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DOD Information Systems Capacity Management Function

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Defense Information Systems Agency

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FINAL PROJECT REPORT

November 16, 1993

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This document is the product of the Activity Based Analysis Workshop led by the Defense Information Systems Agency, Joint Interoperability & Engineering Organization, Center for Information Management (DISA/JIEO/CIM/XI). The team used Integrated Definition (IDEF) techniques as part of the Corporate Information Management (CIM) initiative sponsored by the Office of the Assistant Secretary of Defense, Command, Control, Communications and Intelligence (OASD C3I), Deputy Assistant Secretary of Defense for Information Management (DASD/IM).

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Preface

This report is based on an analysis of Department of Defense (DoD), Capacity Management Function activities, associated with performance measurement and capacity planning processes of Information Processing Centers (IPCs). The modeling results address all aspects of Capacity Management, and apply to all systems and components of the Defense Information Infrastructure. This final report is a composite of all prior working papers, and replaces any previous editions.

Because the modeling results of this report are based on a structured and integrated analytical process, interpreting the results out of context (as provided by the defined terminology) and without respective qualifying conditions, may lead to erroneous conclusions. Questions related to this report should be addressed to The Defense Information Systems Agency, Joint Interoperability & Engineering Organization, Center for Information Management, Infrastructure Program Directorate (DISA/JIEO/CIM/XI). 701 South Court House Road, Arlington, VA 22204-2199, Attention: Mr. Charles A. Archer, Sr., Project Manager [(703) 285-5323].

To ensure the widest dissemination, current planning calls for this document to be made available through the Defense Technology Information Center.

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DoD Information Systems Capacity Management Function
Functional Process Improvement
Activity Based Analysis Workshop

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Section 1
Executive Summary

This report provides the foundation and structure for development of policy for a Department of Defense (DoD), Information Systems, Capacity Management (CM) Function. The objective in this workshop was to provide a DoD-wide standard framework for conducting performance measurement and capacity planning activities across all Defense Information Infrastructure (DII), Information Systems (IS), and configurations (i.e., mainframe/host computers, communication systems, and networks). In many ways, the activities described in this document are similar to collective CM processes used in the DoD today, primarily for mainframe environments. However, the processes modeled in this report were constructed as the "best practices" of all approaches to Capacity Management, and have been extended to include all DoD communication and network systems.

Further, the Capacity Management processes defined in this report are intended for use in all DoD IS environments, such as Megacenters, base-level military installations, and Central Design Activities (CDAs) in all fixed, mobile, and remote locations.

The DoD Information Systems environment to which this CM Function will be applied is represented by 16 (planned) Megacenters currently made up of 194 Data Centers; over 500 mainframes; 650,000 PCs; and 10,000 Local Area Networks, with their associated communications media, modes, and interfaces. Most of these systems currently serve approximately 1,700 military and civilian DoD installations, many of which have requirements for mobile and overseas computer systems capabilities in multi-force and multi-national interoperable environments, and quick-response computing capabilities to meet wartime mission requirements.

This document was prepared during the time-period from July 19, 1993 to October 29, 1993, by a workshop team composed of DoD Capacity Managers, and subject matter experts. The models presented herein were developed using the analytical Functional Process Improvement Methodology, Integrated Definition Language (IDEF) process and modeling techniques, as prescribed by DoD 8020.1-M.

The workshop results presented in this document display an innovative and visionary approach to managing critical performance planning and cost aspects of Information Systems operations across the DoD. All of these models have been constructed at a level of detail sufficient to support DASD (IM) objectives for development of DoD-wide policy and standards for this Capacity Management function. The following summary presents the most significant Capacity Management issues and recommendations presented in this document.

Capacity Management issues include:

- The Capacity Management Function is an integral element of Information Systems Management. If we are to understand system performance issues affecting our current and emerging (e.g., Megacenter) environments, we must have a standard approach for managing systems performance, evaluating capacity requirements, ensuring standard data collection procedures, and standard reporting methods. The CM processes described herein provide a structure to enable standard CM practices across the DoD.

- The cost of Information Systems in the DoD must be better managed and controlled if we are to achieve the goals of systems consolidation and cost-reduction. This CM Function will enable better performance management and capacity planning of all DII Information Systems. This, in turn, will reveal opportunities for system performance cost-savings, and improved cost accounting (e.g., fee-for-service) capabilities through more efficient CM processes and effective performance management, cost-effectiveness, and resource utilization of DoD Information Systems.

- With the move toward open systems and distributed client/server architectures, we must merge our existing legacy mainframe/host computer systems and network environments into interoperable configurations. This CM Function will provide a standard process for the performance measurement and capacity planning of all DII Information Systems, regardless of configuration or design.

- A Capacity Management baseline modeling approach is prescribed for all DII Information Systems. This standard model development activity will ensure that all DII configurations will (1) be modeled in a consistent manner, and (2) that information exchange between various system configurations will provide interoperable and similar data modeling and reporting information.

- The lifecycle development of system designs, communication systems, network topologies, application software, etc., must involve all aspects of the CM Function to ensure that performance implications and capacity issues are addressed in a timely manner prior to implementation.

Recommendations and Improvement Opportunities Include:

- Prepare a C3I policy directive for promulgation of this CM Function across all DoD organizations to ensure a comprehensive and standard CM capability and implementation is achieved.

- Ensure centralized control and distributed execution of the CM Function throughout the DoD.

- Establish a CM Steering Group for coordination of CM issues affecting all DII Information Systems environments.

- Establish a Configuration Control Board (CCB) to provide policy and oversight for changes to all DII/IS configurations.

- Define CM as a major organizational element to ensure effective implementation and management of the CM Function in all information systems organizations across the DoD.

- Ensure that the CM function is included in all Information Systems planning processes including development of short- and long-range (Service, Agency, and DoD) plans, life-cycle design processes, user requirements, system enhancements, CDA/user performance objectives, etc.

It is the opinion of the Workshop Team that the implementation of this CM Function is paramount to the effective establishment and operation of the emerging DoD Megacenter environment. Further, the CM Function will also enable standard and compatible (e.g., with Megacenters, IPCs, CDAs, etc.) performance measurement and capacity planning activities. Without a standard process for managing and reporting the performance and capacity of all DoD Information Systems, effective management, cost-containment of IS resources, and long-range planning will not be possible.

A final workshop report and briefing will be presented to the Deputy Assistant Secretary of Defense for Information Management (DASD/IM) C3I, who sponsored this project. The Defense Information Services Organization (DISO), in the Defense Information Systems Agency (DISA), has been a full time participant in the development of this Capacity Management Function. DISO is preparing to use the results of this effort in their planning for Capacity Management in the new Megacenter environment.

Upon completion of this workshop effort, DISA/JIEO/CIM (Joint Interoperability & Engineering Organization/Center for Information Management), at C3I's direction, will assist DASD/IM C3I, DISO, and DISN in their efforts to implement this CM Function across the DoD.

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Section 2
Introduction and Project Plan

Introduction

In May 1993, the Deputy Assistant Secretary of Defense (DASD) for Information Systems (IS) - [now DASD for Information Management (IM)], C3I, commissioned a workshop to examine and improve activities associated with the DoD Information Systems Capacity Management (CM) Functional Activity, and to broaden the scope of the Capacity Management Function by designing a DoD-wide CM process for all Information Systems, including Communication and Networks. This initiative represents a major step toward effective management of the evolving consolidation of all Department of Defense (DoD) Information Systems, as directed by Defense Management Report Decision (DMRD) 918 and previous DMRDs.

To develop the Capacity Management Function, the workshop team used methods and techniques approved by the Director of Defense Information (DDI); Command, Control, Communications and Intelligence (C3I); as defined under the Corporate Information Management (CIM) Program. Specifically, the workshop team conducted its efforts using IDEF techniques according to the Functional Process Improvement Program (FPIP) for functional managers, as directed by DoD manual 8020.1-M, dated 1 October 1992. (Workshop participants are listed in this section.)

Senior level guidance for this initiative was provided by DASD (IM) C3I; DASD Plans & Resources (P&R), ITR/C3I; and the DISA/JIEO/CIM/XI, Infrastructure Program Director. Project management and direction was provided by Mr. Charles Archer, Sr., DISA/JIEO/CIM/XII.

The DoD is currently involved in a computer systems migration and automation effort on two fronts: (1) moving from an installed base of separate and/or networked base-level computer systems on DoD military and civilian installations to a Megacenter/Mainframe environment; and (2) moving from primarily vendor specific systems (e.g., IBM, UNISYS, etc.) to "open systems" and interoperable environments. The driving force in this effort is DMRD 918, and previous DMRDs, that direct consolidation of data centers into consolidated groups (i.e., Megacenters) of Information System (IS) configurations designed to produce greater processing efficiencies and cost savings.

The successful implementation of C3I policy for this Capacity Management Function, will also support current direction by the Deputy Secretary of Defense to accelerate implementation of migration systems and related process improvement activities toward accomplishment of a new Defense Information Infrastructure (DII). A graphic depiction of the DII is shown in Appendix G.

Background

As a result of discussions in March 1993, between DASD (IS) C3I; DASD (P&R), ITR/C3I; DISA/JIEO/CIM Infrastructure Program Directorate (XI), and DISA/DITSO-GAT [now DISO-UAT], an initiative was begun to perform an IDEF/FPI project for the Capacity Management Function.

An executive session briefing was convened on May 18, 1993, by DASD (IS) to discuss initiation of this Business Process Improvement (BPI) workshop series. This briefing provided the background, and subsequent clarification, of issues to be addressed for the CM Function, as described in

subsequent memoranda from DASD (IS) dated May 11, and June 11, 1993, SUBJECT: Department of Defense Information Systems CM Function.

Subsequently, a five-phase project was designed to establish (1) a Baseline AS-IS Activity Model; (2) an IDEF Training Class; (3) a DII-wide TO-BE (i.e., future) Activity Model and Megacenter/Mainframe Entity Relationship Data Models; (4) DII-wide TO-BE Networks and Communications Activity Templates and Entity Relationship Data Models; and (5) a final report describing the modeling results, interoperability of models, definitions of CM terminology, and narratives discussing the use of the CM Function models.

The Purpose of Capacity Management

Capacity Management (CM) is an umbrella title that provides for the management of all activities of CM. CM includes: performance measurement, capacity planning, and prediction modeling of computer systems, communications systems, and networks.

The primary goal of Capacity Management is to ensure sufficient capacity exists, and is available, to meet the service-level objectives of the user community at any time. The capability to satisfy user requirements, and maintain reserve capacity for peak or unexpected workloads, added workstations, or higher traffic loads on a LAN, etc., is the business of Capacity Management.

The question of why we need capacity management is one that is easily answered with an illustration. Capacity Management originated in the "mainframe" arena, but is now being applied to "open systems" distributed architecture (e.g., client/server) systems, and communications areas. In the mainframe world, monitoring systems usage and workloads processed, as well as, predicting how future workloads would impact system operations became necessary if these systems were to meet user requirements.

Since the advent of distributed systems, the need for performance measurements and capacity planning has become more evident as we try to maintain service-levels and response-times that were planned prior to building a network, and ensure sufficient communications bandwidth (capacity) is available to transmit data across networks.

We have found that, not only do we not know enough about the day-to-day performance characteristics of networks we have established, but that tools and capabilities to perform network measurements are not readily available; especially since interoperable networks (similar vendor configurations and protocols) are not commonplace.

Thus, we have the dilemma of trying to manage performance and capacity in PC-to-Mainframe configurations that do not readily lend themselves to such activities. Further, these configurations are evolving into Megacenters, consolidated LANs/WANs, etc., and the future performance of such consolidations is not readily apparent.

Although the right tools, sizing, and protocol interoperability are keys to successful management of these environments, the Capacity Management Function defined in this document provides a **structured framework** and **standard process** that will enable effective capacity management of all DOD DII/IS configurations.

Use of this framework and the processes modeled, will ensure that consistent methods for Capacity Management are used across the DoD. These methods will also produce credible, comparable, and reliable performance measurements and data, and install common capacity planning and modeling activities in all organizational elements of the DoD for all PC-to-mainframe (end-to-end) configurations.

PC-to-Mainframe Concept

In the case of the Capacity Management Function, the PC-to-mainframe (end-to-end) concept is intended to describe all systems and components of the Defense Information Infrastructure (DII). The "PC" part of this concept includes client/workstations, local area networks (LANs), wide-area networks (WANs), communications systems, network backbones, their protocols, etc, which connect to the "MAINFRAME" end of this concept through network interfaces, front-end processors, etc., that are used to access mainframe/host computers. A conceptual diagram of a PC-to-Mainframe environment follows:

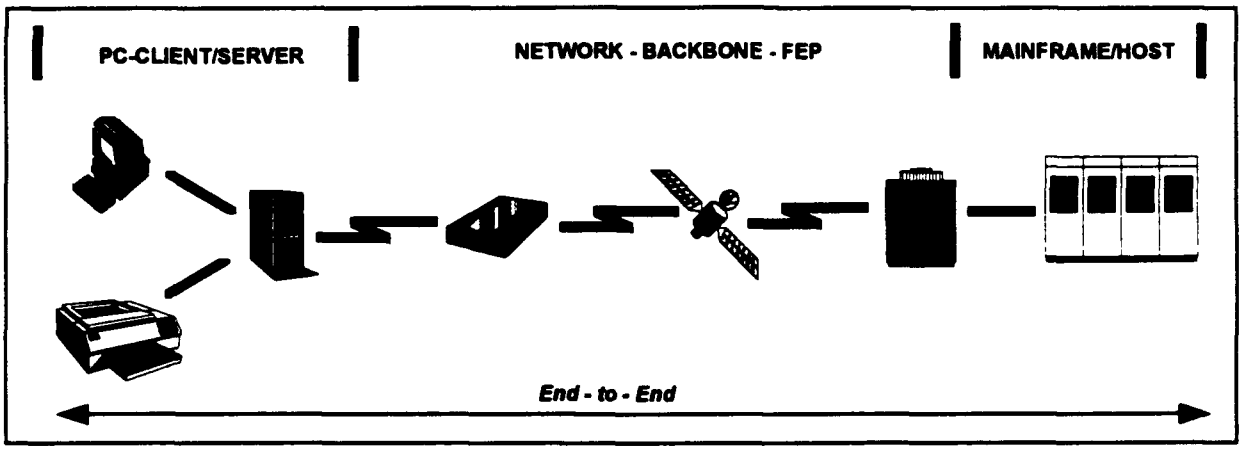


Figure 2-1. PC-to-Mainframe Conceptual Model.

PC-to-Mainframe Measurement Capabilities

The Workshop Team has documented the need for PC-to-Mainframe measurement capabilities (see Improvement Opportunity #12. **Measure PC-to-Mainframe Response-Times for all DII/IS Components**). This is needed if we are to manage our DII/IS configurations better, and gain the ability to detect variances in response-times in a timely manner.

The following discussion portrays how PC-to-Mainframe measurements might occur in DII/IS configurations. Since our heterogeneous environment (vendor-specific hardware, software, protocols, etc.) does not permit performance measurements between components of such configurations, nor can we always extract similar measurements from devices that will present comparable data, it appears that PC-to-Mainframe response-time measurement capabilities will take some time to become available.

In the interim, we believe that the alternative described herein will provide "indicators" of internal and external device propagation delays which can be viewed in a "peer-to-peer response-time" scenario. Thus, the "internal" (vendor supplied) data transfer rates for a specific device can be stated as one element of the total PC-to-Mainframe response-time scenario. The "external" transmission speed of the communications path between any one device can be stated as another element of this same response-time scenario.

When we view the entire combination of devices in any specific configuration, and apply the foregoing time considerations to each device in the configuration, we can add them up and get a pretty good idea of what PC-to-Mainframe response-time should be for that configuration. This, however, will only give us theoretical indicators (not actual) of response-time.

The next step would be to test these measures by executing a PC-to-Mainframe response-time measurement during peak workload hours for this same configuration. An illustration of this measurement process is shown in Figure 2-2, **Peer-to-Peer Propagation Delay Response-Time Measurement**.

In the first column of Figure 2-2, a sample **PC-to-Mainframe configuration** is presented that illustrates all of the major components (devices), and the communication paths between them, for a typical configuration (the Application Database is shown last because you must go through the Mainframe to get to the data).

The second column represents the **minimum** ("internal") component/device measurement (i.e., data transfer rate) as well as, the **minimum** ("external") communications path transmission speed.

The third column is a similar representation of component and communications measurement, but these are **maximum values** that would be collected from real-time tests of the same configuration.

