

# **The Army Operational Architecture Program**

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## **Abstract**

The Army Operational Architecture (AOA) Program provides the framework and integrates the operational architecture development efforts within the Army. OA is an integral part of the Army Enterprise Architecture (AEA) and is one of three architecture views, the others are System and Technical architecture. TPIO-ABCS is the Executive Agent for the Army's entire Operational Architecture (OA) and is responsible for the development, management, and oversight of all OA products. An extensive OA Configuration Management system has been established to ensure all protocols, standards, validation and approved procedures are in compliance. The Army OA Program is a function and responsibility of DCSOPS, DA and is an integral part of the Army Enterprise Architecture (AEA). This document is designed to enlighten the overall architecture community on the current status of the Army OA program. The AOA is a disciplined approach to the Requirements Determination Process and provides synergy and coordination enablers for the Combat Developments arena that meet the Warfighter requirements. Operational Architecture is the catalyst to re-engineering the Army. OA is a disciplined and systematic process used to identify and generate requirements for Doctrine, Training, Leader Development, Organization, Materiel, and Soldier Support (DTLOMS) domain incorporation. OA, as a combat development function, represents a dramatic change in thinking about requirement determination and generation. Given the unprecedented complexity of the digitized battlefield and the current austere resource environment, forming vague battle command information requirements in generic detail will not do. OA is the combat development process capable of accurately identifying force information requirements in sufficient enough detail to properly illuminate the investment decisions that must be made to move the Army forward. OA is focused on Warfighter functions, information requirements, and performance parameters necessary to accomplish the mission.

# Report Documentation Page

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## **EXECUTIVE SUMMARY**

### **INTRODUCTION.**

The Army Operational Architecture (AOA) program provides the framework and integration for the operational architecture development efforts within the Army. This document provides an outline for the direction development, management, and use of the Army's operational architecture. The AOA Program prescribes how to meet the directives of the Army Enterprise Architecture (AEA) Master Plan and AEA Guidance Document (Draft). The Army Science Board (ASB) introduced the architecting approach to information system development and acquisition to the Army in the Fall of 1994. Director of Information Systems for Command, Control, Communication, and Computers (DISC4) and the Army Digitization Office are implementing it at the Department of the Army level. The architecting approach recommended by the ASB included development of three types of architectures – Operational, Systems and Technical.

The AOA Program fulfills the *Clinger-Cohen Act* requirement to develop an enterprise-wide IT architecture.

### **Purpose.**

The principal purpose of the AOA Program is to prescribe the processes for developing, managing, and using the Army's operational architecture—the AOA. The AOA Program provides an Army-wide planning directive that establishes the AOA vision, goals, objectives and strategy. TPIO-ABCS implements processes that synchronizes and integrates OA products. OA is the cornerstone for system development and DTLOMS improvements. It is the Warfighters' responsibility to clearly define functional and informational requirements, and performance parameters needed to support the battlefield mission. The AOA provides a structured process that promotes product reuse and synchronization, and promotes interoperability.

This document supports the development of operational architectures to support the warfighters' operational requirements. It also prescribes a performance-based process for evaluating the AOA. The AOA Program promotes a coordinated approach to developing the AOA and a synchronized approach to AOA planning. It also outlines what comprises an operational architecture, the products involved, and the procedures for configuration management.

### **Scope.**

The scope of the AOA Program focuses on the agencies involved with the AOA and the procedures to follow in developing an OA. The scope includes:

- All AOA development activities
- The management and use of the AOA
- The development of operational architectures and configurations control measures
- The operational architecture validation process and requirements

## **STRATEGY.**

The AOA Program strategy provides the context for the development, management, and use of the AOA and relates the AOA to the Warfighters' information technology (IT) requirements. It describes a process that begins with strategic planning and includes program planning, execution, and performance measurement.

## **ORGANIZATION.**

The AOA Program identifies the Army organizations that play roles in the development, management, and use of the AOA, and specifies responsibilities among those organizations. In addition, the AOA Program describes the strategy for building the AOA, using a requirements-based approach. The strategy establishes the initial priorities for AOA development and provides guidance concerning the establishment and use of performance measures.

The AOA Program supports the development of operational architectures for the Warfighters' operational requirements. It also prescribes an objective-based process for allocating AOA development resources and a performance-based process for evaluating the AOA. The AOA Program promotes a coordinated approach to developing the AOA and a synchronized approach to AOA planning.

We are engaged in building an Army for the 21st Century—an Army that can dominate the land battles in joint and combined operations, across the spectrum of conflict, by gaining, controlling, and exploiting information. Force XXI and the Army After Next show an Army evolving to and beyond the dominant, information-age land force described in *Joint Vision 2010* and *Army Vision 2010*. One of our challenges is to build the 21st Century Army by applying limited resources—people, time, and money—effectively and efficiently.

The ability to transmit, receive, display, process, manage, and use accurate and timely battlefield information, in the context of shared situational awareness, is the key building block of the information-age Army. Efforts to build the information-age Army, therefore, must focus on developing and fielding forces that possess the capabilities to gain and exploit information dominance.

The 1993 *Army Enterprise Strategy* directed the development of operational, systems, and technical architectures to describe Warfighters' information requirements and Army C4I systems that support the Warfighter. Separate efforts to develop and produce each of these architectures are well underway. Since the publication of the *Army Enterprise Strategy*, the Chairman of the Joint Chiefs of Staff published *Joint Vision 2010*, the Chief of Staff of the Army (CSA) published *Army Vision 2010*, both directing that the AEA process be followed. Congress passed the *Clinger-Cohen Act of 1996*, mandating the architecture (OA, SA, and TA) is developed to meet future IT requirements and digitization.

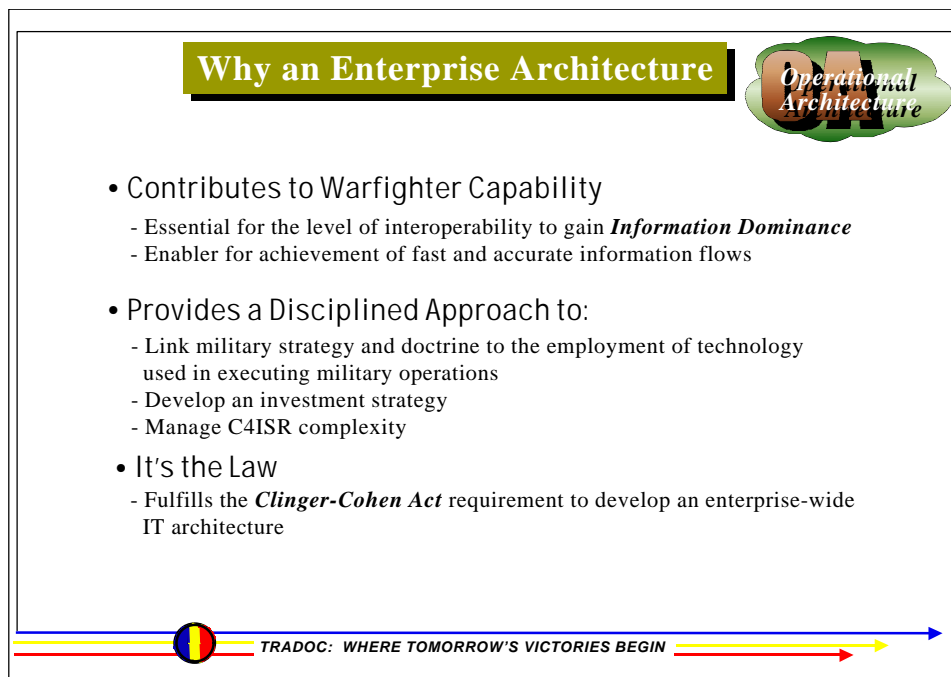
## **The Army Enterprise and the Army Enterprise Architecture.**

The Army Enterprise is the entire Army, including all major commands, headquarters, agencies, installations, and Army forces. The Army Enterprise represents the Army as a corporate entity and prescribes a new way of accomplishing the Army's missions by taking full advantage of IT,

using innovative business practices, and synchronizing Army IT resource management activities toward common goals.

