and programs across multiple bases. Upon proof of concept of the pilot program, it should be migrated DoD-wide. Efforts including GIG NCES CES should be leveraged as much as possible for this effort, as there is significant overlap in the basic functionality to be accomplished, not only regarding Mediation Services, but regarding dynamic management of enterprise assets to complete the mission and tasks at hand.

Implementation of this, of course, happens after we get through the litany "it will be too expensive to implement" excuses. To this, I submit this reply: we can't afford not to. We've been "doing architectures" since 1996, and other than anecdotal evidence of their "benefit to society," there is little quantifiable evidence of their utility beyond the "a-ha" discoveries made during their creation (which, though often very valuable, are not usually quantifiable). Only through the realization of the "strategic information asset base" can we eventually get to the point where we can definitively show the true cost benefit associated with their accomplishment.

CONCLUSION

In the endgame, Integrated Architectures are not about the DoD/C4ISR Framework, engineering notations/boxologies, or "creating pictures and spreadsheets." Integrated Architectures are about "raising the bar" on defining what the *system* is: the business processes, systems that implement them, and the rules by which the processes and systems are implemented. "*The network is the system...*" Truly integrated enterprise architectures should be the basis around which a "strategic information asset base" is built, and should allow:

- The *multiple* CONOPs the enterprise is expected to encounter to be defined and recorded, supporting the doctrine, organization, and training processes (DOT of DOTMLPF)
- The *multiple* SoS/FoS solutions to meet the requirements of CONOPs to be defined and recorded, supporting the securing of systems, personnel, and facilities (MPF of DOTMLPF)
- The use of portfolio management techniques to assist leadership in the analysis and allocation of the best mix of systems within the constraints of budget and schedule (L of DOTMLPF)

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By achieving the vision of an architecture-driven "strategic information asset base," and the standardization of portfolio management tools and techniques DoD-wide, we will achieve savings through economies of scale as well as gaining efficiency. We will accomplish "in the large" what the transformation community is trying to do "in the small" with Net-Centricity; to build a system-of-systems that keeps us inside the adversaries' decision cycles via correct distribution of limited resources more quickly than our adversaries can respond. Can we afford to do this? In my opinion, with the defense of our great nation at stake, we can't afford not to.

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