The iterations (.xxx) shown in Figure 2-2 across from each component, represent time values of propagation delays for each component. The **down arrow** (↓) represents the communication path **between** the components, and has similar time values entered for time intervals computed for (1) types of media, (2) communication path lengths, and (3) transmission speeds. Thus, we have a "picture" of **an estimated minimum and maximum expectation range for propagation delays**. The **"total"** value shown at the bottom of Figure 2-2, shows the collective representation for (**one-way**) PC-to-Mainframe response-time in this configuration example.

Typical Configuration PC-to-Mainframe Component Devices	Minimum One-Way Propagation Delay Component Measurements	Maximum One-Way Propagation Delay Component Measurements
PC ↓	.xxx .xxx	.xxx .xxx
(Communication) Server ↓	.xxx .xxx	.xxx .xxx
Lan (Traffic) ↓	.xxx .xxx	.xxx .xxx
Router/Bridge ↓	.xxx .xxx	.xxx .xxx
Channel Service Unit ↓	.xxx .xxx	.xxx .xxx
Multiplexer ↓	.xxx .xxx	.xxx .xxx
T1/T3 - FDDI-Sonet-ATM ↓	.xxx .xxx	.xxx .xxx
Multiplexer ↓	.xxx .xxx	.xxx .xxx
Channel Service Unit ↓	.xxx .xxx	.xxx .xxx
Router/Bridge ↓	.xxx .xxx	.xxx .xxx
LAN (TCP/IP conversion to SNA) ↓	.xxx .xxx	.xxx .xxx
Protocol Converter/Gateway ↓	.xxx .xxx	.xxx .xxx
Front-End-Processor ↓	.xxx .xxx	.xxx .xxx
Mainframe/Host Channel ↓	.xxx .xxx	.xxx .xxx
Mainframe/VTAM ↓	.xxx .xxx	.xxx .xxx
Application Database ↓	.xxx .xxx	xxx .xxx
TOTAL	x.xxx	x.xxx

(Note: ↓ = communication path between components.)

Figure 2-2. Peer-to-Peer Propagation Delay Response-Time Measurements

If we accept this illustration as being a valid concept for estimating minimum and maximum propagation delays, we can use it as a basis for monitoring response-time problems as experienced by a user (at the PC end).

In addition, we can also use this scenario during preparation of Service Level Agreements, as an indication of what users can expect in terms of response-times. This scenario may not be applicable to all DII environments or configurations, but it is a beginning toward resolving a very complex problem in measuring PC-to-Mainframe response-time.

Capacity Management Function - Management Model

The diagram shown in Figure 2-3 presents a conceptual view of how the flow of management information might occur to be collected, reviewed, or presented from the C3I level, through the Capacity Management Function, and other levels of management. The concept for managing policy and issues for the areas illustrated, as they relate to the Capacity Management Function, is a follows:

- "**DASD (IM) Policy Level - C3I**" - In this scenario, develops policy for:

  - Capacity Management Function, DII Architecture, Configuration Control Board (CCB), Open Systems Interconnection (OSI) requirements, Cost Evaluation/Monitoring/Accounting, etc.

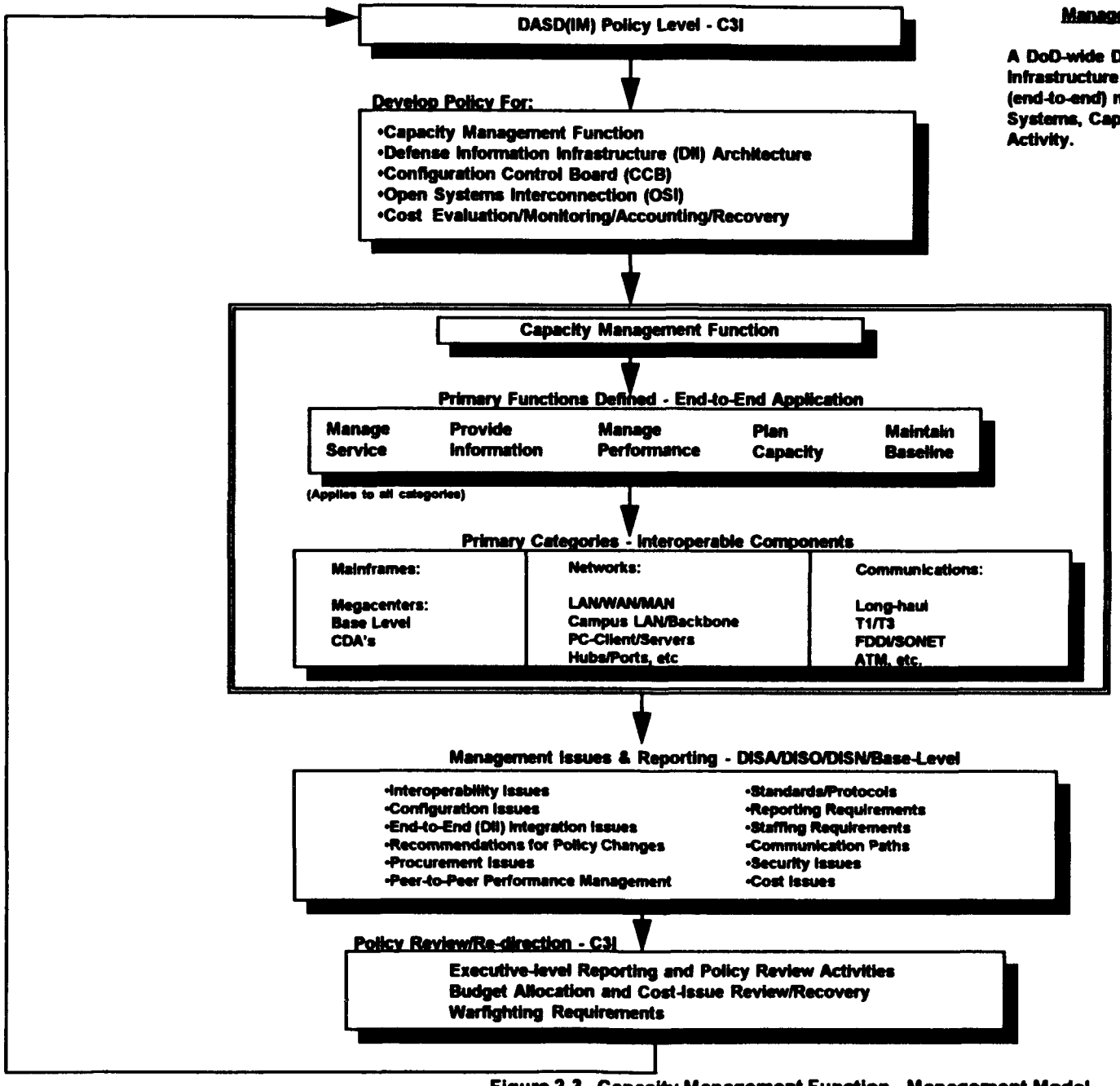
- "**Primary Functions Defined**" - All of these Model Activities apply equally to mainframe, network, and communications systems.

- "**Primary Categories**" - These are logical separations of functional areas that were used in the CM Function models. However, they may be logical organizational structures too, especially in terms of managing the DII/IS. They are examples of the categories of mainframe, network, and communication systems that make up the DII/IS, to which the "Primary Functions" are applied.

- "**Management Issues & Reporting**" - These are examples of management oversight areas and issues that would be considered and managed by DISA/DISO. Reports to this level would come from the Megacenters, as well as, other network, communication, and base-level structures.

- "**Policy Review/Re-direction - C3I**" - This area represents executive-level reporting at the end of the management cycle, and suggests a feedback loop occurs between DISA and C3I for policy review.

DOD IS CAPACITY MANAGEMENT FUNCTION



Management Model

A DoD-wide Defense Information Infrastructure (DII) PC-to-Mainframe (end-to-end) model for the Information Systems, Capacity Management Functional Activity.

Figure 2-3. Capacity Management Function - Management Model

Project Objectives

The objectives of this project were to define a CM Function to promote **standard** cost efficient and effective performance management and capacity planning of Information Systems (including Communications and Networks), and aid in ensuring that Information Systems resources are available to deliver capacity and performance levels in a timely manner at acceptable levels of satisfaction to the user community. It is also necessary that this function enable capacity managers to meet user Service Level Objectives (defined in Service Level Agreements) by recognizing and forecasting systems resource, utilization, workload, performance, and capacity requirements; acquiring resources in a timely and cost-effective manner; and providing **standard** reporting information to upper management in a consistent manner.

This project was conducted in concert with the Defense Information Services Organization (DISO), along with participation from other DoD Services and Agencies. All DoD Services and Agencies were invited to participate in the workshop series. The results of this project are viewed as an effective way to document the TO-BE (future) capacity management processes that are necessary to design a DoD-wide CM Function, and to provide effective management of this function across the DoD.

In summary, the achievement of these project objectives provides an understanding of common process requirements and permits streamlining of processing actions. It also fosters identification and measurement of efficiencies, conservation of resources, empowerment of quality efforts, and promotes responsive and effective support functions. Integration of the results of this project, with other DISA/JIEO/CIM and DISA/DISO ongoing initiatives (that further develop the CM Function), will result in a comprehensive and inter-related set of processes that, when structured as DoD-wide C3I policy, will ensure that Information Systems across the DoD can be planned and managed by the best practices and cost-efficient methods available.

DoD/DASD (IM) Mission Statement

The Department of Defense has, through DMRD 918, promulgated the reduction of costs, and establishment of Megacenters, for Information Systems processing environments across the DoD. This move toward PC-to-Mainframe (end-to-end) cost-reduction for Information Systems, and emphasis on focused consolidation and management for these systems, will require additions to current policy and planning as this new environment is developed.

The DASD (IM) has responsibility for policy development and management of DoD-wide Information Systems and, therefore, established the need for an improved CM Function that could be applied to all elements of the DII. The results of this workshop will provide C3I with the foundation (along with other related and on-going C3I initiatives) for development of policy and management guidance for implementing the CM Function across the DoD.

Issues Affecting CM Policy Implementation

As a result of the modeling effort to develop the Capacity Management Function, the Workshop Team discovered a number of issues that must be addressed if a Capacity Management (CM) policy is to be successfully implemented throughout the DoD. The following issues are discussed further in Section 5 Recommendations. Parenthetical numbers provide cross-references to each improvement opportunity as they relate to these issues.

1. **Roles and Responsibilities**

This workshop established a need for a Configuration Control Board (CCB) and a Capacity Management (CM) "Steering Group" for the purposes of managing and controlling performance and planning activities of Defense Information Infrastructure (DII) Information Systems (IS) configurations. (See discussion in Section 5 Recommendations: Improvement Opportunities #1, 5, 6, 10). It is recommended that the CCB issue policy for controlling and effecting changes to the DII Information Systems (IS) configurations, at all levels. The Steering Group should be responsible for guiding a central policy, and providing direction of DII/IS Operations and CM Functions that affect all DII configurations.

A probable scenario describing how levels of management for the CM Function, and subsequent activities might occur is as follows. Current planning indicates that C3I (DASD/IM) will prepare overall policy guidance for implementation of this CM Function by all DoD elements. C3I would also promulgate implementation of the CCB. As a manager of all DII/IS, DISA would have responsibilities for mandating implementation and execution of the CM Function policy across all affected areas of DoD, and for providing guidance for the interface of the CCB and the CM Steering Group with organizational elements across the DoD.

This, in turn, would require DISO to implement a CM Program (which is already underway) for all DII/IS Megacenter configurations, as well as, establishing a CM Steering Group. Under this scenario, DISO would have the lead for all Megacenter CM Function activities, establishing standards of management and operations, defining reporting requirements etc. At C3I direction, DISA would be responsible for coordinating CM Functions, etc., with Services and Agencies that would occur at base-level or in other organizational structures, and promote standards for CM execution.

2. **Standards**

A key element to effective implementation of CM policy will be the promulgation of standards for use among all DII Information Systems and components. This includes standard practices for managing CM Functions, providing standard software measurement tools, ensuring interoperability in design, ensuring standard data collection practices, providing standard modeling capabilities, and producing standard reports.

The activities defined in the models in this document enable the development and use of standards for performing CM across all elements of the DII. The comprehensive and "generic" approach taken in building these models was designed to promote standard use for computer, communications, or networking environments. However, standards must also be developed to ensure capabilities of performance measurement across system platforms and configurations.

3. **Reporting**

A significant aspect of managing a CM Function is obtaining information on subjects such as: performance measurements, achievement of service objectives, capacity availability and usage, resource utilization, cost-performance analyses, workload statistics, on-line/network traffic loads, communications performance trends, file server performance, etc. All of these reports, and more (See Capacity Management Reporting Requirements, Table 4-5) must be provided to various levels of management on a periodic basis. These reports will provide information that is needed to evaluate performance and capacity of DII/IS components, as well as, monitor activities associated with performance in meeting user service-level objectives.

To ensure their credibility, and utility in comparing reported information (e.g., between Megacenters, configurations, etc.) all reports must have standard origins at each reporting "center", and must also be drawn from the same base of information. This CM Function model provides for this process.

4. **Cost Accounting**

It is necessary to enable the CM Function to determine certain costs associated with its activities. This can be achieved through a Fee-for-Service or cost-recovery (e.g., Chargeback) system. Through such a system, we can view some aspects of the CM Function as "an application", and measure the amount of capacity being used, as well as, attribute the unit cost of this usage in terms of dollars. This will help to understand costs for most activities of the CM Function, justify higher levels of capacity requirements, and predict the cost of achieving user performance objectives.

A benefit of cost accounting that is of added value to CM, is the ability for the CM Function to integrate cost information into models associated with performance, feasibility studies, configurations, etc. Thus, the "cost of doing business," and cost-effectiveness of related performance services (e.g., response-time improvements, improved failure ratios MTBF, reduction of networking and communications overhead) can be accurately described.

5. **Organizational Structures**

To facilitate implementation of a CM policy, it is necessary to ensure that an adequate organizational structure is defined that will foster effective implementation of the CM Function at the program execution level. Further, because Capacity Management is a full-time activity, it should occupy a prominent position in the organizational hierarchy, along with other organizational elements (e.g., the applications division, software division, etc.).

Placing the CM Function in an organizational structure equal to other organizational elements (e.g., applications, operations, etc.), will permit CM management to take a pro-active and equal role in decision making regarding: tasking, system performance, capacity planning, funding, staffing, and other issues. Further, being on an appropriate level of management will ensure that CM managers have direct access to appropriate Megacenter, IPC, etc., management levels. This will also aid in ensuring that the CM Function has an integral role in the life-cycle system design and implementation process.

6. **Centralized Management Control and Distributed Execution**

This is a concept of management that, if used for the CM Function, would permit all DII/IS environments (e.g., CDAs, Megacenters, IPCs, base-level installations, large networked

environments, etc.), to provide local support to their user communities for system performance, application development, and system design efforts, etc., while providing a central higher-level management of all DoD Capacity Management activities. This concept would also foster management control (oversight) for establishing performance objectives, standards, reporting, and other requirements common to all DoD organizations, while giving "local" sites (e.g., Megacenters, IPCs, base-level installations, etc.) the latitude to ensure effective execution of the CM Function.

Thus, the day-to-day activities of CM would occur at a level where close working relationships and performance monitoring are needed, yet ensure that upper management could establish standards and level of oversight required. However, in the short-term (1-2 years) this distributed execution concept might need revision to accommodate a future "lights out" or remote Capacity Management operations concept, when centralized execution might be more appropriate.

7. **Implementation Support**

Effective implementation of C3I policy for this Capacity Management Function will require the concurrence and support of top management at all DoD Services and Agencies, C3I, DISA, DISN, and DISO. Further, if the implementation of C3I policy for this CM Function is to be effective, a management plan must be developed to foster incorporation and establishment of all aspects of this CM Function at DOD organizations. A central liaison for all Services and Agencies would help understanding and implementation of the CM Function.

8. **Baseline DII/IS Models**

A significant element of this CM Function is the requirement for constructing Capacity Management models of hardware and software components, as well as, computer systems, communications, and network components. Often, documentation in these areas is incomplete and there are no "baseline" models available that can be used for documentation, illustration, performance prediction, "what if" scenarios, workload characterization, cost-performance ratio analysis, etc.

This report presents a baseline modeling approach for Capacity Management that is prescribed for use in all DII/IS. Use of this approach will (1) promote consistency in modeling, (2) ensure that models are available for upgrading systems and other uses, (3) permit interoperable information exchange between various system configurations, and produce standard reporting results.