The Army Enterprise Architecture (AEA) fulfills the *Clinger-Cohen Act* requirement to develop an enterprise-wide IT architecture across the command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) spectrum. The AEA is an Army-wide IT architecture that describes the relationships among key Army institutional processes and IT to ensure: 1) the alignment of the requirements for information systems with the processes that support the Army's missions; 2) adequate Army, joint, and combined interoperability; and 3) the application and maintenance of a set of standards (including technical standards) by which the Army evaluates and acquires new systems.

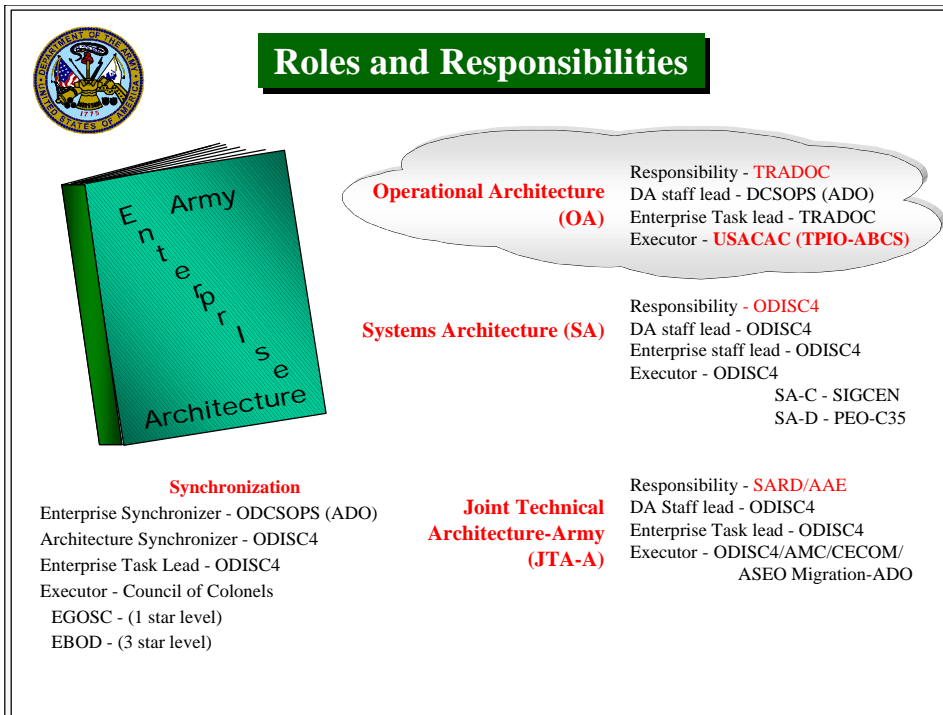
Some key points of interest on why there is an AEA are depicted in Figure 1.



**Figure 1. Why an Enterprise Architecture**

The AEA takes a system of systems approach to transforming the Army's operational patterns into warfighting "capability packages." This approach takes full advantage of and promotes horizontal information technology insertion and cuts across "functional stovepipes" and Service boundaries.

The AEA is comprised of the AOA, the Army Systems Architecture (ASA), and the Joint Technical Architecture-Army (JTA-A). The AEA roles and relationships for OA, SA, and TA, and the agency responsibilities are depicted in Figure 2.



**Figure 2. AEA Roles and Relationships**

**Army Operational Architecture.**

The AOA provides a disciplined and systematic process to identify the warfighters' functions, information requirements, and performance parameters. AOA is a valuable source for DTLOMS assessments. OA precisely identifies the functions performed within command systems, associated data elements, and their flows. This process provides the information requirements and means required to assess trade-offs and value added by various possible changes in existing or planned systems. OA provides the functional requirement that enables the system architect to build the appropriate battle command system. OA provides systems and technical architects with the specific information they need to optimize their functions. OA facilitates intelligent information system decision-making at the very earliest stages of requirement determination; as such, it is producing a revolution in the way battle command system combat developments are accomplished.

**Army Systems Architecture (ASA).**

A description, including graphics, of the systems and interconnections providing for or supporting a warfighting function. ASA defines the physical connection, location, and identification of key nodes, circuits, networks, warfighting platforms, etc., and allocates system and component performance parameters. System architecture is constructed to satisfy an OA per standards defined in the governing technical architecture. The OA is a critical element for the SA developments, as the OA provides the SA with the warfighter functions, information requirements, and performance measures. ASA shows how multiple systems within a domain or operational scenario link and interoperate, and may describe the internal construction or operations of particular SA systems. The Office of the Director for Information Systems

Command, Control, Communications, and Computers (ODISC4) is the executive agent responsible for ASA.

### **Joint Technical Architecture-Army (JTA-A).**

The minimal set of rules governing the arrangement, interaction, and interdependence of the parts or elements of a system to ensure that a system satisfies a specified set of requirements. JTA-A identifies services, interfaces, standards, and their relationships. It provides the technical guidelines for implementation of systems upon which engineering specifications are based, common building blocks are built, and product lines are developed. JTA-A provides the parameters for the ASA in its development of the SA. DISC4 is the executive agent responsible for JTA-A.

Figure 3 depicts Operational Architecture and gives a definition of the three architectural views within the Army Enterprise Architecture.

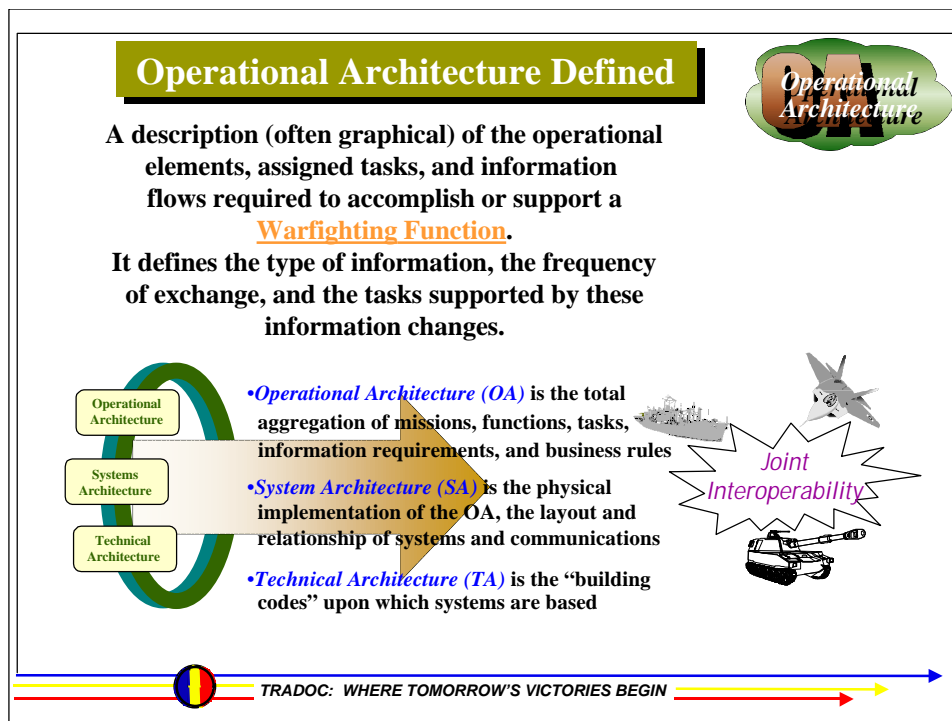


Figure 3. Operational Architecture Defined

### **AOA Vision.**

The following vision of the future describes the desired end-state of AOA development activities: An Army Operational Architecture that is warfighter based to build a comprehensive and dynamic Army-wide IT architecture, that is founded in DTLOMS analysis and Business Process Re-engineering. The AOA will enable the 21st Century Army to gain and exploit information dominance which enables the warfighter to more efficiently conduct military operations in Army, joint, and combined environments.

### **AOA Goals.**

Provide accurate and timely analysis of alternatives to support the Army decision making process to impact the C4ISR systems.

Enable stronger Army, joint, and combined interoperability and flexibility that enhances the warfighter's capabilities to efficiently conduct military operations.

Integrate and synchronize OA analyses that support warfighters' planning and operational needs through the DTLOMS domains.

Provide valid OA analysis that provides the SA and TA communities the foundation for developing and fielding integrated systems with the capabilities that meet Army warfighting requirements.

### **AOA Objectives.**

The AOA program objectives support achieving a specified end-state and describe specific measurable states to be accomplished for the Warfighter. The AOA objectives are derived from, and support, achieving the AOA goals and vision. The objectives are:

An operational architecture that represents the IT requirements for the Division XXI (This objective supports the Chief of Staff's digitization and interoperability goals for Division XXI for 2000.)

An operational architecture that represents the IT requirements for the Corps XXI (This objective supports the Chief of Staff's digitization and interoperability goals for Corps XXI for 2004.)

An operational architecture that represents the IT requirements for Army XXI (This objective supports the Chief of Staff's digitization and interoperability goals for Army XXI for 2006.)

A seamless, joint, interoperable IT architecture that increases Army readiness, enhances the warfighting capabilities of Army forces, promotes the effective and efficient allocation of architecture development resources, and sets the stage for building the Army After Next

In addition to supporting the AOA vision and goals, achieving the objectives can produce a variety of related benefits. By requiring the OA analysis, a disciplined and systemic process is used to identify battle command functions, information exchange requirements (IERS), and performance parameters. Precisely identifying the functions performed within an organization, and the information requirements to perform the functions, provides a disciplined requirements based approach analysis to the SA and TA communities and becomes the basis for Army force modernization efforts and the requirements determination process.

## **AOA Roles and Responsibilities.**

**Commanding General (CG), Training and Doctrine Command (TRADOC).** The CG, TRADOC is the Architect for the Army. TRADOC centers, schools, battle labs, TRADOC systems managers, and the TRADOC staff support the CG, TRADOC in the development of operational architectures. CG, TRADOC approves all Army requirements and oversees the development of Mission Needs Statements (MNSs) and Operational Requirements Documents (ORDs) that describe requirements. As the Operational Architect for the Army, CG, TRADOC directs the development of the Army Operational Architecture and all supporting operational architectures. Specific CG, TRADOC responsibilities relating to the AOA are shown below.

- Coordinate with DCSOPS and DISC4 to establish AOA program priorities and funding. Oversee the development and management of AOA.
- Incorporate AOA into the Requirements Determination Process and into TRADOC PAM 71-9 (Lead).
- Coordinate and synchronize with DISC4 to ensure OA priorities support SA priorities.
- Support the establishment and implementation of AOA rules, procedures, and guidelines.
- Provide information to support AOA development planning and programming.
- Support requirement determination and validation (Lead) through the AOA.
- Support the establishment of AOA performance measures.
- Measure AOA performance, as required.
- Participate in the process of using the AOA to support battlefield process reengineering.

## **Commander (CDR), Combined Arms Center (CAC).**

The CG, TRADOC has delegated the role of the Operational Architect for the Army to the CDR, CAC. The CDR, CAC directs the synchronization between TRADOC Program Integration Office-Army Battle Command System (TPIO-ABCS), the TRADOC schools and centers, and the warfighter concerning the development of the AOA and OA products. Specific CDR, CAC AOA responsibilities are:

- Coordinate with Headquarters (HQ) TRADOC, DCSOPS, and DISC4 to establish AOA program priorities and funding.
- Oversee the development and management of AOA.
- Incorporate AOA into the Requirements Determination Process and into TRADOC PAM 71-9.
- Coordinate and synchronize with HQ TRADOC, DISC4, and the TRADOC Signal Center to ensure OA priorities support SA priorities.
- Oversee the development of OA products through TPIO-ABCS and the TRADOC schools and centers.
- Support the establishment and implementation of AOA rules, procedures, and guidelines.
- Provide information to support AOA development planning and programming.
- Support requirement determination and validation (Lead) through the AOA.
- Support the establishment of AOA performance measures.

- Measure AOA performance, as required.
- Participate in the process of using the AOA to support battlefield process reengineering.

### **TRADOC Program Integration Office - Army Battle Command Systems (TPIO-ABCS).**

TPIO-ABCS is the Army's executive agent for the AOA. TPIO-ABCS is responsible for the development, management, and implementation of the AOA. The AOA program execution authority is delegated to TPIO-ABCS. Specific TPIO-ABCS AOA responsibilities are:

- Develop objective operational architectures for Division, Corps, EAC and Army XXI for all BOSs (Lead).
- Coordinate recommendations for AOA program priorities, funding, and development with HQ TRADOC, the DISC4, and the TRADOC Signal Center.
- Develop seamless, joint, interoperable operational architectures (Lead).
- Develop and manage the AOA (Lead).
- Establish AOA rules, procedures, and guidelines (Lead).
- Synchronize AOA priorities and activities with HQ TRADOC and the TRADOC schools and centers.
- Develop and provide operational architectural solutions to warfighters' operational and planning requirements (including, but not limited to operational architectures that support MNSs and ORDs) (Lead).
- Use the AOA to support requirement determination and validation.
- Establish AOA performance measures (Lead).
- Use AOA to support battlefield process reengineering.
- Develop operational architecture validation and configuration control measures (Lead).
- Establish and maintain the AOA repository.
- Provide information, architecture models and products, and other data for inclusion in the AEA repository.
- Maintain and update the AOA Implementation Plan as required (Lead).
- Direct, chair, and facilitate the Configuration Control Board (Lead).
- Conduct dynamic modeling and simulations in support of analyses and business process re-engineering efforts.

### **TRADOC Proponent Centers and Schools.**

The TRADOC proponent centers and schools have a major role in the development of OA projects. They develop their own proponent OA initiatives and support the TPIO-ABCS OA program. Proponents will follow the performance measures and the OA project process. Specific TRADOC centers and schools responsibilities relating to the AOA are:

Develop operational architecture solutions (models and products) in support of proponent initiatives and respective battlefield functional areas, following the procedures provided by the AOA Program.

Support TPIO-ABCS in the development of an overarching OA that integrates the proponent functional area OAs into a seamless, joint, and interoperable operational architecture.

Follow the AOA Program performance measures.

Provide input to support the establishment of AOA rules, procedures, and guidelines.

Use the AOA to support requirement determination and validation.

Use OA to support battlefield process re-engineering.