These Capacity Management (CM) models will, generally, be mathematical representations of DII/IS configurations. They will be used to measure queuing statistics, predict systems performance, simulate workloads, benchmark vendor/system characteristics, etc. Not all models used or created in the CM Function will originate there. The CM Function will also require the use of models produced by the Configuration Management staff. These models will be used to evaluate DII/IS component configuration changes, response-times, verify the effect of upgrades, etc.

9. **Life-cycle Design and Development**

In mainframe/host, network, and communications environments, user computing requirements are at the beginning of the life-cycle design. Whether these activities are performed at a CDA, DISN, Megacenter, or base-level military installation, performance and capacity are always major issues to be resolved. Because the very nature of design indicates performance requirements must be met, it is essential that the CM Function become a part of the application or system development life-cycle process, from the beginning to implementation. The CM Function's role in life-cyle processes would

include: monitoring test scenarios, evaluating the performance feasibility of an application or DII/IS component or system design, and providing recommendations/feedback (e.g., feasibility of meeting performance objectives, etc.) to the development community.

An illustration of a typical life-cycle process in which Capacity Management would play a role, is presented in Figure 2-4 Typical Life Cycle Design and Development Process on pages 2-14 to 2-15. This figure displays areas of performance measurement or performance modeling that are required during the design and development required during the design and development phases in satisfying user service objectives.

10. **Staffing Requirements**

The Capacity Management Function normally requires a variety of management and professional/technical skills, experience, and knowledge. Implementing the TO-BE Capacity Management Function (e.g., performance measurement, capacity planning, configuration modeling, etc.) for DII Information Systems (including networks and communication systems) will require expertise in these and other CM Functional areas (e.g., LAN/WAN performance, optical fiber FDDI, etc.)

Some areas (e.g., local area networks) may not have adequate tools or measurement capabilities to collect required reporting data. However, adequate staffing levels and skill sets must be provided to ensure that day-to-day performance management, data collection and analysis, and planning for any DII configuration is successful.

(Note: DISA/JIEO/CIM/XI currently has an on-going project to examine, customize, and prepare skill sets, etc., that will be needed to perform the Capacity Management Function.)

11. **Training**

A number of the CM functional activities described in this report will be new to some IPCs and Megacenters. Many of these CM activities are not performed in many centers; especially in communication or networking environments. Therefore, it will be necessary to develop training programs to provide for the various skills and skill-levels needed for effective execution and management of these CM functional areas. A policy that establishes training "requirements" in terms of skill levels to be maintained, is needed to ensure that each site performing the CM Function has adequate numbers of trained personnel to take care of day-to-day technical processes such as performance monitoring, as well as, capacity planning and modeling activities.

12. **Improvement Opportunities**

A number of the improvement opportunities listed in this report (See Section 5 Recommendations) are integral parts of the TO-BE model for this CM Function. Many of these improvement opportunities have been incorporated into the models as they were built. It is recommended that all of the improvement opportunities be implemented since they provide, in most cases, a direct impact on the effective implementation of C3I policy for the CM Function.

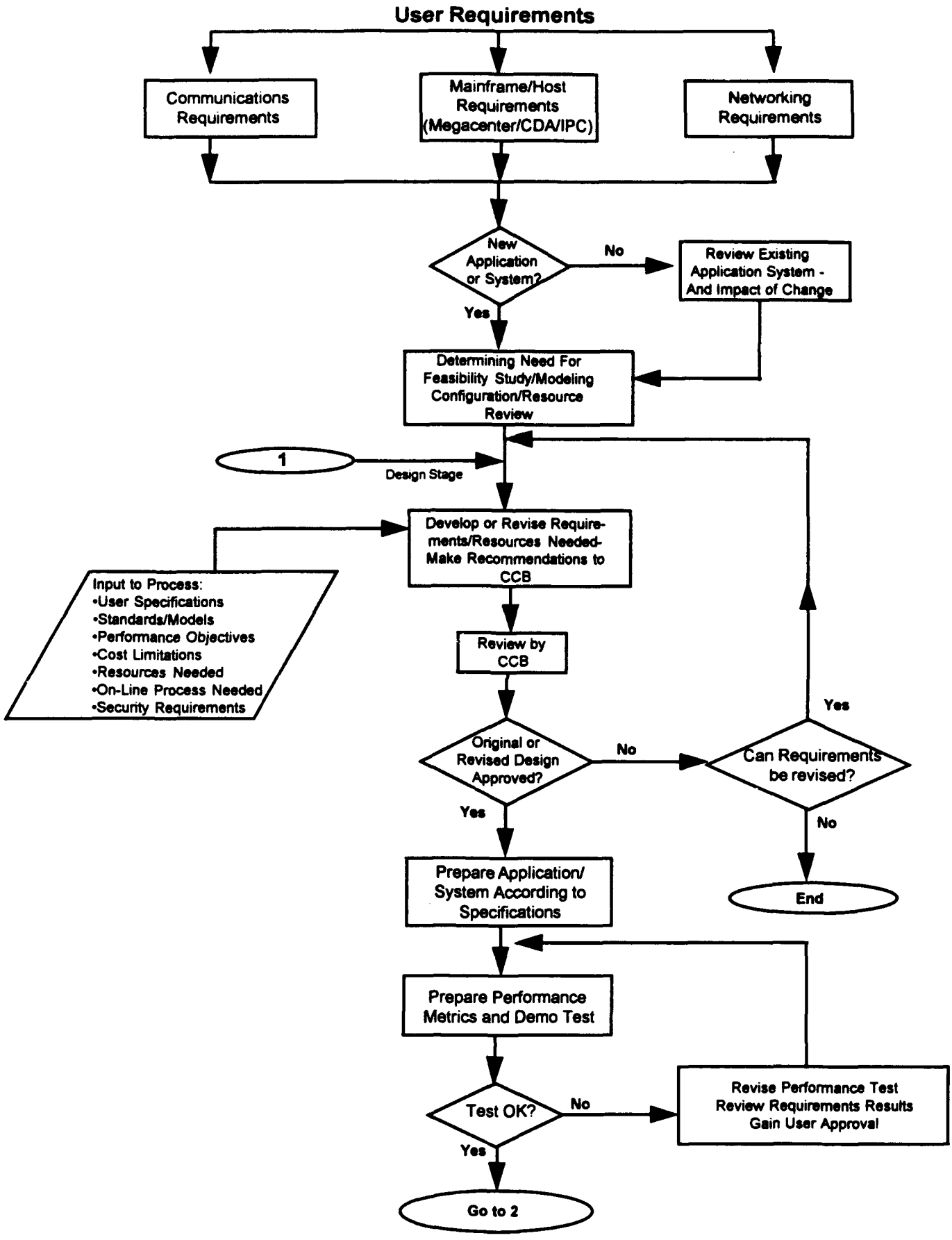


Figure 2-4
Typical Life-Cycle Design and Development Process

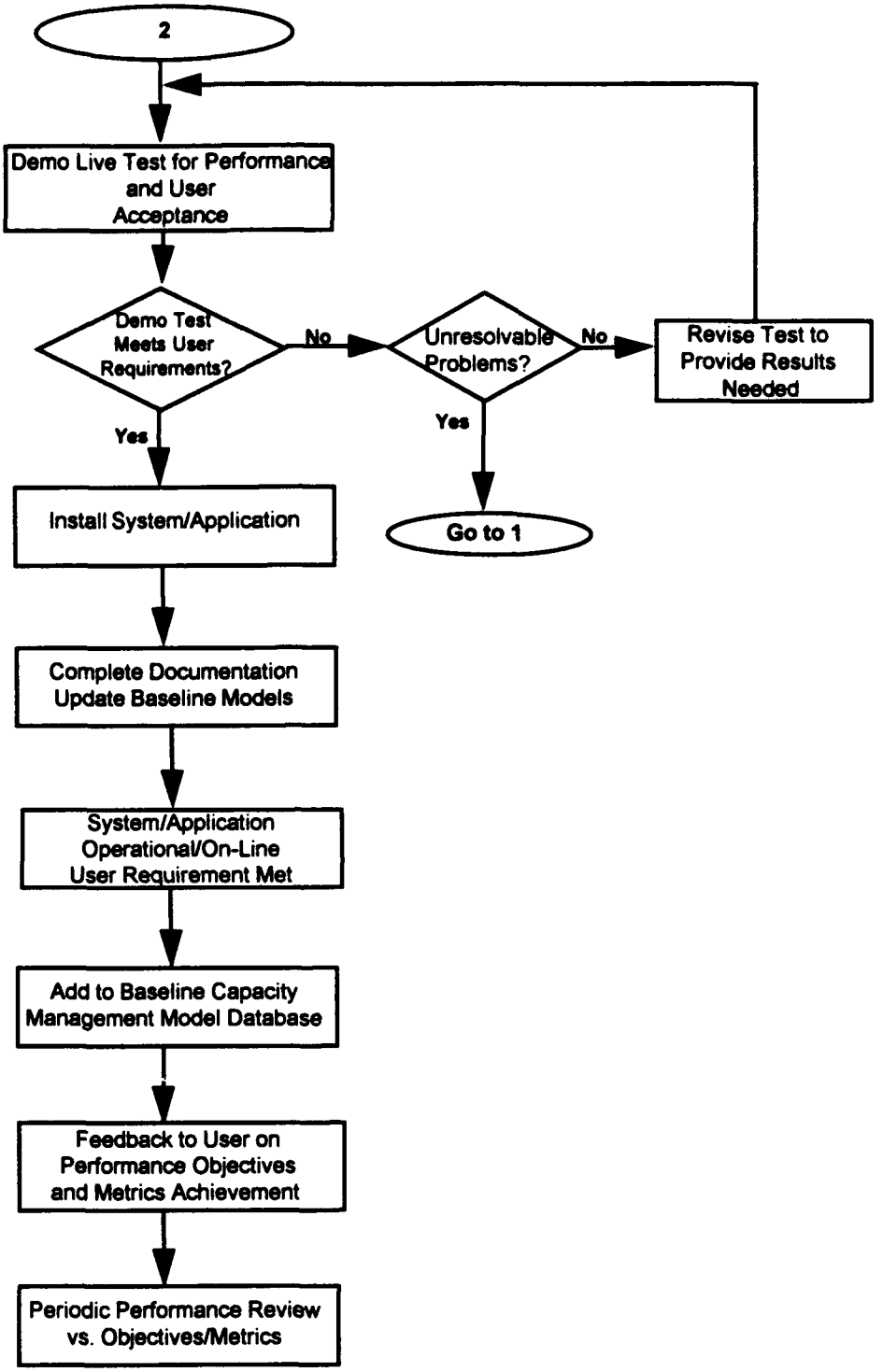


Figure 2-4
Typical Life-Cycle Design and Development Process (Continued)

Discussion and Recommended Guidelines for CM Policy

The workshop team recognizes that implementation of this Capacity Management (CM) Function across the entire Department of Defense (DoD) will require understanding, cooperation, and planning by all DoD Services and Agencies. For this implementation to be successful, a comprehensive and DoD-wide application of these CM functional activities must occur.

This will require executive-level management commitment and support by each DoD Service and Agency. Participation of senior management includes providing the authority for implementing and executing the CM Function, as well as, establishing overall objectives and standards, defining reporting requirements, and ensuring all the elements needed for a quality CM Function are in place. These elements include, funding, procurement vehicles, adequate staffing levels and skills, backup disaster recovery capability, cost-recovery processes (e.g., "chargeback"), etc. Further, senior management must ensure that this CM Function is incorporated into all DII/IS performance, planning, and life-cycle activities for mainframes, networks, and communication systems.

Since there are many capacity management (or other named "performance") programs in place for Information Systems throughout the DoD, C3I policy should promulgate this CM Function as the target-objective program to be implemented by all Services and Agencies, over a specific period of time.

This CM Function is designed to promote standard CM practices and reporting for all levels of management. Although the "mainframe" area of the DII has used capacity management processes for a longer period of time, standard performance measurement data are available for most (if not all) computers, networks, and communication systems. (However, the lack of interoperability of many network protocols is still a problem, and comparability of report content is often not possible.)

Overall C3I policy must encourage, support, and require that common standards and measurement capabilities for performance measurements, capacity planning, performance prediction (e.g., for workloads, system operations, networked user configurations) etc., are identified and used for all DII/IS configurations.

It is through these standard CM practices that planning for current and future DII/IS requirements can be documented, and addressed from comparable sources, that will illustrate (through various levels of detail) what the "big picture" looks like.

Thus, standard reporting practices will enable senior management to make knowledgeable decisions affecting changes to operational systems, procurement of new systems, development of funding requirements, preparation of justifications for enhancements, merger of systems, etc.

(Note: These recommended guidelines are supported throughout the narrative text in Section 2 of this report, and the recommendations in Section 5 [Improvement Opportunities].)

Next Steps Toward Implementation

The results of this workshop will provide C3I with the foundation, along with other related and on-going C3I initiatives, to develop policy and management guidance for implementing the CM Function across the DoD.

Next steps include delivery and briefing of the workshop results to DISA and the Deputy Assistant Secretary of Defense for Information Management (DASD/IM) C3I, (who sponsored this project), and to Defense Information Services Organization (DISO). DISO has been a full time participant in the development of this Capacity Management Function and is preparing to use results of this workshop in their implementation planning for Capacity Management in the new Megacenter environment.

Upon completion of this workshop effort, DISA/JIEO/CIM (Joint Interoperability & Engineering Organization/Center for Information Management) will assist both DASD/IM C3I, and DISO, in their efforts to implement this CM Function across the DoD. Additional DISA efforts may include (at C3I direction) assisting all DoD Services and Agencies in understanding and implementing this Capacity Management Function.

Workshop Mission

The mission of this Capacity Management workshop is to define and prepare a TO-BE (future) DII model of activities and data for : CM Function, and to develop comprehensive templates that can be used DoD-wide across all Information Systems (IS) and networked components. This workshop is intended to provide integrated models that can be used DII-wide, and that DASD (IM) can use as a basis for developing CM policy and guidance.

Workshop Objectives

The objectives of the workshop were to:

(1) Identify, document, and model all primary DoD Capacity Management practices and Activities including:

- Identify Requirements Support Activities
- Elements of Capacity Management
- Capacity Planning Practices
- Performance Measurement and Monitoring Processes
- CDA System Development Processes
- CM Project Management Activities
- Baseline Capacity Management Modeling Processes

(2) Transform the baseline AS-IS model into a TO-BE model, eliminating non-value added processes and providing the additional functionality to meet future DoD DII/IS requirements, while adhering to "best business practices".

(3) Focus on defining a DII-wide activity model, and discovering improved CM functional processes for Megacenter/Mainframe and Communications Network environments..

(4) Produce a foundation model to provide input to C3I policy, and the design of a strategic CM plan to aid implementation at the operational level (e.g. DISO, DISN base-level military installations, CDAs, Network and Communications Centers, etc.)

Workshop Scope

The scope of this workshop is to define the TO-BE process and data models for the DoD Information Systems Capacity Management Functional Activity. This scope covers the PC-to-Mainframe (end-to-end) environment of the Defense Information Infrastructure (DII), including Megacenters/Mainframes, CDAs, Networks, DISN, and Client/Server and distributed architectures to which the CM Function will eventually be applied to foster end-to-end Capacity Management capabilities.

Workshop Schedule

TASKS	19-23 July	26-30 July	2-6 Aug	16-20 Aug	23-27 Aug	13-17 Sep.	20-24 Sep	27 Sep-1 Oct	4-8 Oct	18-22 Oct.	25-29 Oct.
(1) Define Mission, Scope and Objectives											
(2) Review Baseline AS-IS Activity Models											
(3) Develop TO-BE (DII-wide focus) Activity Model and Definitions											
(4) Develop High Level Entity Relationship Matrix											
(5) Identify Improvement Opportunities (IOs)											
(6) Develop TO-BE (Generic Template) Data Model and Definitions											
(7) Organize/Structure Improvement Opportunities											
(8) Prepare Phase III Working Papers											
(9) Prepare Phase III Brief											
(10) Conduct Interim In Progress Review (IPR)											
(11) Develop Communications/ Network Modeling Strategy											
(12) Validate TO-BE Activity Models with SMEs											
(13) Develop TO-BE Data Models for Mainframes, Networks, Communications											
(14) Develop TO-BE Data Model for DII/IS CM Function											
(15) Structure Improvement Opportunities											
(16) Develop Detailed Activity Models for Performance Management											
(17) Define DII/IS Components & Performance Measurements											
(18) Define CM Reporting Requirements											
(19) Prepare Phase IV Working Papers											

TASKS	19-23 July	26-30 July	2-6 Aug	16-20 Aug	23-27 Aug	13-17 Sep.	20-24 Sep	27 Sep-1 Oct	4-8 Oct	18-22 Oct.	25-29 Oct.
(20) Prepare Phase IV Brief											
(21) Evaluate Interoperability of Models and Clarify Definitions											
(22) Prepare Detailed Activity Narratives											
(23) Prepare Draft Final Report											
(24) Prepare Recommendations, Action Plans, & Issues											
(25) Prepare & Deliver Final Report											
(26) Prepare Final Briefing											

Table 2-1. Workshop Schedule (Continued)

List of Participants

The participants who provided the energy and talent to accomplish this workshop are listed below. The Core Team members shown are experts in the field of Capacity Management, provided the fundamental model design, and produced the content of this report. The Subject Matter Experts (SMEs) were brought in at various times to provide specific knowledge to the model development process.