Provide information, architecture models and products to TPIO-ABCS for inclusion in the AOA repository.

#### **TRADOC Signal Center (SIGCEN).**

The SIGCEN is responsible for the conceptual development of the SA and the Command, Control, Communications, and Computers Requirements Definition Program (C4RDP). In addition to TRADOC proponent center and school responsibilities, specific SIGCEN responsibilities relating to the AOA are shown below.

Develop and coordinate conceptual SA requirements with TPIO-ABCS and DISC4.

Integrate configuration controlled OA structures approved by the TPIO-ABCS into the C4RDP.

Integrate functional and informational requirements produced by a TPIO-ABCS approved OA into the C4RDP.

#### **TRADOC Battle Laboratories (BLs).**

The TRADOC BLs have a major role in the supporting the development of OA projects, by including OA as a basis for futuristic initiatives. Specific TRADOC BL responsibilities relating to the AOA are.

Incorporate OA into battlefield process reengineering.

Develop operational architecture solutions (models and products) in support of BL initiatives, following the AOA Program procedures.

Provide information, architecture models and products to TPIO-ABCS for inclusion in the AOA repository.

#### **TRADOC System Managers (TSMs).**

The TSMs have a major role in supporting the development of OA projects, by providing generated user requirements for their respective systems. Specific TSMs responsibilities relating to the AOA are.

Incorporate OA into battlefield process reengineering.

Evaluate OA products for accuracy and provide TPIO-ABCS technical comments to keep AOA products updated.

Develop operational architecture solutions (models and products) in support of TSM initiatives, following the procedures in this Implementation Plan.

Use the AOA to support requirement determination and validation.

Provide information, architecture models and products to TPIO-ABCS for inclusion in the AOA repository.

### **AOA Process.**

The process under which operational architectures are developed is supportive of the Army's combat development activities and is founded upon the requirements identified within this document. This process ensures the Army is building and fielding capabilities which support the warfighter, represent the optimum value added, and provides the analytic basis for sound decisions concerning reengineering opportunities across the DTLOMS domains and realistic assessments of return on investments. The OA process, and resultant operational architecture development, is executed along two axes simultaneously (standards-based and capabilities-based axes). OA policy and guidance serve as control measures that guide efforts along both axes. Warfighters' visions and concepts that lead to requirements are the starting points, or foundation, of the process.

The standards-based axis includes compliance with and application of the Joint Technical Architecture-Army (JTA-A). Compliance with the applicable JTA-A standards will enable Army forces to be interoperable and flexible. Application of the JTA-A involves the use of common operating systems, common software, data standardization, data definition standardization, development and adherence to a common data element dictionary, and software reuse. The application of and adherence to these standards and principles will ensure systems compatibility and interoperability when fielded and support the seamless exchange of information throughout the Army, in the joint environment, and with our allies.

The capabilities-based axis involves supporting the development of objective Information Technologies (ITs) capabilities through architecture development efforts. These efforts may be focused toward the development and enhancement of specific capabilities—situational awareness, battlefield visualization, information operations, cooperative engagement, etc.; or toward specific Army organizations—Division XXI, Corps XXI, Army XXI, and the Army After Next (AAN). The main focus on the capabilities-based axis is the development of objective IT architectures for Division, Corps, and Army XXI. Division, Corps, and Army XXI represent capabilities and the operational architectures describe those capabilities. In that context, the representative IT architectures are capability configurations.

The primary purpose of the OA is to define the requirements (functions) and IERs within the desired mission area. The process of developing the OA is analytical and can be used to develop an OA at any level of an organization or combinations of organizations. The process uses five phases, each with multiple steps. Identify the requirement to perform an OA.

Form an OA project team.

Conduct a front-end analysis.

This includes an environmental assessment, determination of the purpose, scope, and context of the OA and any that changes or requires an OA. Functions, information requirements and performance parameters have changed (been merged, deleted or are new). Unit mission has been changed or modified. A DTLOMS domain has been changed or modified. Joint or Coalition functions or mission have changed

Determine the Purpose of the OA.

The purpose provides the background of the organization, and explains the necessity for developing an OA. The purpose also explains what the OA will accomplish and how it may affect the organization or how it may affect system development.

Determine the Scope of the OA.

The scope of the OA is a clear identification of the architecture in terms of type of architecture, subject area, temporal nature, and intended users.

Validate the Context of the OA.

Validation is a critical step in the process of developing the OA. Validation of the context is necessary to ensure that development and ultimate implementation of the OA proceed according to the plans and intent of management. The following sub-steps apply: **Confirmation**. The staff must confirm that the scope, purpose, and context are correct. Once the context is established, it should be reviewed by the Commander and disseminated to staff members who provide input or are affected for confirmation and comment. This procedure ensures everyone starts from a common perspective and serves as a double check that the context is complete and well defined. **Approval**. The Commander must accept the scope, purpose, and context as the correct start of the OA development process. Once the context is confirmed, the Commander approves, rejects, or modifies it. The OA project team modifies it as required until approved. **Decision**. Once the stated scope, purpose, and context are approved, a decision to accept and proceed with the remainder of the OA development must be made. Only when the context is accepted and approved does the Commander decide to move on to the next step.

In general, the OA should present the following information:

Missions to be accomplished.

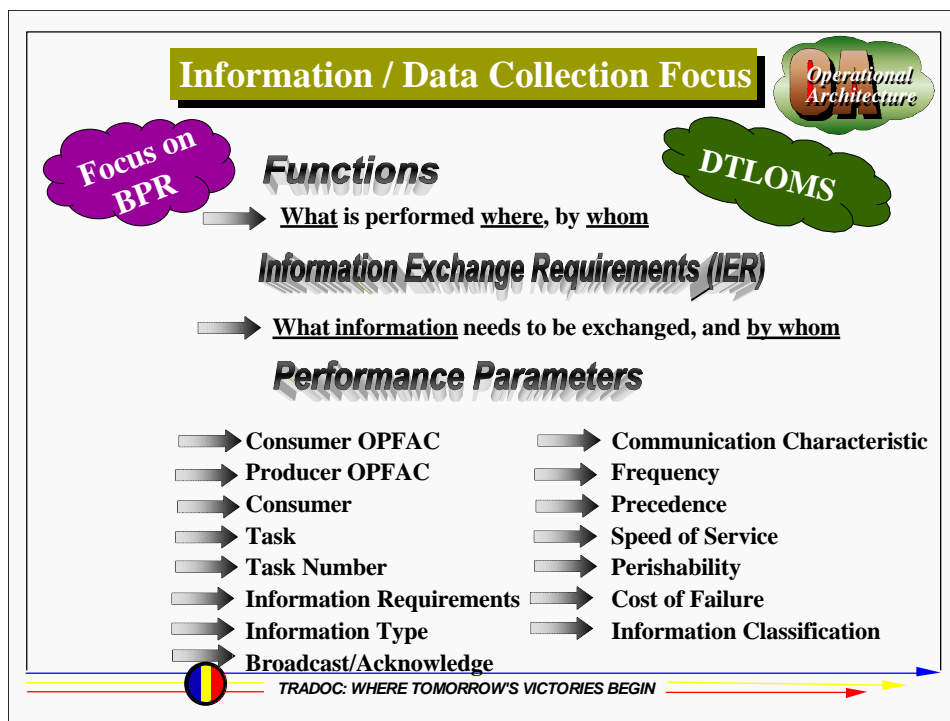
Operational elements to whom the missions are assigned.

Nodes, geographic or functional locations, where the operational elements are located.

Functions, tasks, and activities that the operational elements perform.

Information flows required to perform the tasks.

The purpose of developing the OA is to identify the functions, information requirements, and performance parameters, then apply business process reengineering methodologies and analyses to assess the impact across the DTLOMS domains, refer to Figure 5.



**Figure 4. Purpose of developing the OA**

**OA Life Cycle.**

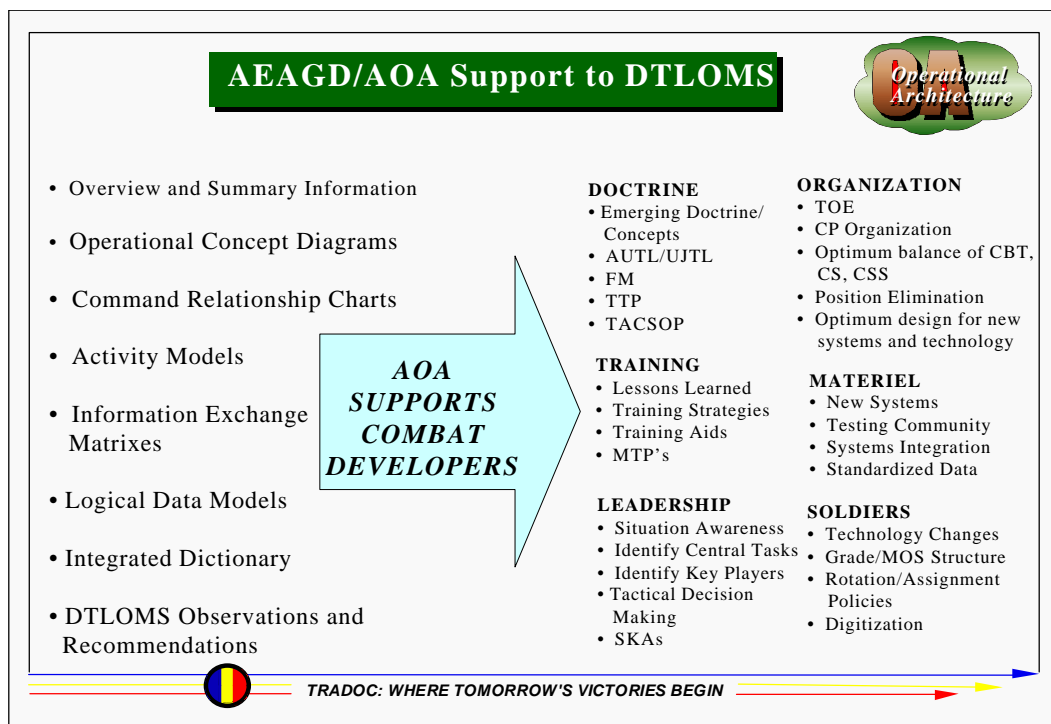
The AOA Life Cycle is a living development cycle within itself in defining and describing the warfighter requirements. The cycle is an evolutionary process that incorporates a cradle to grave approach in developing the warfighter requirements. The four phases consist of conceptual, developmental, verification and validation, and fielding.

**Conceptual Phase.** It begins with the initial definition of the functional requirements as defined by the warfighter. Interviews and analysis are conducted with the warfighter to determine the functional tasks and activities, information requirements, and performance parameters.

**Developmental Phase.** Activity models, node trees and context diagrams document the requirements as defined from the initial interviews. From these products are generated the data models that define the informational exchange requirements for the warfighter.

**Verification and Validation Phase.** Once the products are developed, they are verified and validated by the TRADOC TPIO-ABCS, schools, centers, and the Warfighter community. Changes to the baseline OA products are controlled, authorized, and executed by the Configuration Control Board (CCB). Products will be verified to ensure they conform to applicable Government standards, plans, and doctrine.

**Fielding Phase.** Verified and validated products will be distributed or fielded to the applicable TRADOC organization, schools, centers, SA and Materiel Developer for implementation. The SA and Materiel Developer will work with TPIO-ABCS OA staff regarding any anomalies, risk factors, schedules, and required resources. Any detected anomalies will be documented and reported back to the TPIO-ABCS for investigation. TPIO-ABCS will post approved OA products on the TPIO-ABCS OA home page (<http://leav-www.army.mil/oa/>).



**Figure 5.**

The operational architecture is a view of the functions performed across the battlespace (physical and logical). An OA is completed to allow and support the development of re-engineering recommendations relative to the DTLOMS domains. Figure 5, provides some examples of OA product impact on different DTLOMS domains. It is the baseline for the identification of new C3I requirements and requirements generation for each functional area and

serves to facilitate the development of new concepts. Development of operational architectures also allows the Army leadership to better understand the impact of changes throughout the force as they relate to the DTLOMS. The development of operational architectures also provides the mechanism and process to identify new IERs; information exchanges requirements, and associated information elements for the force. Operational Architecture development supports the warfighter, the modeling and simulations community, the training community, force design decisions, doctrinal changes, the development and fielding of technology enhancements/systems, software development, and the build of system architectures.

**OA provides five key elements to the base line of TRADOC Pam 71-9.**

OA is a functional blueprint that provides a disciplined approach to the requirement determination process (RDP), and is the cornerstone for the RDP.

OA provides the functions, information requirements, and the performance parameters that a warfighter needs to perform his mission. The ASA community to develop and field the correct type and number of systems to enable the warfighter to execute functional requirements uses the OA.

OA should precede the development of system architectures. This ensures full advantage is taken of reengineering potentials identified through the operational architecture process, and that technology enhancements are analytic based and represent optimized battlefield return on investment, see figure 6. If an OA is not produced than the Warfighters requirements will not be defined in an accurate and objective manner which will lead to misunderstanding and precious time and resources will be miss-directed or incorrectly used.

OA's identify and document new and emerging operational requirements and act as the change catalyst for development of operational capabilities supporting the warfighter.

The OA provides the functional and information exchange requirements (IERs) for the C4RDP.

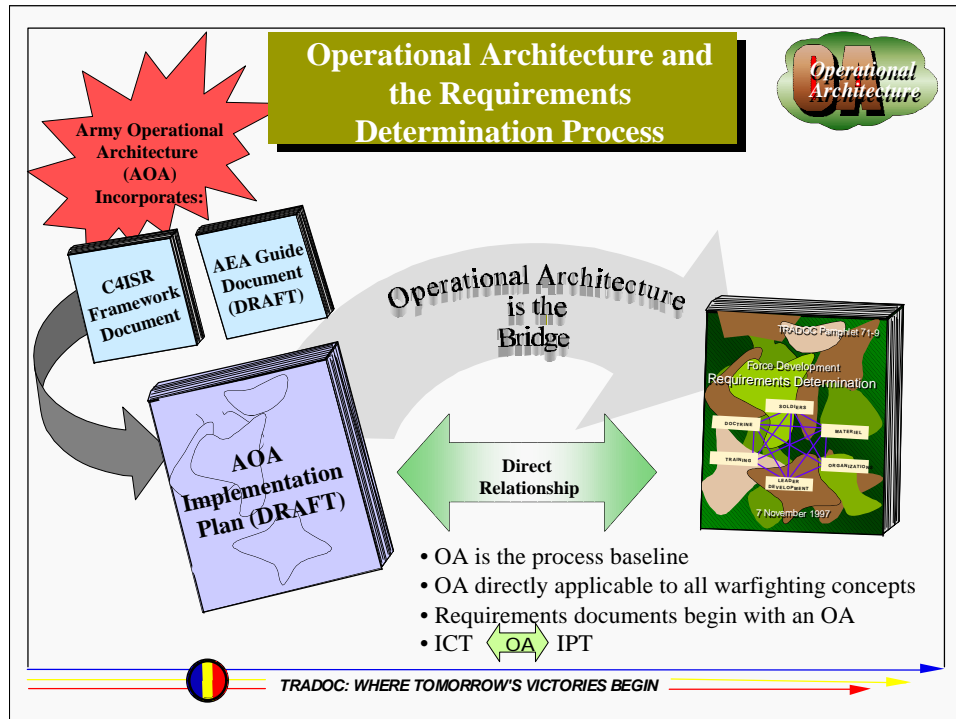


Figure 6.