NAME	AFFILIATION	ROLE	PHONE NUMBER
Tom Adkins	NCTC	Core Team Member	(202) 282-0784
Charles Archer, Sr.	DISA/JIEO/CIM/XII	Core Team Member	(703) 285-5323
Dean Eads	DISO-UFCSH	Core Team Member	(513) 257-7751
James Haskins	DLA (DSAC)	Core Team Member	(614) 692-9432
Lawrence Lewandowski	DISO-UMILTP	Core Team Member	(216) 522-5935
Richard Robinson	DISA-UNRRB	Core Team Member	(614) 692-9965
John Bayley	USAISSC	Subject Matter Expert	(703) 806-3583
Lindsay Carpen	DISA/CFE (TEGBN)	Subject Matter Expert	(703) 487-3332
Mary Eskridge	DLA (DSAC)	Subject Matter Expert	(614) 692-9430
Hal Folts	DISA/CFE	Subject Matter Expert	(703) 487-3121
James Howard	DISA/CFE	Subject Matter Expert	(703) 487-3106
Steve Hughes	DLA/DSAC-RMB	Subject Matter Expert	(614) 692-8266
James Kilgore	DISA/CIM	Subject Matter Expert	(703) 285-5323
Eric Meister	DISA/DISO	Subject Matter Expert	(703) 285-5185
Lou Morgan	DISA/DISPO	Subject Matter Expert	(703) 285-5045
Ron Torezan	DASD P&R (ITR) C3I	Subject Matter Expert	(703) 614-1996

Table 2-2. Workshop Team.

The Review Team was a group of senior OSD and DISA managers who participated in a weekly workshop review process which was designed to provide feedback to the core team, and support production of a quality workshop product.

NAME	AFFILIATION	ROLE	PHONE NUMBER
Bill Beyer	DASD P&R (ITR) C3I	Review Team Member	(703) 614-1953
John Hunter	DISO-UAT	Review Team Member	(703) 285-5195
Mark Scher	DISA/JIEO/CIM/XI	Review Team Member	(703) 285-5323
Jack Williams, Jr.	DISO DCSOPS	Review Team Member	(301) 878-5595
Warren Woolsey	DISA/CFE (TEGBN)	Review Team Member	(703) 487-3332

Table 2-3. Review Team.

NAME	AFFILIATION	ROLE	PHONE NUMBER
Steven Stark	D. Appleton Company, Inc.	Facilitator	(703) 812-8666
Catherine Wood	D. Appleton Company, Inc.	Assistant Facilitator	(703) 812-8666
Stacey Kenton	D. Appleton Company, Inc.	Technical Analyst	(703) 812-8666

Table 2-4. Facilitation Team.

Core Team Member Profiles

NAME	PROFILE
Tom Adkins	Naval Computer and Telecommunications Command. Head of DPI Operations for nine regional computer centers. Responsibilities include: Performance Management, Systems Software, and Capital Purchase Programs.
Charles Archer, Sr.	Project Manager for CM in the Defense Information Systems Agency, Joint Interoperability & Engineering Organization, Center for Information Management (DISA/JIEO/CIM/XII). Project Manager and Action Officer for the DoD Information Systems Capacity Management Function for C3I.
Dean Eads	Serves as lead of the Capacity and Performance Management (CPM) function in the Defense Information Services Organization - Air Force Information Service Center (DISO - AFISC), Systems Engineering Office, Hardware Management Division. Responsible for conducting the DISO - AFISC Capacity and Performance Management Program.
James Haskins	Serves as the Chief, CM Division in the DLA Systems Automation Center. Responsible for conducting the DLA CM Program.
Lawrence Lewandowski	Defense Information Services Organization - Cleveland Center (DISO-CL). Chief, Technical Platforms. Lead Center for Technical Platforms for DISO.
Richard Robinson	Serves as Chief, Configuration Management Branch at the DISN Level II Network Management Center in Columbus, OH (DISA-UNRRB). Responsible for configuration management of the DISN elements managed by the center. Formerly responsible for wide area network design and the development of telecommunications connectivity solutions for the Defense Logistics Agency.

Table 2-5. Core Team Member Profiles.

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Section 3
Approach

Corporate Information Management Methodology

Adherence to the Corporate Information Management (CIM) methodology is an integral part of the strategy for DoD Capacity Management. The focus of the CIM initiative is to affect process improvement within DoD through analysis, simplification, and elimination of non-value added activities, and to employ technological solutions against proven areas in support of functional cost reductions.

The main focus of the CIM initiative is on process improvement and the requirement to develop a business case before specifying policy and/or approving the development of new information systems. CIM objectives include managing DoD system investments to involve the migration and evolution of assets already in place, pointing to development of shared data systems and software reuse. To meet these objectives, the CIM methodology requires the development of a functionally oriented business case that supports the concept of continuous process modernization and improvement as the way of doing business within DoD. To achieve its objectives CIM has stated three principles that will guide its efforts (as taken from the *CIM Process Improvement Methodology for DoD Functional Manager's* guide):

- The customer (the functional proponent with business process authority and performance accountability) defines systems requirements, manages implementation and measures results. The information technology organization becomes a fee-for-service technology service.

- The business process must be simplified before it is computerized. Effectiveness is gained and cost is reduced by changing the way people work.

- Fastest progress, at lowest risk, is achieved by evolutionary migration. Organizations learn best by experiencing frequent successes.

The functional management process, as promulgated by DoD 8020.1-M, is the key directive of the CIM program, and is the official guide to achieving functional process improvements. In accordance with this directive, the Office of the Secretary of Defense (OSD) Principle Staff Assistants are responsible for the development of functional objectives, analysis of the processes, data and supporting information systems needed to satisfy these objectives, development of any necessary process, data, and systems changes to streamline operations and improve cost effective performance, and implementation of the process, data and system changes. OSD Principal Staff Assistants designate Functional Activity Program Managers (PMs) accountable for execution of the functional management process. PMs develop functional architectures and strategic plans, and establish the process, data and information system baselines to support functional activities within the functional area. PMs then conduct a structured, iterative process improvement program that identifies, analyzes and evaluates opportunities to evolve operations toward the functional objectives.

Functional Process Improvement Program

The Functional Process Improvement program (FPIP) was established to implement the CIM objectives through application of process improvement principles across Services and Agencies. It encompasses the general concepts and steps associated with business process improvement as well as the business case when considering investments. The FPIP entails a series of steps aimed at identifying problem areas, formulating strategies for improvement, and assisting the change proponents in selling the plan to the key players in the approval process. These steps are typically undertaken within the forum of a workshop, where functional experts embark on a mission of information collection, analysis, discovery, and strategy formulation.

Specific methodologies adopted and incorporated in FPIP include the use of Integrated Definition (IDEF) modeling and Activity Based Costing (ABC) techniques for the facilitation of business process improvement. IDEF modeling techniques have been used successfully by both the private and public sectors for several years. IDEF was created to define advanced concepts, techniques and procedures for developing logical models to display semantic characteristics of a business environment. These semantic models serve to support business process improvement determination, management of data as a resource, integration of information systems, and building of computer databases. ABC is a disciplined application of cost factors to discrete activity work breakdown structures of a functional area under analysis. The resulting cost structure serves to support analysis and determination of improvement opportunities for process change and subsequent cost reduction. Each decision, beginning with migration system selection and continuing through iterative process improvement and information system technical enhancement, is based upon, and documented through, preparation of Functional Economic Analyses (FEAs). Preliminary FEAs are used by functional area program managers to evaluate alternatives and select a preferred course of action. Final FEAs that incorporate detailed data administration and information system requirements are used to secure OSD Principal Staff Assistant approval to proceed with execution.

Using these techniques, a formal process improvement methodology is followed when business processes are analyzed. This methodology is used to understand the current working environment in terms of its activities in order to apply metrics for improvement, characterize the value or need of each activity, and rank activities for improvements. The ultimate goal is to provide a foundation for and facilitate continuous process improvement. The key elements comprising the process (as identified in the *CIM Process Improvement Methodology For DoD Functional Managers* guide) include:

- Building a model and establishing cost and performance measures of the baseline to be able to demonstrate improvements;
- Identifying and eliminating non-value added activities;
- Emphasizing reuse of assets where possible;
- Automating only after the underlying business process has been cleaned up; and
- Aligning goals, policies and procedures within the CIM Integration Architecture.

CIM Business Process Improvement Workshops

CIM Business Process Improvement Workshops are designed to provide DoD functional managers with an understanding of the business process improvement objectives associated with the CIM initiative. The workshops enable functional managers to identify current problems, establish business activity costs, propose change alternatives and implement process improvements in their organizations. The CIM methodology employs established modeling techniques, (e.g., IDEF0, IDEF1X, Activity Based Analysis, Activity Based Costing (ABC), etc), to aid in the discovery of process inefficiencies, costly non-value added activities and poor business practices. For reference, a guide to IDEF modeling techniques is contained in Appendix A.

A typical sequence of workshops begins with a two week Baseline Workshop that identifies one or more specific areas for process improvement. The workshop team explores a wide range of business processes and assesses the quality of the AS-IS process. From this analysis, improvement targets are identified and documented to become the subject of follow-on workshops.

Capacity Management ABA Process Improvement Workshop Approach

The approach used in this workshop differs from traditional ABC Foundation workshops, due to the need to rapidly develop the TO-BE activity and data models for the future CM Function. ABC foundation cost analysis techniques were not used in this workshop, although future workshops for CM may well involve detailed cost analyses.

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Section 4
Activity and Data Models

Introduction to Activity Models

The team develops workshop core activity models from their collective knowledge about the process during facilitated sessions. Subject matter experts are interviewed on areas determined to be outside the team's collective expertise. They may also gain knowledge and insight into processes through available materials (e.g., documents, forms, procedures, and existing activity models, etc.). The scope, purpose, and viewpoint are boundaries that help the team determine what is relevant for inclusion in the models. A detailed explanation of IDEF modeling techniques is provided in Appendix A.

An activity model has three components:

- Node Tree Diagrams
- Context Diagram
- Decomposition Diagrams

Node Tree Diagrams

Node tree diagrams are used to portray activities in a hierarchical format. Each activity is represented by a dot. The parent activity that entails the scope of the activity model is placed above its component sub-activities, with lines connecting the top node to each sub-activity node. The sum of the sub-activities equal the whole of a complex activity. It is analogous to a work breakdown structure. The component nodes may be further decomposed into sub-components, until a level is reached that adequately represents the required activity breakdown. Each node is labeled with the name of the activity or sub-activity it represents, with an additional identifier consisting of a letter followed by one or more numerals. A node tree diagram is often thought of as a table of contents for the activity model. As such, it depicts the breadth of the business area being modeled and the depth of the modeling effort.

Perform Capacity Management Node Tree

The node tree produced in the DISA Capacity Management ABA Workshop on the following page, is developed to represent the scope of the activities being modeled. The node trees show the activities and the associated sub-activities. Each node or dot on the diagrams represents a significant activity, and each line represents a decomposition relationship between the activities. These models are created as a decomposition of the A0 Activity **Perform Capacity Management**.

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ELECTRONIC FILE NAME: NODETREE	AUTHOR: DoD Capacity Management Team NEW DATE: 11/16/93 PROJECT: DoD Capacity Management REV DATE: 10/27/93 REV NO: NOTES: 1 2 3 4 5 6 7 8 9 10		WORKING	READER	DATE	CONTEXT: Top
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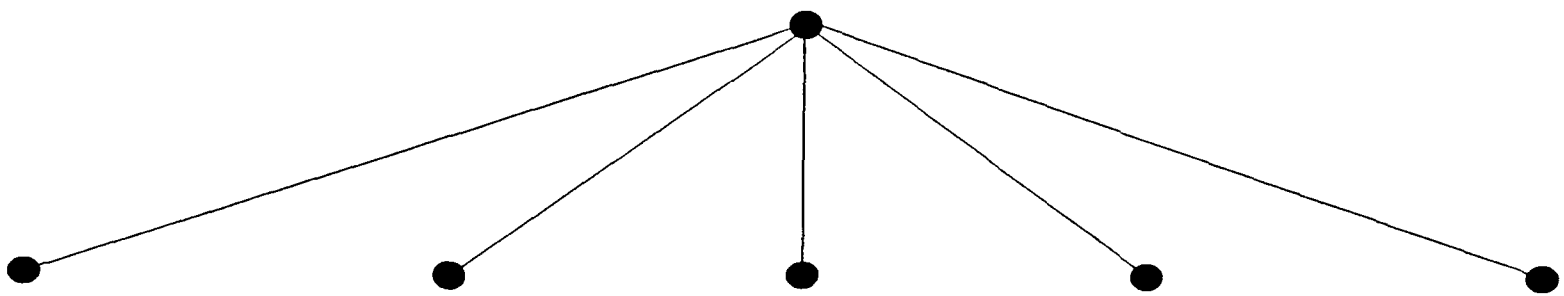

A0
PERFORM CAPACITY MANAGEMENT

A1
MANAGE SERVICE

A11 Provide Requirements Support

- **A111 Register Request**
- **A112 Determine Feasibility of Request**
- **A113 Provide Support Liaison**

A12 Provide Project Management

- **A121 Perform Project Planning**
- **A122 Perform Requirements Analysis**
- **A123 Schedule Projects**

A13 Establish Support Requirements

- **A131 Prepare Financial Support Requirements**
- **A132 Establish Staff Support Requirements**
- **A133 Establish Training Support Requirements**
- **A134 Establish Contractual Support Requirements**

A2
PROVIDE INFORMATION

A21 Acquire Data

A22 Administer Data

A23 Provide Routine Reporting

A3
MANAGE PERFORMANCE

A31 Measure Performance

- **A311 Establish Measurement Plan**
  - **A3111 Determine Components to be Measured**
  - **A3112 Establish Performance Metrics**
  - **A3113 Identify Performance Targets and Thresholds**
- **A312 Retrieve Selected Data**
- **A313 Conduct Performance Measurement**

A32 Monitor Performance

- ***A321 Compare Performance with Targets and Thresholds***
- **A322 Determine Performance Exceptions**
- **A323 Generate Performance Reports**

A33 Perform Benchmarking
A34 Conduct Problem Diagnosis
A35 Conduct Problem Resolution

A4
PLAN CAPACITY

A41 Analyze Capacity

- **A411 Establish Analysis Approach**
- **A412 ID User Workload Projections**
- **A413 Modify Workload Modeling Parameters**
- **A414 Perform Modeling Modification Analysis**
- **A415 Conduct Performance Prediction Impact Analysis**

A42 Develop Capacity Plans

A43 Develop Change Recommendations

A44 Develop Network/Communication Interface Requirements

A5
MAINTAIN CAPACITY MANAGEMENT MODELS

A51 Certify Baseline DII/IS Models

A52 Build Baseline DII/IS Models

A53 Validate Baseline DII/IS Models

NODE: NODE TREE	TITLE: PERFORM CAPACITY MANAGEMENT	VIEWPOINT: DII/DASD(IS)

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Context Diagram

The parent activity represented in the context diagram is equivalent to the top most activity node in the node tree diagram. A context diagram consists of a single activity box and its related inputs, controls, outputs, and mechanisms (ICOMs). The context diagram establishes the scope of the process being modeled. ICOMs are used to represent information or materials used in or produced by an activity, and data or objects involved in an activity. The ICOM names or labels are nouns and noun phrases. An ICOM has four possible roles relative to an activity:

- Input. Information or materials which are transformed or consumed in the production of the outputs of an activity. (Arrow entering left side of an activity box.)

- Control. Information or materials that govern, constrain, or trigger the operation of an activity. It regulates the transformation of inputs to outputs. (Arrow entering the top of an activity box.)