## **The OA Products.**

Architecture products are graphical, textual, and tabular items developed in the course of building an operational architecture and describe characteristics pertinent to the architecture and its purpose. The set of operational architecture products varies depending upon the type of architecture being developed and its specific objectives and scope. The decision of which operational architecture products to build is based on the area the architecture is intended to explore and the resulting characteristics that the architecture must capture and describe. A given architecture may consist of all the products described in the C4ISR Architecture Framework, or it may be a selected subset of those products. Templates are provided for developing textual and graphic architectural products. The relationship among the architecture products facilitates traceability of solutions back to the operational warfighter support requirements. At a minimum the following products are required in every OA project.

- Overview and Summary Information
- High-Level Operational Concept Diagrams
- Command Relationship Charts
- Activity Models
- Information Exchange Requirements
- Logical Data Models
- Integrated Dictionary
- DTLOMS Observations

A common theme among these products is the *information flow* that links operational elements and the activities required to accomplish operational missions. The content of OA products is key to the strategic and operational vision and mission. As a result, the level of detail within each product will vary from OA to OA.

Each product and the characteristics it will capture are addressed. Additionally, a description of how the product can be used, and why they are needed is provided. Refer to the C4ISR Architecture Framework and the AEA Guide Document for a more detailed description of the products, the Integrated Dictionary Attributes for each product, and how the products relate and support the development of the Systems Architecture products.

In addition to these products there are other supporting OA products. Supporting products will be developed that match the purpose and objectives of the architecture and provide data needed to build the essential products. Other products, found in one or more references (e.g., DoD, C4ISR Architecture Framework, AEA Guide Document, and the JTA-A), may be required to ensure that specific architectures are complete and in conformance with current policy and formal direction. The supporting OA products include.

- Node Connectivity Diagram
- Operational Rules Model
- Operational State Transition Description
- Operational Event/Trace Description

The outcome of developing an OA, is the total aggregation of mission, functions, tasks, information requirements, and business rules, is a set of products that provides the basis for the technical and system architectures as well as the information to review or redesign the organization. For the operational architecture product types, a generic "template" is shown that illustrates the basic format of the product, describes the characteristics to be captured in the product, and lists some of the uses of the product. For any architecture effort, the specific products to be produced and the level of detail to which they are developed depends on the purpose of the architecture.

**The Operational Concept Diagram.** These diagrams are developed in two parts. The first is the development of an operational concept for battle deployment of the unit being modeled. The second is a graphic representation or depiction of that concept. While the graphic representation depicts the concept in a simple, pictorial form (using Microsoft PowerPoint software), the operational concept must define how the concept is expected to support the warfighting requirement and enhance command and control across the battlefield. The operational concept diagram is used to describe, in general terms, how command and control will be executed for the organization to be modeled and provide the focus, or view, against which the modeling and analysis will be completed.

Throughout all the phases of architecture development, the Operational Concept Diagram serves as the single picture that conveys the concept of the fielded architecture. This product Shows the “who, what, when, where, why, and how” documented in the Overview and Summary. The Operational Concept Graphic builds on the information used in creating the Overview and Summary. From this starting point assign organizations to perform each activity. The original need for the architecture will govern the level of detail used in assigning organizations. For example, if the purpose of the architecture was to refine organizational roles, the activities and organizations should be broken down into enough detail to show one organization for each activity.

Once the data have been organized, build the first Operational Graphic. Think of this product as a graphic summary of the architecture. Use the type of graphic that best portrays the use of the architecture. Like the Overview and Summary, the Operational Concept Diagram information will be used to defend budgetary decisions, and to track and guide the development of the architecture at all levels.

The diagram uses generic icons that represent various classes of entities in the architecture and can be tailored as needed (e.g., a tank icon can represent a particular type vehicle, a particular armor organization, or the armor assets of a joint task force). The icons represent missions or functions. The lines connecting the icons show connectivity information exchanges. How the template is tailored depends on the scope and intent of the architecture. In general however, an operational concept diagram typically shows the mission, high-level functions, organizations, and relative distribution of assets.

**The Command Relationships Chart.** is used to show the operational elements involved in a particular military operation and the relationships among them. It depicts lines of command and coordination among operational elements and may depict operational elements either in generic

terms or by particular organizational element, depending on the particular need. The level of detail to be shown on this chart is commensurate with the intended use of the architecture. This type of chart should be drawn only to the level that depicts the applicable operational elements and lines of command.

Command relationships illustrate command, control, and coordination relationships among operational elements in an organization. For example, command and control relationships may differ under different circumstances; such as for various phases of warfare; these command structures may mean that activities are performed differently or by different units. Different coordination relationships may change connectivity requirements.

**Activity Modeling.** Activity and process modeling provide a description of the activities and functions being performed at each level within the structure(s) being modeled. Additionally, the process models provide necessary timing data and information, which support the development of dynamic modeling and simulation. These models are developed using Integration Definition (IDEF0) language (for Function Modeling) with standard IDEF conventions and notations. The IDEF0 activity models are in compliance with the Federal Information Processing Standards Publications (FIPS) 183. The activity (IDEF0) and process (IDEF3) models provide the identification of functions/activities performed, associated processes, and information relative to information flow and IERs. The results of these modeling activities provide the basis from which to execute further dynamic modeling and simulations and conduct refined analytic analysis and assessments. These are the basis upon which business process reengineering (BPR) recommendations are made and the future or “to-be” OA’s are developed. BPR is a method for looking at the current function of an element, and determining if a better alternative is available to enhance future functional efficiencies. Utilization of this modeling software and techniques provide a disciplined approach to data/information capture, documentation, standardization of definitions/terms, and a thorough understanding and description of the activities associated with specific nodes. These IDEF models provide the detailed information relative to managing needs and functional analysis, requirement definition, and IERs from which additional OA products are developed.

The Activity Model describes the applicable activities associated with the architecture, the data and/or information exchanged between activities, and the data and/or information exchanged with other activities that are outside the scope of the model (i.e., external exchanges). Activity models are hierarchical in nature; that is, they begin with a single box that represents the overall function and proceed successively to decompose processes into activities to the level required by the purpose of the architecture. This is analogous to a work breakdown structure for a system.

Using the IDEF process the Activity Model captures the activities performed in a business process or mission and their ICOMs (Inputs, Controls, Outputs, and Mechanisms). Mechanisms perform an activity, usually a person, duty position, or work cell within an organization. Inputs are things changed or used in the activity, usually information, a decision, or a sensor feed. Controls are the rules that govern the activity, this can be in the form of higher’s orders, and regulations. And outputs are what leave the activity; examples are annexes, orders, decision, or information. Annotations to the model may identify the nodes where the activities take place or the costs (actual or estimated) associated with performing each activity.

The Activity Model can capture valuable information about an organization. However, care must be taken to not collect extraneous information. There are two modeling approaches; generic and detailed. The generic model approach is to specify the activities, generic ICOM categories, and specific characteristics to be captured in the models. The objective of this technique is to focus the modeling effort so that a number of small, quickly developed activity models can be produced instead of a large, many-layered model. However, the resolution in the decomposition of functions may not be to sufficient detail. The detailed model approach specifies the activities in greater details, decomposing functions to the node level. Node level is defined as the lowest level that a function is performed which requires information to perform that function, or a function, which produces information. TPIO-ABCS has developed a generic Army Common Activity Model (ACAM) which will serve as a basis for building the various other activity models.

The Activity Model generally includes a chart of the hierarchy of activities covered in the model, facing-page text for each diagram that provides any required detail, and a dictionary that defines all activities and terms used in the diagrams. The Integrated Dictionary product serves as this dictionary. The applicable activities associated with specific functions and processes that must be accomplished to support a particular mission, the relationship among activities, the data or information exchanged between activities and the data or information exchanged with other activities that are outside the scope of the model.

**Information Exchange Requirements (IER) Matrix.** This matrix identifies the connectivity between the various operational elements at the leaf node level and provides the performance parameters associated with leaf node information requirements (inputs and outputs). The operational element connectivity will be shown as information exchanges between a producer (normally one person) and various users. This information and the definitions provided with the activity model are of major importance to the Systems Architects. Through the development of the IER matrix, current information requirements (IR's) and IER's within the C4RDP will be validated as well as identification and creation of new IR's, IER's, and OPFAC rules which will be feed into the C4RDP data base. The SIGCEN oversees the management of the C4RDP database.

The IER matrix expresses the relationship across the three basic entities (tasks, operational elements, and information flow) in an OA. The IER is defined as the requirement for information to be passed between and among forces, organizations, or administrative structures concerning ongoing activities. IERs identify who exchanges what information with whom, why the information is necessary, and in what manner the exchange takes place. IERs identify the elements of warfighter information used in support of a particular activity and between any two activities. The information media (e.g., data, voice, and video), quality (e.g., frequency, timeliness, and security), and quantity (e.g., volume and speed) are attributes of the information exchange that may be included in the IER. Particular capabilities such as automated data processing capabilities, secure communications, facsimile, database query, and large-screen display may also be captured for each exchange. Required capabilities may be extended to capture other needs such as personnel skills or facilities. The specific attributes used to describe the information exchange are driven by the purpose for which the architecture is being developed.

**Logical Data Modeling.** IDEF1X data modeling supports the IRs identified in the activity model, and describes in detail the information entities, attributes, and entity relationships. DoD manual 8320.1-M-1 and FIPS 183 and 184 require all data models to be activity model based. Prior to the execution of data models, the C2 Core Data Model (C2CDM) will be queried to ensure no duplication of effort will exist and that all data models to be developed are valid extensions to the C2CDM. Additionally, the C4ISR Core Architecture Data Model (CADM) and the Joint Transition Data Model (JTDM), will also be queried to ensure maximum optimization of work already performed/completed is taken advantage of. The development of data models/extensions provides the necessary resolution of information/data to the material developer, systems engineer, and software developer to develop systems and software in an optimal manner. The TRADOC Systems Managers for respective systems must be a part of this process and support the development of data models for their systems. All data modeling initiatives being conducted in support of TRADOC systems will be coordinated with the Commanding General, Combined Arms Center (TPIO-ABCS as the USACAC lead). TPIO-ABCS will validate the requirement, coordinate execution with Headquarters, TRADOC (as necessary), and ensure the data modeling approach is consistent and complementary to development of the Operational Architecture initiatives. Currently Platinum software ERwin is FIPS 184 compliant and it will be used to perform the IDEF1X data modeling.

**Integrated Dictionary.** The Integrated Dictionary contains definitions of all significant terms used in the products. It is not assigned to any one architecture type because it supports and is populated by all three architectures (operational, systems, and technical). Similarly, the data model is not assigned to any one type of architecture. However, the data dictionary and the data model development should begin in parallel with the development of the OA.

This is also a DoD essential product. At a minimum, the Integrated Dictionary is a glossary with definitions of terms used in the given architecture description. There must be definitions and data associated with these essential products. The Integrated Dictionary provides a central source for this information. The Integrated Dictionary makes the set of architecture products stand-alone and allows it to be read and understood without reference to other documents.

The contents for the Integrated Dictionary entries for the OA products are evolving. Refer to the Attribute Tables provided for architecture products in Appendix A to *C4ISR Architecture Framework, Version 2.0* for instructions to produce the Integrated Dictionary. These attributes are consistent with the CADM for the architecture products. An architecture's Integrated Dictionary product contains the specific values of the data, while the CADM describes the types and relationships of these data.

The *C4ISR Architecture Framework, Version 2.0*, directs that architects should use terms from existing, approved dictionaries and lexicons. All definitions from existing dictionaries should provide a reference to show the source. At times, however, new terms and/or modified definitions of existing terms will be needed. This can happen when a given architecture is at a different level of detail than existing architectures or lexicons, or when new concepts are devised for objective architectures. In those cases, the new terms should be submitted to the maintainer of the approved dictionaries.

The dictionary is a compilation of dictionary entries for each product generated by the architecture. The dictionary begins with the entries about the first version of the Overview and Summary Information. The final version of the integrated dictionary will be done when the last product is produced and its entries included. To prevent confusion within and across architectures, care must be taken to avoid duplication of names or descriptions without proper reference to their origin.

**Conduct Analysis.** After the OA is developed, it can be analyzed to define an organization, to reevaluate an existing organization, develop a system or process, or assess the impact on the DTLOMS domains.

IDEF models are used to develop BPR recommendations and changes to DTLOMS domains. BPR is a method for looking at the current function of an element, and determining if a better alternative is available to enhance future functional efficiencies. The activity/process models are utilized by the modeling and simulations community, such as the TRADOC Analysis Command (TRAC), the National Simulations Center (NSC), the Army Systems Architect in the development of systems architectures, software engineers and designers to gain a greater understanding of the functions/activities the software must support, doctrine writers to write emerging concepts and doctrine, the warfighter to assess where efficiencies may be gained in either their force structure or conduct of operations, and the training community in the development of training support plans (TSP's) and development of new training tasks. The results of the data/information collection and IDEF modeling also populate numerous databases, such as the Enterprise Architecture database (vis-à-vis the C4RDP), the DISA C2CDM, the Army Common DataBase (ACDB), and the CADM. The OA may be used to develop or validate an organizational structure, and it may also be used to develop a systems architecture. A discussion on how the OA is used to develop the systems architecture is presented at in the C4ISR Architecture Framework.

During the development of the OA, DTLOMS impacts, insights, and analysis produce observations. These observations are listed in matrix form (Access database). The OA and the follow-on analyses document the impact across the DTLOMS. Through business process reengineering methodologies efficiencies are optimized, redundancies eliminated, and 'what if' analysis performed (Figure A-26).

The OA has a number of characteristics that make it useful as a tool for developing and validating organizational structures. They are itemized below:

The OA embraces the range of potential environmental conditions such that the resulting architecture is generic and is insensitive to any specific environment (physical, military, and civilian).

The OA identifies and defines the principal components in the operational scenarios and general nature of the information elements that need to be exchanged.

The OA encompasses the operational influences of doctrine, policy, tactics, techniques, and procedures.

The OA identifies existing constraints (i.e., manpower, logistics, training, and funding).