- Output. Information or materials that are produced by an activity or results from an activity. (Arrow leaving the right side of an activity box.)

- Mechanism. People, machines, resources or existing systems that perform (enable) an activity, or provide energy to an activity. (Arrow entering the bottom of an activity box.)

The scope for the current modeling effort was initially identified and recommended by the DISA Capacity Management Baseline Workshop completed 2 July 1993. The scope of that two-week effort focused modeling the AS-IS process of the CM function for DoD Megacenters and their Central Design Activity (CDA) Interfaces.

This ABA Workshop focused on modeling the TO-BE processes of "**Perform Capacity Management**" across Mainframe, Megacenters, Networks and Communication Systems. The team developed the A0 level for this model, using the baseline model developed during the first DISA Capacity Management Workshop as a starting point. The Capacity Management Context diagram developed by this workshop is shown on page 4-7.

A-0 PERFORM CAPACITY MANAGEMENT

The CM Function provides a structured framework for managing the performance and capacity planning of Information Systems, networks, and communications resources (PC-to-Mainframe) to ensure that: (1) resources are sufficient and available to meet defined user service-level objectives and capacity requirements, (2) resource utilization is cost-efficient, effective, and well-managed, (3) performance is monitored, measured, and evaluated to ensure maintenance of required performance levels, and (4) workload forecasts are made, reserve capacity is available, and all security requirements are met.

The CM Function is composed of five model Activities:

(1) **Manage Service**
(2) **Provide Information**
(3) **Manage Performance**
(4) **Plan Capacity**
(5) **Maintain Capacity Management Models**

It provides a structured process for analyzing and managing the performance and capacity planning activities associated with information systems (including: networks and communication modes/media) and the services they provide to meet user performance objectives. CM also involves performance evaluation of hardware and software, system resources, network topologies, communications capabilities, capacity thresholds, costs, configurations, and capacity levels. Performance levels and metrics are primarily defined and measured against (1) service level objectives, and (2) vendor operating specifications. Further quality controls are necessary for all CM functions to ensure that desired results are produced which promote efficiency and effectiveness in the performance of CM activities. The primary focus of these activities is to ensure that user requirements can be met in current and future system environments in a cost effective and timely manner.

The Activities modeled in this CM Function are intended to provide a standard approach for the implementation of a CM Function for all systems and components of the Defense Information Infrastructure/Information Systems (DII/IS), which includes all computers, communications and networks in the CONUS and other theaters of DOD fixed and mobile operations. To provide this support, the CM Function coordinates with the appropriate divisions of each organizational element (e.g., Megacenter, CDAs, base-level military installation, IPC, MILDEP, etc.) that interfaces with their user community, and where CM Functions are implemented. The CM Function also provides information to the IRM planning process on system capacity and performance issues. Baseline and performance prediction models are developed and maintained by the CM Function, and may be used as input to the design and configuration functional areas. An element essential to the effectiveness of the CM Function is the use of cost-recovery systems (i.e., Fee-For-Service) that can provide information on resource and capacity utilization, and cost attribution, as is related to the performance and use of DII/IS components. All of these CM activities provide an integrated base for the effective performance management of an organization's information systems assets.

Electronic File Name:	AUTHOR: DoD Capacity Management Team	NEW DATE: 11/16/93	RECOMMENDED			CONTEXT:
CAPMGT.IDD	PROJECT: DoD Information Systems (IS) Capacity Management Function	REV DATE: 10/27/93	WORKING			Top
		REV NO:	DRAFT			
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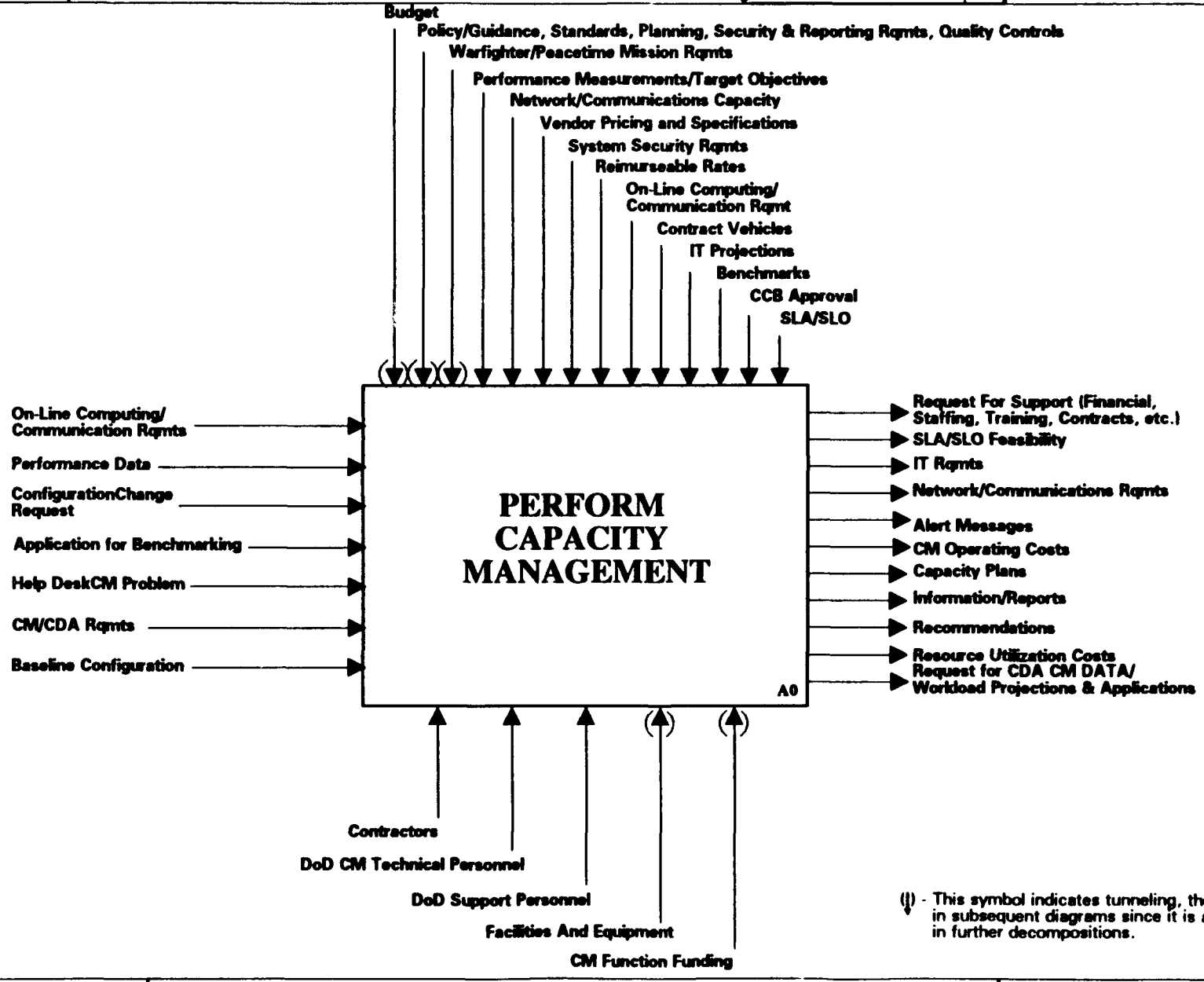

(!) - This symbol indicates tunneling, the ICOM will not appear in subsequent diagrams since it is an ICOM to all activities in further decompositions.

NODE:	TITLE:	VIEWPOINT:
A-0	Perform Capacity Management	DII/DASD(IM)

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Decomposition Diagrams

A decomposition diagram describes the details of an activity and the relationships between the activities within a decomposition level. In the decomposition process, the modelers break down an activity by identifying its sub-activities. The ICOMs that interact with the activities are depicted, documenting the activity associations and the data needed within the process. Unlike a node tree, which can show several levels of sub-component activities at once, a decomposition diagram shows only one level of the sub-activities. Each decomposition diagram further details the component activities of its parent activity. The activity modelers check to ensure that the activity views are consistent from one level to the next.

Perform Capacity Management Decomposition Diagrams

The team uses decomposition diagrams to represent the TO-BE business processes in Capacity Management. The models reflect the consensus of the Services and Agencies represented in the workshop.

The purpose of this activity modeling effort is to discover the business process improvement opportunities for A0 Perform Capacity Management.

The core team identified five major sub-activities of A0 Perform Capacity Management: A1 Manage Service, A2 Provide Information, A3 Manage Performance, A4 Plan Capacity, and A5 Maintain Baseline Models. The decomposition diagrams depicting these activities begin on page 4-11 of this report.

While all five of the activities are equally important to the process of Perform Capacity Management, the time schedule allocated for this workshop precluded detailed decomposition and analysis of all 5 major sub-activities. Thus, the group prioritized the **A3 Manage Performance** and **A4 Plan Capacity** Activities for detailed analysis in this workshop. The criteria for prioritization was based on what the team intuitively felt would hold the highest return on investment in terms of improvement. Page 4-17 begins the decomposition diagrams for Activity **A3 Manage Performance**. Page 4-25 begins the decomposition diagrams for Activity, **A4 Plan Capacity**.

Descriptions of each activity are contained in Appendix B, and the Input, Control, Output, and Mechanism (ICOM) definitions are contained in Appendix C.

A0 PERFORM CAPACITY MANAGEMENT

Perform Capacity Management activity is comprised of five major activities: (1) **Manage Service**, (2) **Provide Information**, (3) **Manage Performance**, (4) **Plan Capacity**, and (5) **Maintain Capacity Management Models**. Each of these activities have a specific purpose and are integral processes that support the effectiveness of the CM Function across DII/IS configurations. The roles of these activities are explained below.

Manage Service can best be described as a "front door" of the CM Function. It provides an interface to the Information Processing Center (IPC), Central Design Activity (CDA), or other management structures for providing support for performance or capacity planning issues in meeting user requirements and service level objectives, as well as, performance measurement or modeling activities. These CM support requirements, etc., are determined by a specific organizational element (e.g., CDA/IPC, application division, communications and/or network divisions, etc.), with the assistance of the CM staff as pertains to performance and feasibility issues, or customer service unit that works with the CM staff, to ensure user support requirements (e.g., service level objectives, etc.) can be met, and that user service indicators are meaningful and measurable.

The primary purpose of the Manage Service function is to ensure that all measures, configuration changes, performance software, version upgrades, network and communications requirements are registered (logged in), analyzed for feasibility, and entered into the on-line project management tracking system, where they will eventually be submitted to the appropriate CM area in the form of a work assignment.

Provide Information is the area of CM that maintains a central CM information/DII/IS model database. The Provide Information activity provides information for the generation of standard and ad hoc reports, and cost information on resource utilization for CM performance and planning activities for the information system environment. It also provides a central source (e.g., CM information/DII/IS model database) for the maintenance, distribution, or reporting of CM information. This activity collects data/model information received from all performance and capacity planning activities, and works in conjunction with the Manage Service Activity. This Activity receives tasking from the **Manage Service** Activity and enters the tasking information into an on-line project management and tracking system.

Manage Performance describes how we measure, monitor, and control the performance levels and configuration of an information systems environment. It is also concerned with how to achieve measurable service level objectives, and with using advances in technology to enhance system operations. In addition, determinations and recommendations are made here on how the performance of applications or system components may be improved, as observed during performance monitoring activities.

Plan Capacity is a focus on the future: how to predict the performance of current and future workload requirements (e.g., added capacity requirements, additional terminal or network connectivity, added communications capabilities, etc.), and identify the costs associated with elements of future capacity planning. This activity also provides reports and guidance for input to the Agency or Department Information Resource Management (IRM) plan, and the IPC/Megacenter CM short- and long-range plan.

Maintain Capacity Management Models is concerned with the maintenance, development, refinement, and management of current baseline Capacity Management models. These baseline models will be used to identify hardware, software, and configurations of current systems and components, as a basis for comparing and modeling changes to configurations that may enhance performance or capacity requirements. Further, these models may be used for simulating database information size requirements, new applications and system configurations, etc., that may be added to the current environment. All baseline models (e.g., CDA-application, baseline, data, and configuration models, etc.) are provided to the **Provide Information** Function, and are stored in a CM information/configuration model database.

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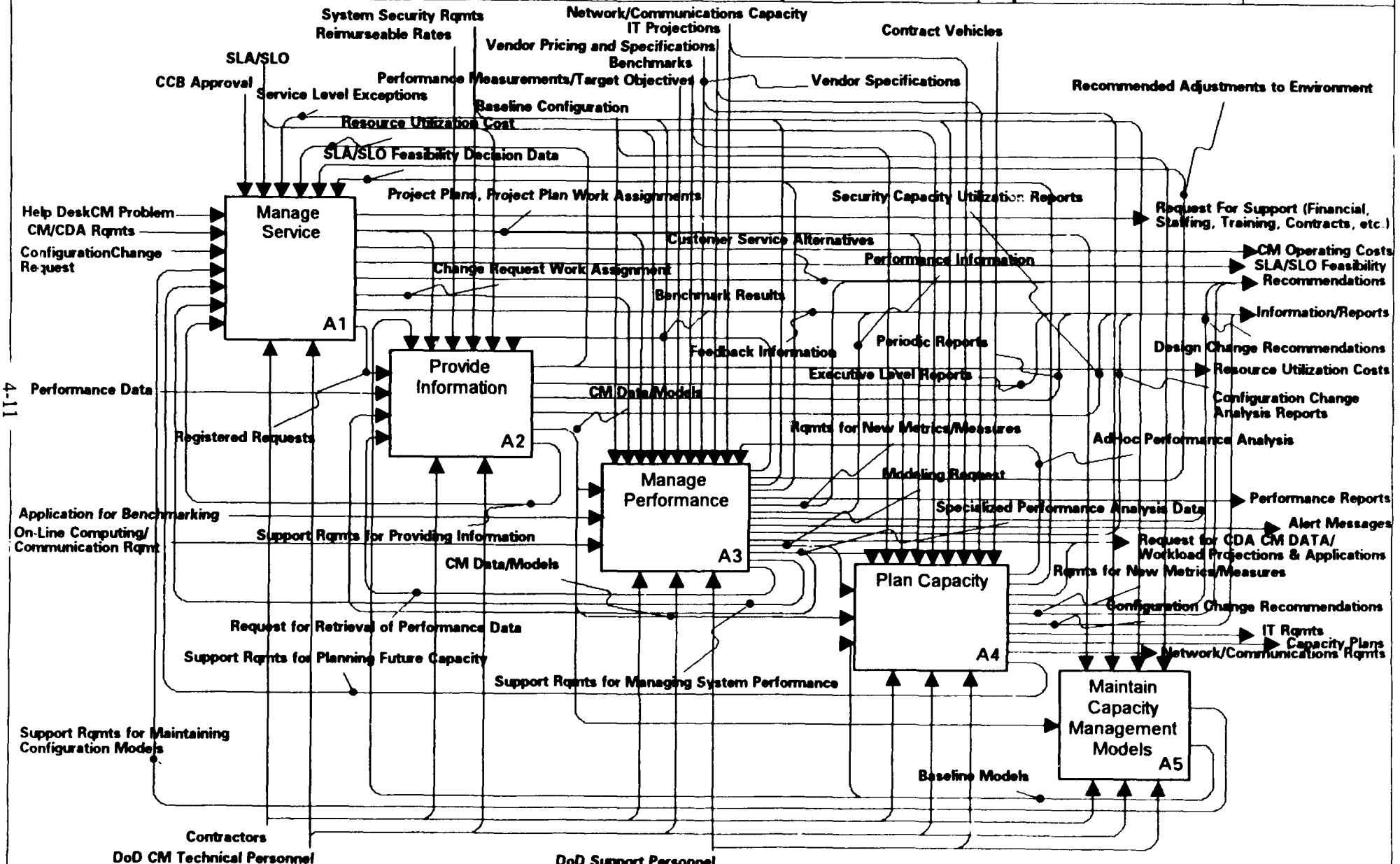

NODE:	TITLE:	VIEWPOINT:
A0	PERFORM CAPACITY MANAGEMENT	DII/DASD(IM)

A1 MANAGE SERVICE

Manage Service is comprised of three major activities: (1) **Provide Requirements Support**, (2) **Provide Project Management**, and (3) **Establish Support Requirements** (Financial, Staffing, Training, and Contracts, etc.). All three processes provide a fundamental "front door" to management of the whole Capacity Management function. These activities all focus on the management of CM Functions, and they provide a liaison or interface with various organizational and management levels of a Megacenter, CDA, IPC, etc., on capacity management-related issues in support of user community requirements.