### **Configuration Management.**

The purpose of Configuration Management (CM) is to establish an orderly method of control over the configured baseline OA products. The major elements of the configuration management concept are shown in Figure 5. A complete description of the OA CM is contained in the TPIO-ABCS Configuration Management Plan (CMP) for the AOA. The TPIO-ABCS CM Plan is posted on the OA web site. The specified procedures provide:

A means for requested changes to be initiated, reviewed, approved, prioritized, and implemented.  
A means to track the implementation of changes made to the OA product set and repositories through a configuration control process.

A means for issues to be identified, reviewed, and resolved or put into the change process.

No changes to the OA products will be implemented unless it is authorized and approved by the Configuration Control Board (CCB) and verified and validated by the CM process, see Figure 7.

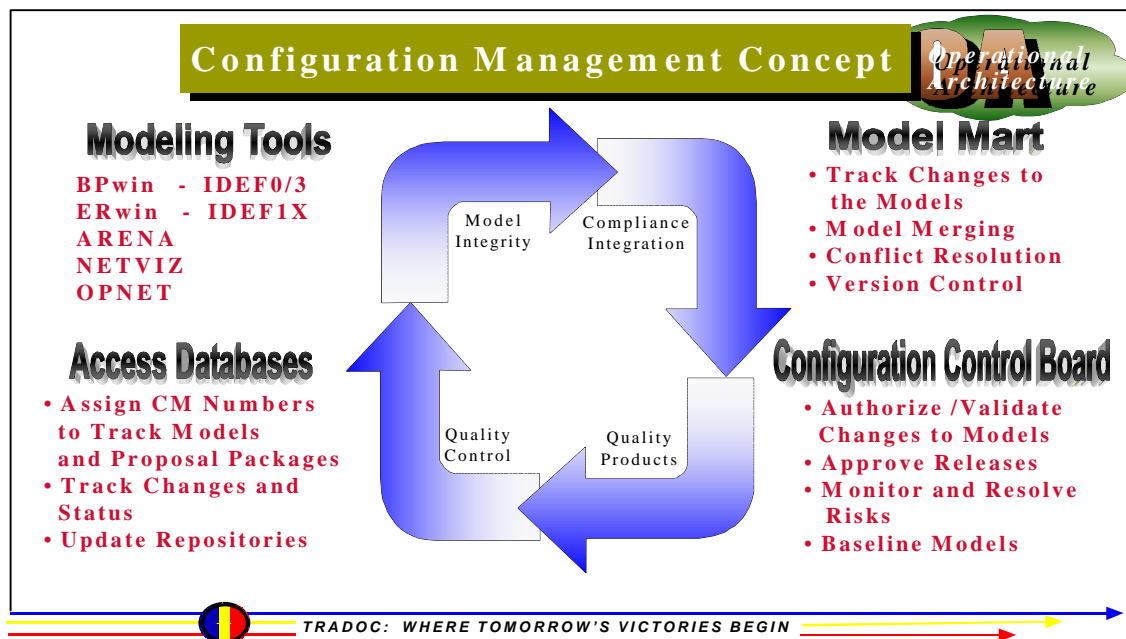


Figure 7.

### **OA Laboratory and Integration Center.**

The TRADOC Operational Architecture Laboratory and Integration Center is located within the TPIO-ABCS. Its purpose is to provide the capability to conduct dynamic modeling and simulation, support the assessment and development of recommended changes to the DTLOMS, provide the ability to merge and integrate various activity/process models and data models, and provide configuration control and management of all OA activities within TRADOC. Access to the OA lab is through a server administered by TPIO-ABCS OA Branch. The OA products and models will be available to view and pull down.

### **AOA Repository.**

TPIO-ABCS will maintain the Army's OA repository. After an OA is completed, and accepted by the OA CCB, it will reside in the OA repository. TPIO-ABCS will control access to the repository. The OA products and models will be available to view and retrieve. This is essential in order to maximize product reuse, thereby creating efficiencies and saving resources. Any agency conducting an OA must review the products in the repository to evaluate the reuse potential. Contact TPIO-ABCS OA personnel for recommendations of which models will provide the most reuse value.

The AOA provides the functional and IERs for the C4RDP. OA products will not be provided to the C4RDP until it is approved by the TPIO-ABCS OA. The TPIO-ABCS OA and C4RDP will work together to ensure any detected anomalies are reported to the OA CCB for resolution.

### **Measurements.**

TPIO-ABCS OA must collect data that focuses on criteria that evaluates the cost factors of implementing OA, identified analytical issues, and potential impacts. These factors fall into three basic categories; performance, analytical results, and risk management. Because of their potential magnitude, all three data collection areas are critical to the success of the OA program.

### **Performance Measures.**

The Army must measure performance to determine the degree of how to use its resources effectively and efficiently. The Chief of Staff of the Army has determined that increased return on investment will be a key criterion for performance measurement. To implement this requirement, TPIO-ABCS will collect data gathered in each of the OA Life Cycle phases. The data will focus in two main areas: internal and external. Internally, the OA staff must collect data on expended man-hours, funds, and resources to implement OA. Externally, data must be collected on how the implementation of OA has provided cost savings and reduced risks. OA performance measures provide the focus and structure required to support the disciplined approach that OA brings to the Requirements Determination Process.

**Analysis Results.** Issues and observations are discovered during each of the OA Life Cycle phases. This data can include issues related to resources, doctrine, training, reports, manpower, or DTLOMS criteria. These findings will be submitted to TPIO-ABCS. In turn, TPIO-ABCS will evaluate these findings and forward them to either the AOA CCB or appropriate agency for consideration. Pending the findings, it is possible that this data can also be considered performance measure criteria or a risk factor.

**Risk Management.** A risk is defined as a factor, an element, or a requirement that has the potential to cause a problem or impact. During each phase of the OA Life Cycle, numerous risks can surface which could turn into potential problems for the program. To ensure that these problems are identified and properly controlled, the CCB will be the mediator for risk management. The goal is to identify, track, manage, and resolve each identified risk so that it does not reach an uncontrollable state.

**OA Web Page.** TPIO-ABCS OA Branch will maintain an OA web page (<http://leav-www.army.mil/oa/>) that will notify users of the latest AOA information. This will include the

AOA Implementation Plan, OA products, OA Tool Box, Product Change Request (PCR) status, information on the repository, the CMP, the CCB Charter, and updates on the AOA program.

**Tools.** Currently, TPIO-ABCS is utilizing Platinum BPwin for activity modeling (IDEF0) development, ERwin for data modeling (IDEF1X) development, and Model Mart for configuration management of the models. BPwin and ERwin are in compliance with the Federal Information Process Standards (FIPS) and DoD 8320.1-M-1 directives. Microsoft Access data base software is used to produce the IER matrices.

**Configuration Control Management (CCM).** Configuration control management will be performed IAW the TPIO-ABCS Configuration Control Management Plan for the Army Operational Architecture (AOA). The AOA CCB will operate IAW the TPIO-ABCS Army Operational Architecture (AOA) CCB.

### **AOA PROGRAM SUMMARY**

The Army's Operational Architecture codifies the Warfighter's functional requirements across the battlefield. It serves as the foundation for all DTLOMS development and provides a disciplined/analytic approach to change recommendations across the DTLOMS. It serves as a mechanism/tool supporting cost containment strategies. AOA captures/develops future C4I requirements and is the basic tenet of Army's Requirements Determination Process. Most importantly AOA serves as a catalyst for *Business Process Re-engineering* of the Army of today and the future.