Provide Requirements Support is the interface to the CM Function that provides "help desk" liaison and feedback on performance measurement of service level objectives, capacity planning, and workload forecasting activities to a requestor (e.g., Megacenter, IPC, CDA management, etc.). In addition, this activity also registers (logs in) the request for support, determines the feasibility of executing the request, and enters the support request into the on-line project management and tracking system for further action.

Provide Project Management translates requirements for performance support services into project plans/work assignments. This activity analyzes incoming requirements in order to plan and schedule all CM projects (e.g., performance feasibility studies, software performance changes, etc.). All tasks are tracked to completion through the on-line project management and tracking system.

Establish Support Requirements (Financial, Staffing, Training, Contracts, etc.) receives input from all other activities of the CM Function. These inputs are translated into support requirements necessary for the continued and projected support of day-to-day operations of the CM function. Most of these support requirements are provided to upper management in the form of periodic reports that are prepared in **Provide Information**.

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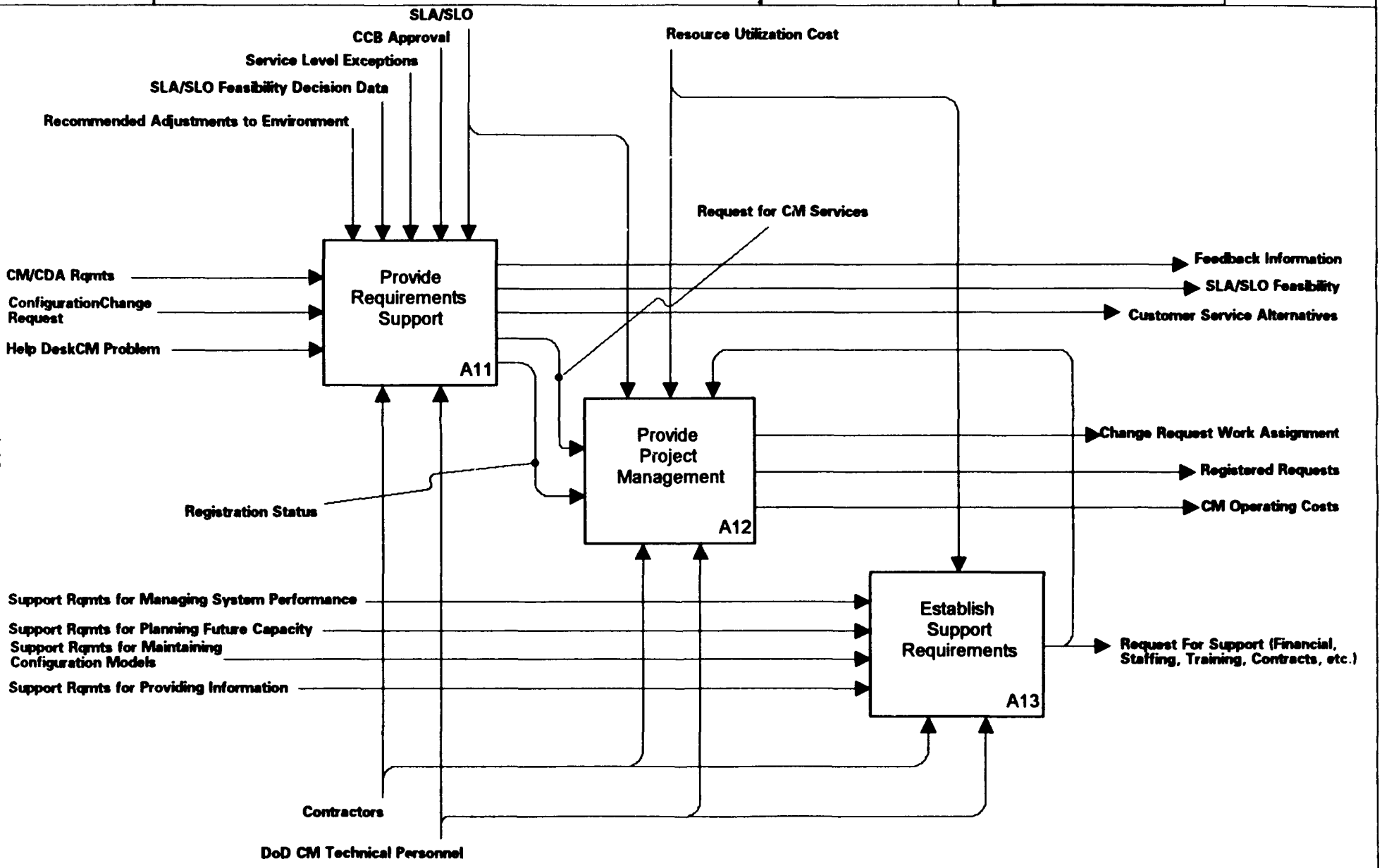

NODE:	TITLE:	VIEWPOINT:
A1	Manage Service	DII/DASD(IM)

A2 PROVIDE INFORMATION

Provide Information is the functional area that stores all data, information, baseline models and reports created by the CM function. It is comprised of three major activities: (1) **Acquire Data**, (2) **Administer Data**, and (3) **Provide Routine Reporting.** The first two activities concentrate on the vital function of ensuring that data required to support capacity management is collected, verified for completeness and accuracy and stored for use in a CM information/DII/IS model database. These data are the foundation from which all reports for capacity management functions are derived. **PROVIDE ROUTINE REPORTING** uses this data to produce periodic and executive level reports.

Acquire Data collects and screens the data necessary to enable the analysis of performance and the monitoring of services provided.

Administer Data ensures that data collected is valid, complete, comprehensive, and accurate. Further, this activity ensures that the data complies with DoD data administration standards, and represents all CM Functional areas.

Provide Routine Reporting uses the stored data to produce periodic reports to various levels of management both internal and external to the CM Function. These reports may include: summaries of changes that occurred during the reporting period, utilization data, workload data, trend data, reliability data, etc. A listing of typical reports produced is shown in Table 4-4, Capacity Management Reporting Requirements. (Note: It was considered that most of the reports required for the CM Function might be stored in a maximum of one or two databases.)

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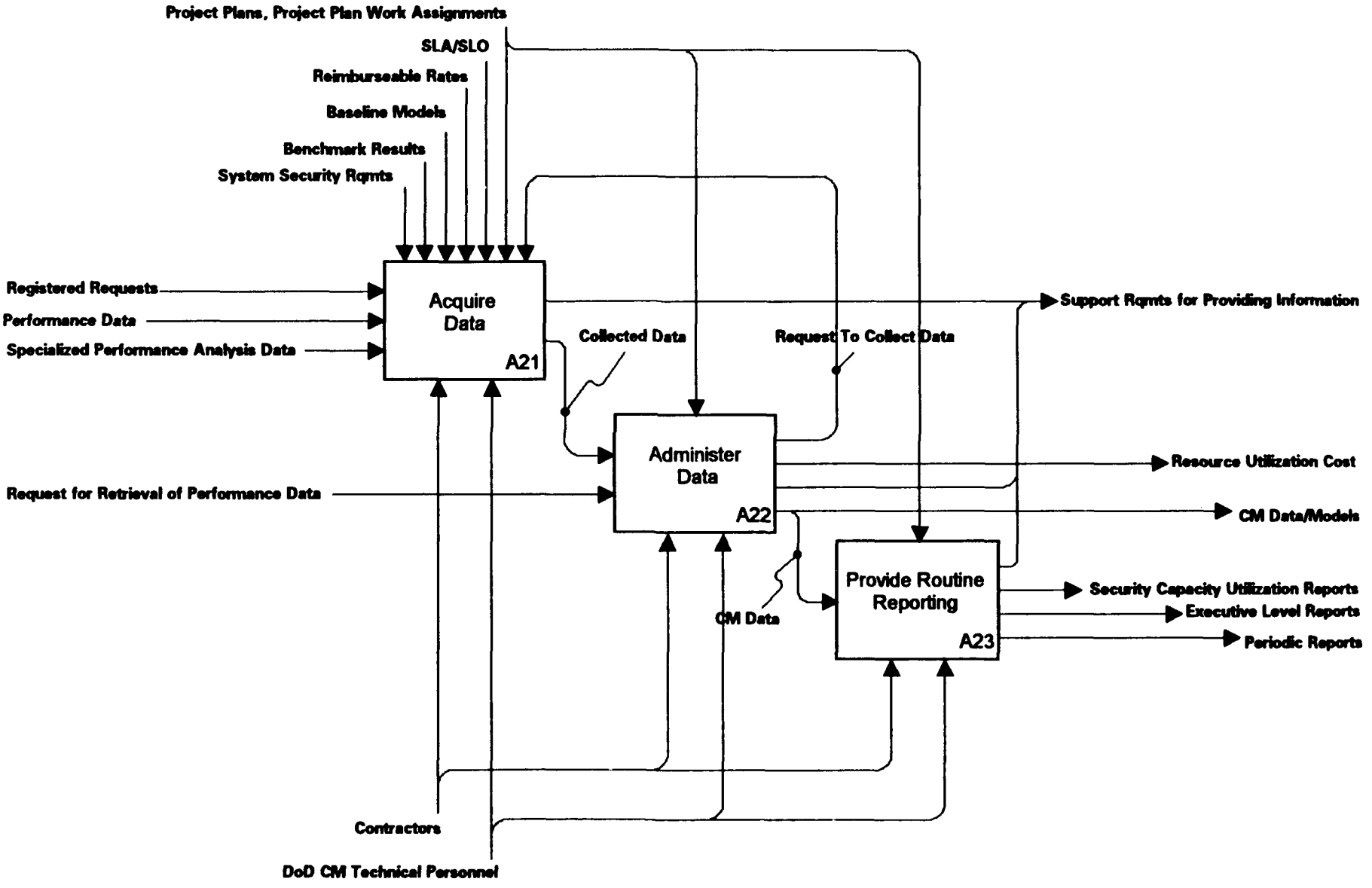

NODE:	TITLE:	VIEWPOINT:
A2	Provide Information	DII/DASD(IM)

A3 MANAGE PERFORMANCE

Manage Performance is comprised of five major activities: (1) **Measure Performance**, (2) **Monitor Performance**, (3) **Perform Benchmarking**, (4) **Conduct Problem Diagnosis**, and (5) **Conduct Problem Resolution**. The purpose of this activity is to measure, monitor, report on performance levels and the configurations of DII/IS environment.

Measure Performance retrieves CM data (e.g., component utilization, throughput, response times, latency, reserve capacity, etc.) from a performance data base repository and generates levels of performance measurements of the DII(IS) environment.

Monitor Performance uses the generated measures to compare the performance of the DII(IS) environment to established standardized targets and service level objectives. This activity identifies performance problems for action and resolution.

Perform Benchmarking is a test of hardware/software components or applications that execute on an IS environment. A benchmark provides an evaluation or comparison of performance tests of information system and/or application programs based upon specific criteria and standards. This activity is performed in order to better understand and predict performance results and impacts on an operational IS environment.

Conduct Problem Diagnosis analyzes and evaluates performance problems in order to identify their cause(s). Specialized performance data may also be gathered and analyzed to assist in understanding the problem and developing diagnoses. The diagnoses are passed on for performance problem resolution.

Conduct Problem Resolution recommends solutions to the identified performance problems commensurate with the diagnoses. The result is recommended performance adjustments and performance tuning recommendations to the IS environment.

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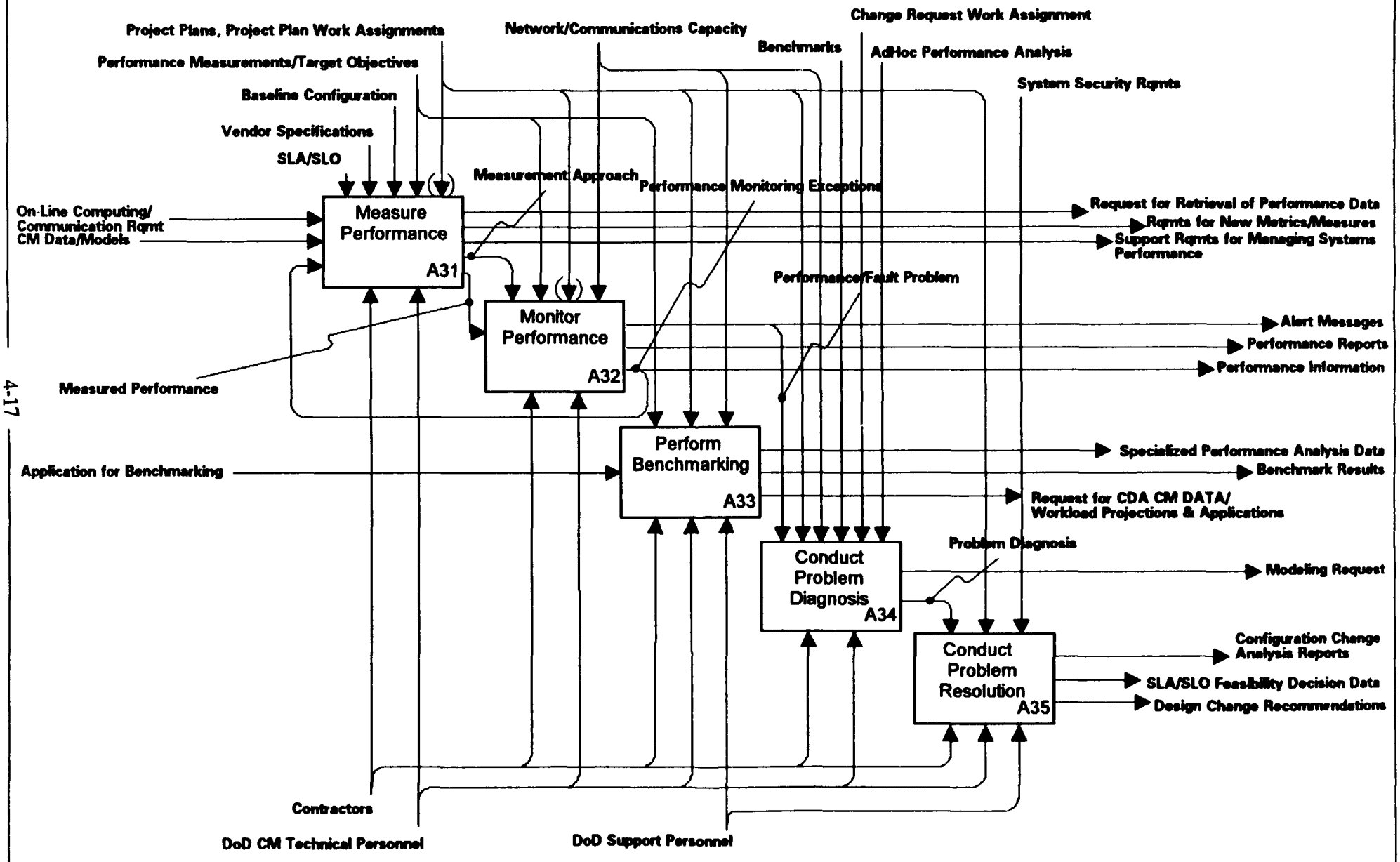

NODE: A3	TITLE: Manage Performance	VIEWPOINT: DII/DASD(IM)

A31 MEASURE PERFORMANCE

Measure Performance retrieves/collects and analyzes data to determine performance levels of all systems and components (e.g., mainframes, communication systems, networks). Measurements include system utilization, memory storage, disk usage, etc.

Establish Measurement Plan is an activity that defines the goals and objectives for measuring specific components of the DII/IS configuration. This includes (1) identification of performance targets and thresholds to be met, (2) systems and components to be measured, and (3) specific metrics to be used to measure achievement of performance objectives. This includes a determination of which specific tools and data extraction or manipulation routines are needed to perform the measurements.

Retrieve Selected Data supports the performance measurement process. It is necessary that sufficient data of an adequate level of detail be captured and stored for retrieval upon demand. This requires that use of data collection routines and software for monitoring and measuring the performance of all system components. The data collected must be stored in a compatible and accessible format.

Conduct Performance Measurement conducts specific performance measurements on components of the DII/IS using established and related metrics. These systems or component measurements include: memory utilization, CPU busy, bandwidth capacity, response-time, port/hub contention, queuing delays, etc., and associated metrics. These measurements cover mainframe, communications, and network configurations. The established criteria used must ensure that comparative analyses can reveal whether or not the system or component is performing at acceptable levels (e.g., meeting SLOs, established targets, and thresholds, etc.).

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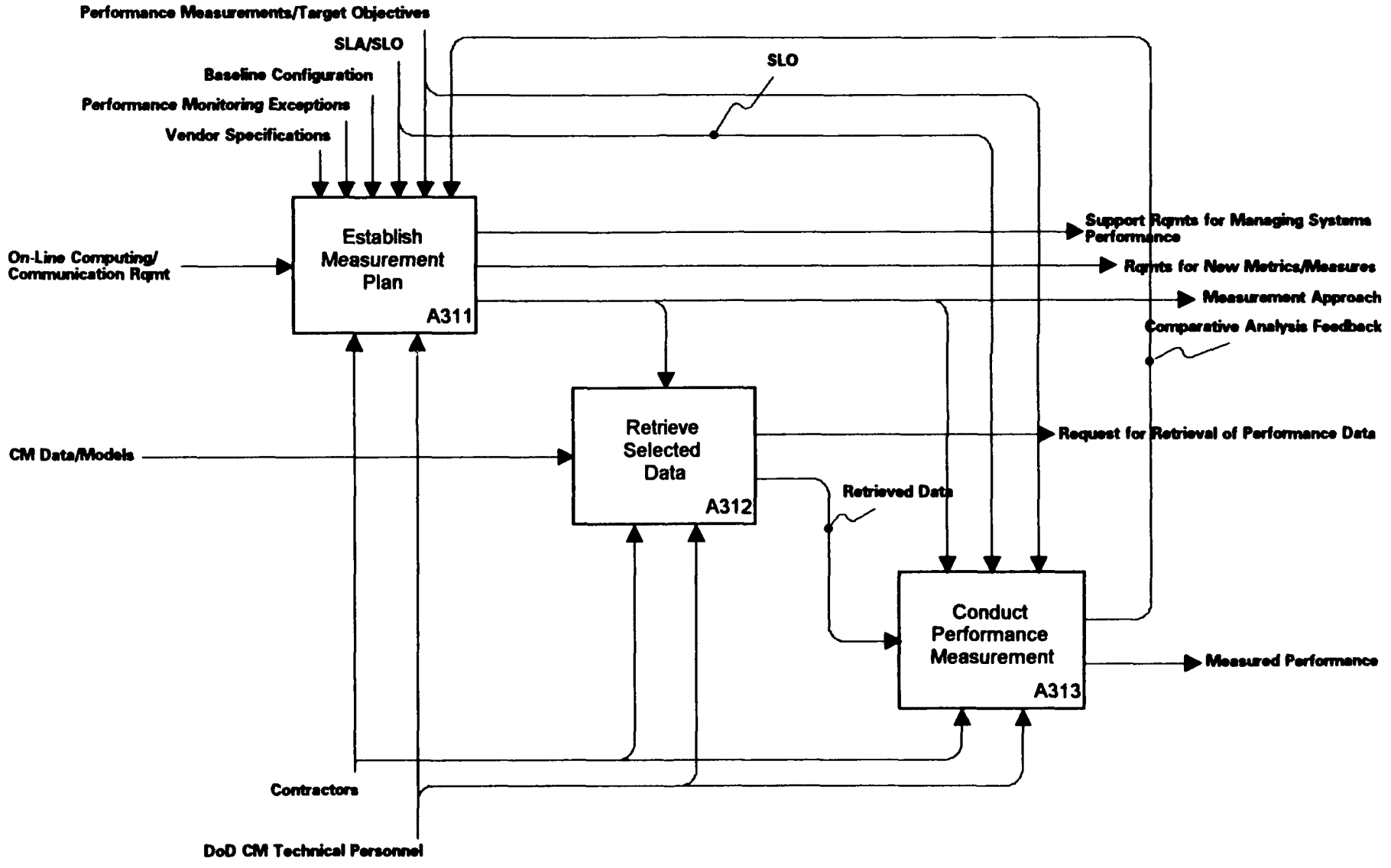

NODE: A31	TITLE: Measure Performance	VIEWPOINT: DII/DASD(IM)

A311 ESTABLISH MEASUREMENT PLAN

Establish Measurement Plan defines the goals and objectives for measuring specific components of the DII/IS configuration. This includes (1) systems and components to be measured, (2) identification of performance targets and thresholds to be met, and (3) specific metrics to be used to measure achievement of performance objectives. The plan would include a determination of which specific tools and data extraction or manipulation routines are needed to perform the measurements.

Determine Components to be Measured determines the DII/IS system, network, and communications components to be measured, as well as, the capability of measuring each component. Components to be measured are those that reflect system performance, or have an impact (direct or peripheral) on the system being measured. They will form the basis for measuring any system or component of the DII/IS configuration.

Establish Performance Metrics determines the performance measurement criteria (i.e., metrics) that are used, or are appropriate, to represent the performance of the system components previously identified and being measured. Since there can be more than one measurement criterion for a specific component, it is necessary to establish comprehensive and representative sets of metrics for each component, and to ensure that metrics are established to measure the performance of all DII/IS system components.

Identify Performance Targets and Thresholds are designed to foster accurate analyses of system components. This is necessary to identify specific target goals, and acceptable thresholds, and to ensure efficient and effective performance and operations. These targets and thresholds for the measured components must, collectively, support organizational performance goals and objectives, user SLOs, and warfighter mission requirements.

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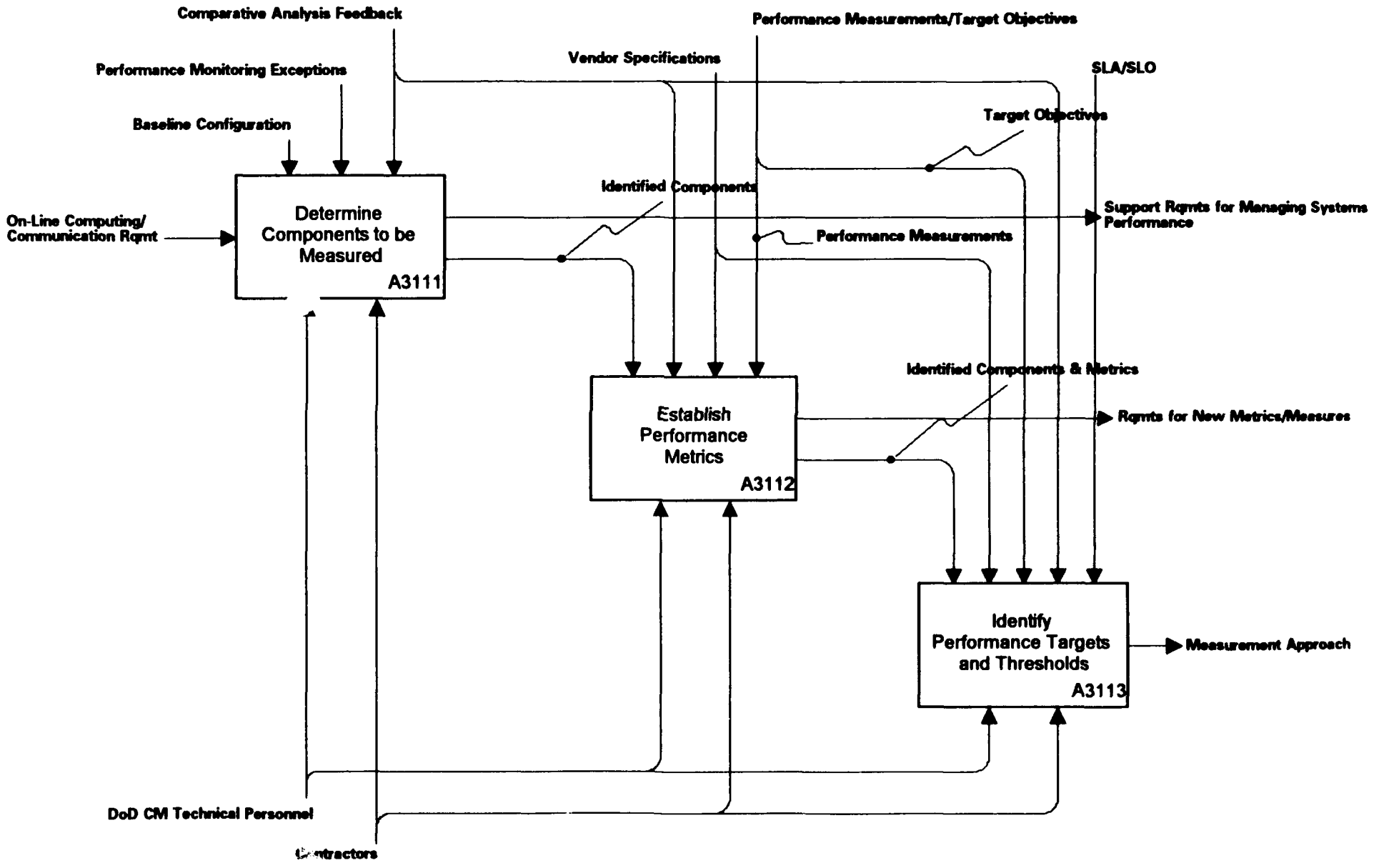

NODE: A311	TITLE: Establish Measurement Plan	VIEWPOINT: DII/DASD(IM)

A32 MONITOR PERFORMANCE

Monitor Performance monitors the level of actual performance activities against the defined target objectives. It also identifies performance exceptions and provides reports on performance monitoring activities.

Compare Performance with Targets and Thresholds receives performance measurement data from the **Measure Performance** Activity and compares these measurements against established performance objectives (i.e., targets and thresholds). Examples of performance data include: utilization, response time, transaction rates, million of instructions per second (MIPS), etc. The measurement data will be compared against the service level objectives (SLOs), vendor component specifications for performance levels of DII/IS components and systems, etc., to produce a performance comparison report.

Determine Performance Exceptions identifies exceptions where actual components and systems (collections of DII/IS components) have exceeded performance measurement thresholds or alarm conditions. For example, if the threshold SLO for user response time is two seconds, any measurement of response time greater than two seconds would be viewed as an exception. Performance exceptions may also be caused by: incomplete, unclear, or insufficient measurement data.

Generate Performance Reports generates information reports on a variety of issues relating to the comparison of performance measurements. These reports will document how well actual established targets and thresholds are met for components measured . This activity also provides exception reports that assess incomplete component measurements, or incidents when anomalies have occurred during the measurement process, or have not provided sufficient data to perform a comparative analysis.

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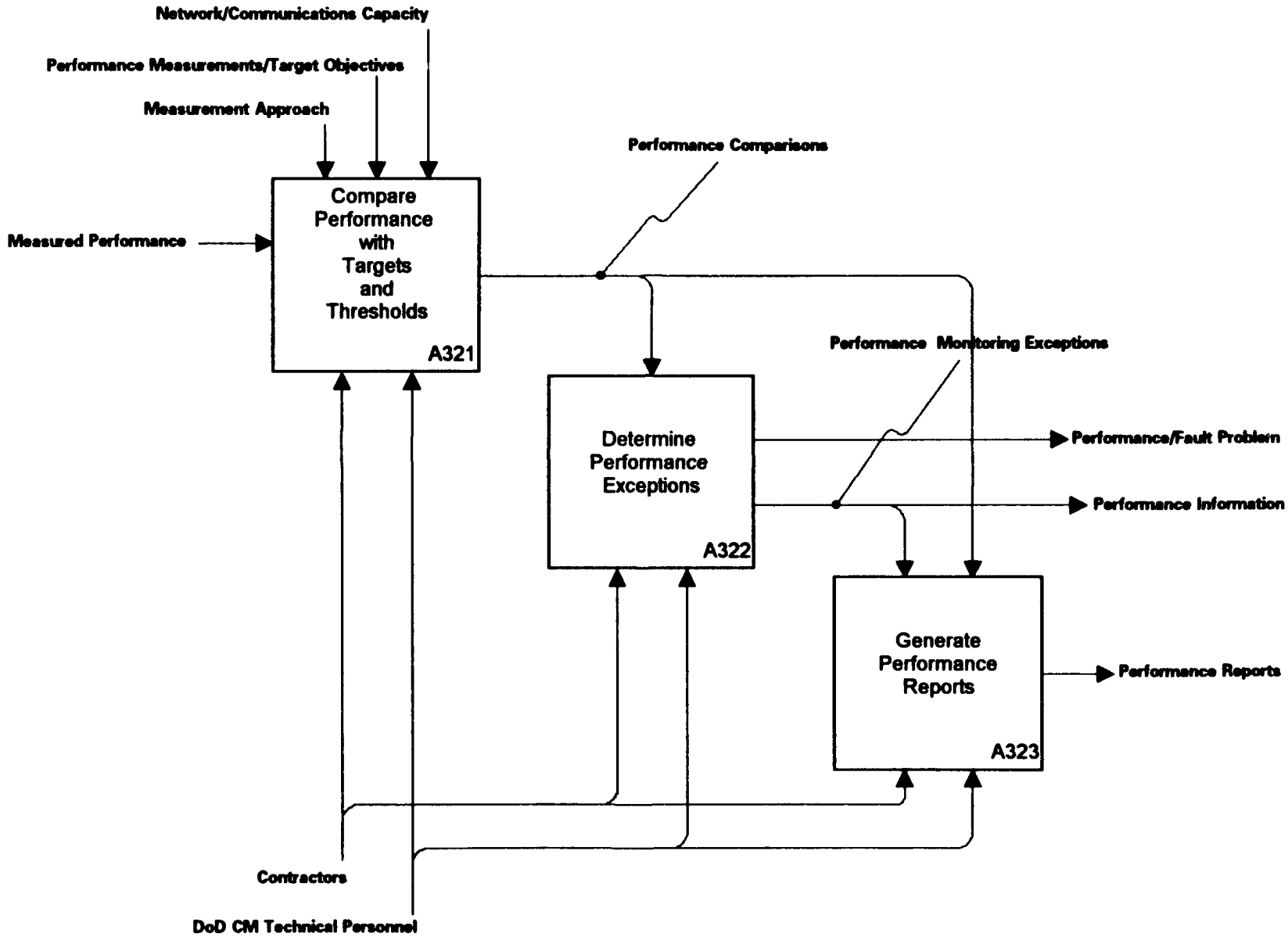

NODE: A32	TITLE: Monitor Performance	VIEWPOINT: DII/DASD(IM)

A4 PLAN CAPACITY

Plan Capacity is comprised of five major activities: (1) **Analyze Capacity**, (2) **Develop Capacity Plans**, (3) **Develop Change Recommendations**, and (4) **Develop Network/Communication Interface Requirements**. The goal of Plan Capacity is to determine and recommend to Information Resource Management (IRM) the resources required to meet future workload demands and to satisfy service level objectives. Short-term and long-term capacity plans will also be generated to support the IRM planning process. Configuration change recommendations are provided to the appropriate configuration management staff.

Analyze Capacity applies forecasted workload against baseline and alternative hardware/software configuration descriptions in order to predict performance, and to determine the optimum configuration required to meet service level objectives at minimum cost. Forecasted workload changes addressed by capacity planning studies include: changes in workload arrival rates for existing workloads; resource consumption profiles, transaction volumes, user counts, etc. for new workloads; or estimates of changes in the resource profile of an existing workload.

Develop Capacity Plans prepares formal reports describing and documenting the results of capacity planning studies. These documents define the strategy used for conducting capacity analysis, including assumptions made, major milestones, alternative solutions, rationale, conclusions, and recommendations.

Develop Change Recommendations recommends changes to information systems which may cause changes to the baseline configuration. The changes will be documented in accordance with Configuration Control Board (CCB) guidelines and forwarded to the appropriate configuration management staff.

Develop Network Communication Interface Requirements communicates workload predictions, capacity, and performance requirements affecting network capacity for DII/IS environments. This information will enable effective end-to-end CM. These requirements, which are the by-product of capacity planning studies. Any area of the DII/IS environment may be affected by these requirements, and may include such system loads as: interactive transaction volumes, print volumes, bandwidth requirements, packet transmission requirements, etc.

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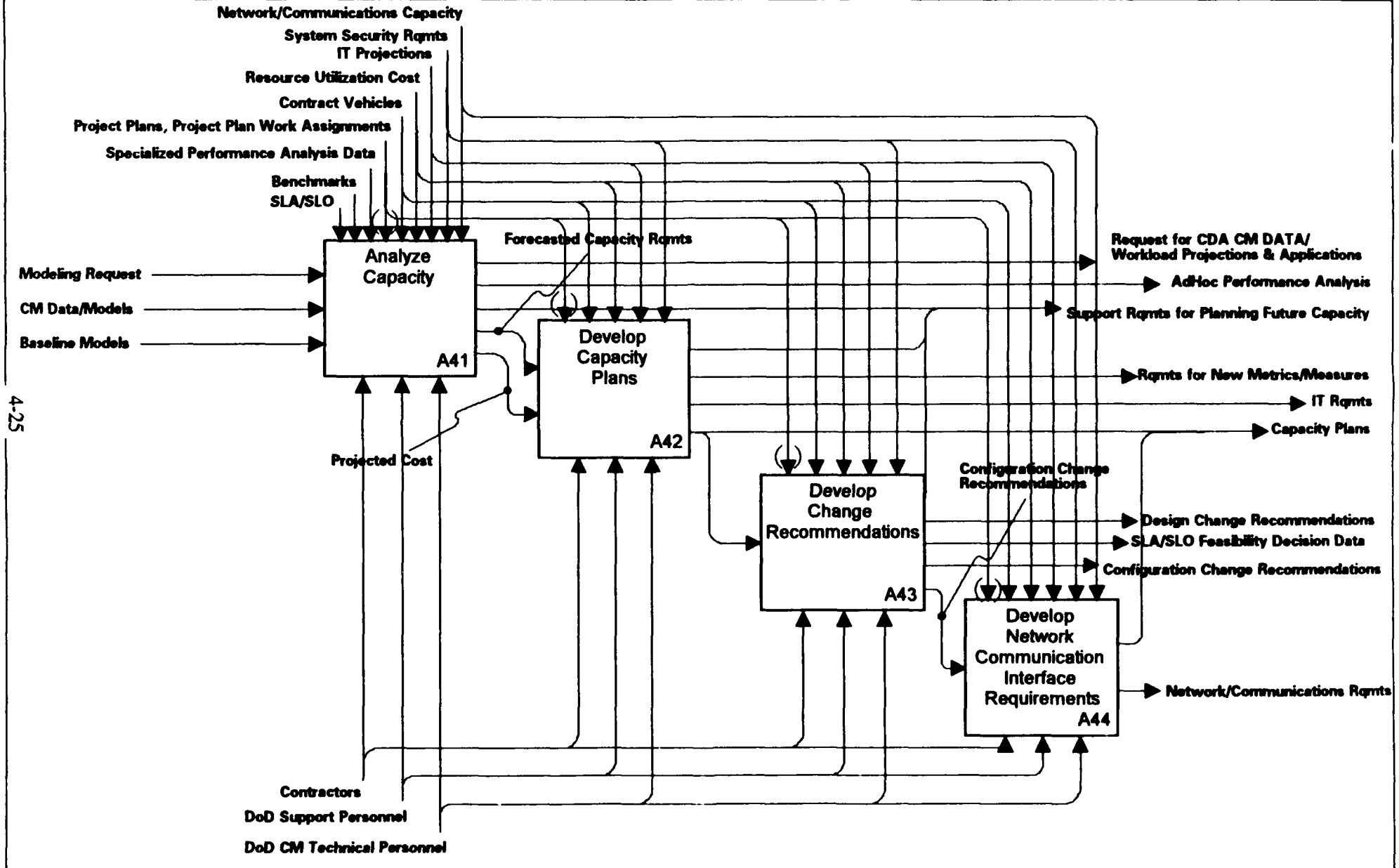

NODE: A4	TITLE: Plan Capacity	VIEWPOINT: DII/DASD(IM)

A41 ANALYZE CAPACITY

Analyze Capacity is comprised of five major activities: (1) **Establish Analysis Approach**, (2) **ID User Workload Projections**, (3) **Modify Workload Modeling Techniques**, (4) **Perform Modeling Modification Analysis**, and (5) **Conduct Performance Prediction Impact Analysis**. The purpose of these activities is to apply forecasted workload against baseline and alternative hardware/software configuration descriptions in order to predict performance and to determine the optimal configuration required to meet service level objectives at minimum cost.

Establish Analysis Approach determines the approach to take for evaluating the modeling request and how to proceed in the modeling effort.

ID User Workload Projections works with the user to identify all aspects and characteristics of the workload to develop the best model of the projected new or changed workload.

Modify Workload Modeling Parameters makes changes/modifications to the model parameters as progressive models are developed. The parameters are changed due to changes in workload. Also parameter changes are due to exceeding the current baseline model.

Perform Modeling Modification Analysis is an iterative process of model modification and evaluation in order to evaluate various study scenarios, determine causes of hardware saturation, evaluate various hardware options, etc. The final modeling results are generated from the process.

Conduct Performance Prediction Impact Analysis reviews the performance predictions of the alternative modeled scenarios and analyzes the impact on the current IS configurations.

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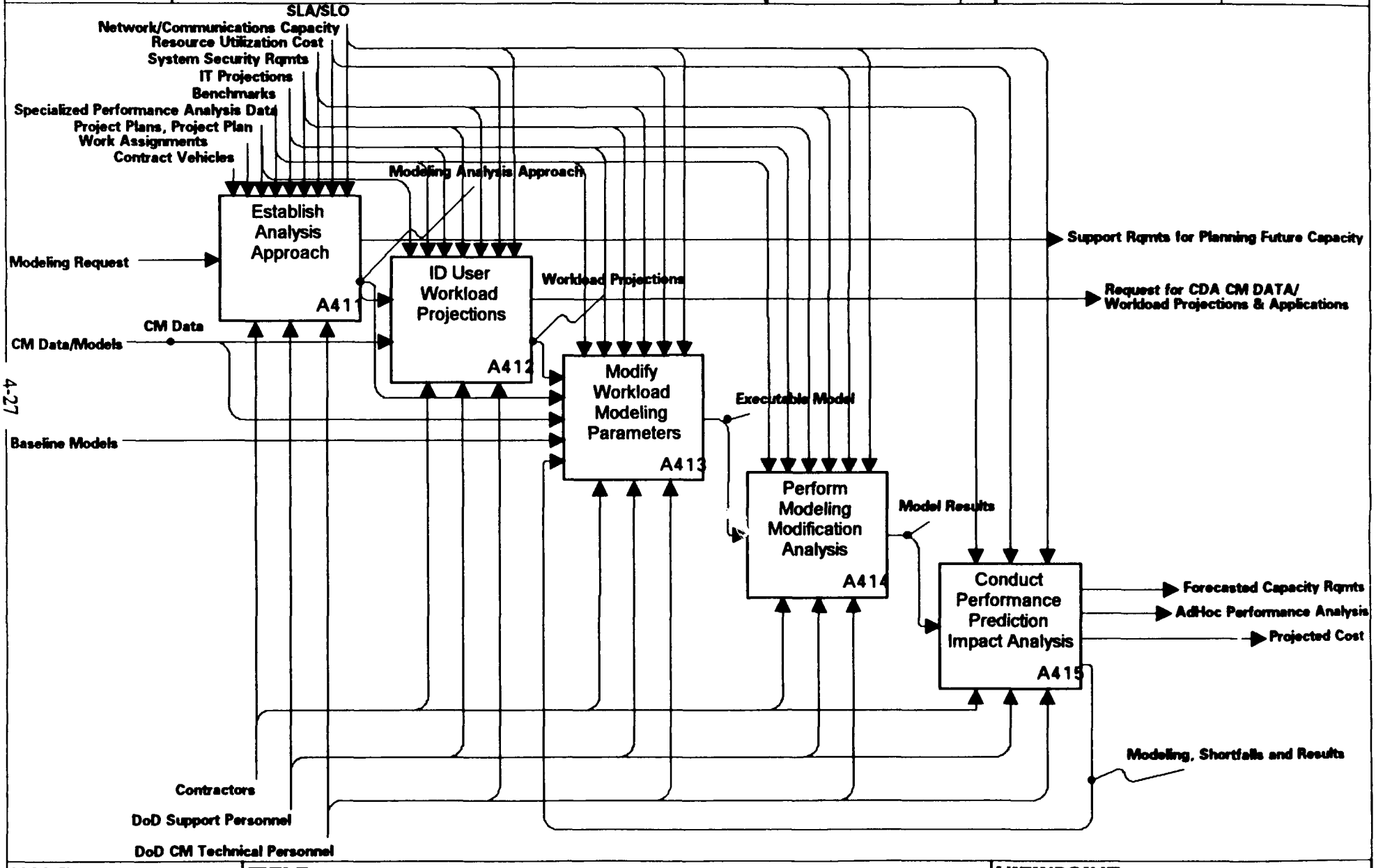

NODE:	TITLE:	VIEWPOINT:
A41	Analyze Capacity	DII/DASD(IM)

A5 MAINTAIN CAPACITY MANAGEMENT MODELS

Maintain Capacity Management Models is comprised of three major activities: (1) **Certify Baseline DII/IS Models**, (2) **Build Baseline DII/ISModels** and (3) **Validate Baseline DII/IS Models**. The purpose of these activities is to review, refine, create, validate, archive, catalog and manage models of current DII/IS environments that are used for performance evaluation and capacity planning studies. Current models will be available to provide input for comparative evaluations and development alternatives. Some of the models are created within the CM Function others may be models provided by the configuration management staff. Some of these models are created within the CM Function. Other models of hardware and software configurations, are provided by the configuration management staff. These activities will be performed on a continuing basis.

Certify Baseline DII/IS Models determines how accurately an existing baseline model reflects the current DII/IS environment. Analysis will reveal what changes, if any, are required to update baseline models to more accurately reflect current baseline environments.

Build Baseline DII/IS Models refines an existing baseline model or creates a new baseline model. This process is used when it has been determined that the baseline model no longer reflects the current DII/IS environment.

Validate Baseline DII/IS Models compares the predicted outcomes of the newly created baseline models against actual measurements and criteria obtained from the operational DII/IS environment.

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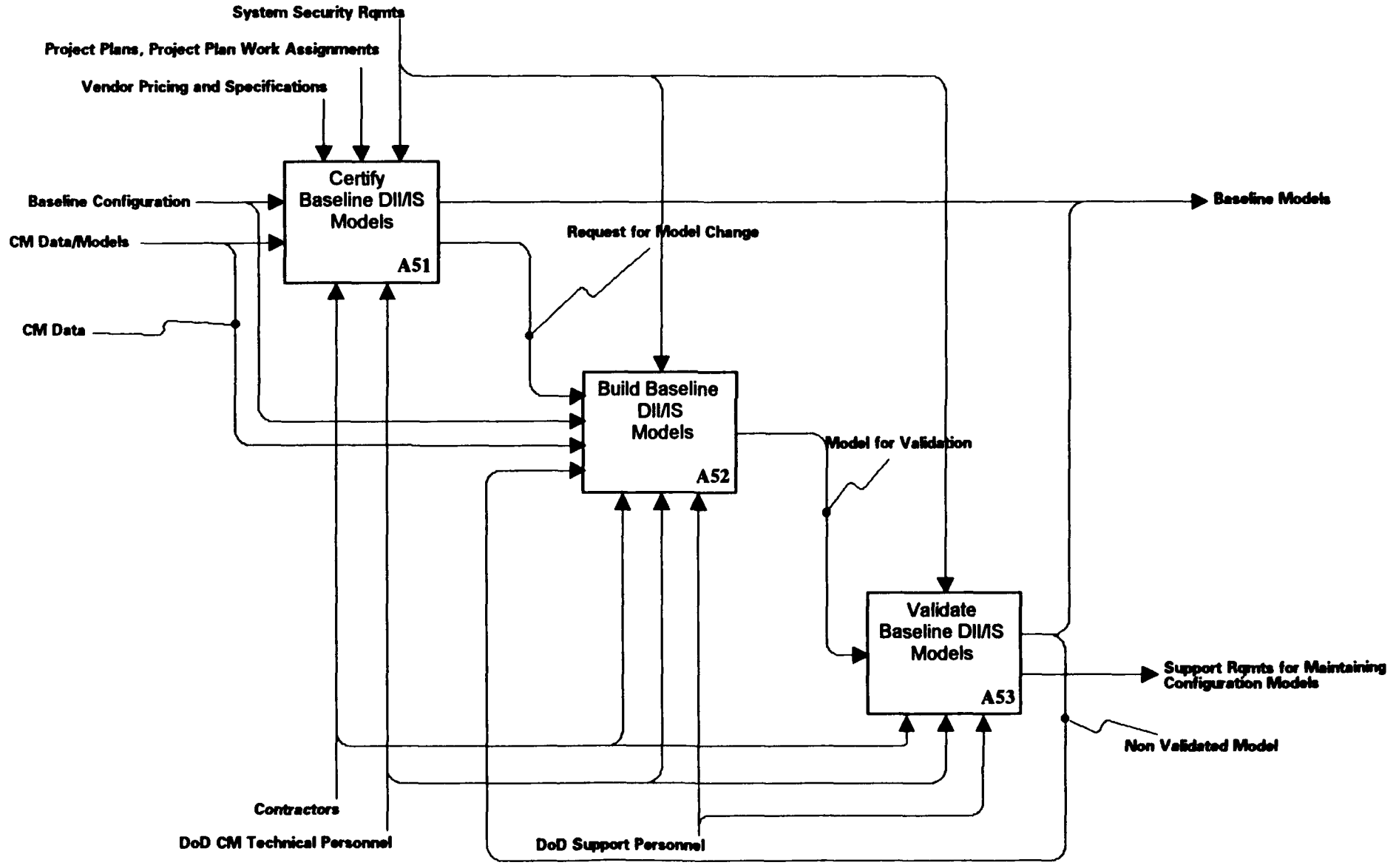

NODE: A5	TITLE: Maintain Capacity Management Models	VIEWPOINT: DII/DASD(IM)

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Introduction to Data Modeling

The primary purpose of data modeling is to capture the logical data structures and business rules required to support an activity's information needs and relate them to data shared with other significant activities or organizations. The data model consists of the following:

> **Entity** - Represents a set of real-world objects (people, places, things, events, etc.) that have common characteristics. An entity represents a class of real-world objects about which we want to retain data. An entity name is a noun phrase that describes the object. An entity instance is one member of that set of real-world objects.
>
> **Entity Relationship** - A dependence or inter-relationship between entities. The relationships model the real-world associations between persons, places, things, events, etc. Relationships represent the business rules that govern a process or organization (e.g., "can a material requisition exist that has not been submitted by a requesting organization?").

The first step in developing a data model is to identify potential or candidate entities (Entity Pool). One of the best sources for identifying candidate entities is to review the ICOMs or information flows from activity models. These often express the information needs of an activity that can be associated with entities.

The IDEF1X modeling technique is the data modeling method of choice in the DoD CIM initiative and was used in this workshop. A more detailed description of IDEF1X data modeling is contained in the IDEF Modeling Reader's Guide (Appendix A).

DISA Capacity Management ABA Workshop Data Modeling Activity

The core team developed a high level entity relationship model for the DII/IS Capacity Management Function in compliance with the TO-BE activity model for CM. The model was created in four phases. First, a generic "template" model for CM was created, identifying the highest level entities for the CM function independent of mainframe or communication networking viewpoints. The entity pool for this model is presented on page 4-33. The model is shown on page 4-34, and the associated business rules are described on pages 4-35 through 4-38. The entities are defined in Appendix D.

In the second phase, the data entities specific to the Mainframe/Host (centralized processing) environment were identified, defined, and related in an entity relationship model. The **Entity Pool for the Mainframe/Host Environment** is presented on page 4-39. The **Mainframe/Host Environment Entity Pool Matrix** is presented in Table 4-1, on pages 4-40 through 4-41. The corresponding **DII/IS Capacity Management Mainframe/Host Entity Relationship Model** is presented on page 4-42, and the **Business Rules for Mainframe/Host Environment** are shown on page 4-43 through 4-48. The **Entity Definitions** are located in Appendix D.

In the third phase, the data entities specific to the Communications Network (distributed processing) environment were identified, defined, and related in an entity relationship model. The entity pool for Communications Network is presented on page 4-49. The Communications Network Entity Pool Matrix is presented in Table 4-2 on page 4-50. The corresponding entity relationship diagram is presented on page 4-51, and the associated business rules are shown on page 4-52 through 4-56. The entities are defined in Appendix D.

In phase four, the two specific data views for Mainframe/Host and Communications Network are integrated into the phase 1 generic "template" model to create the DII/IS CM Entity Relationship model, page 4-57.

High Level Entity Pool for Perform Capacity Management Function Generic "Template"

The following high level classes of data were selected for the Generic "Template" Data Models. The specified entities are independent of mainframe and communications, network environments.

APPLICATION-FUNCTIONAL-REQUIREMENT

APPLICATION-PROCESSING-REQUIREMENT

BASELINE-MODEL

BENCHMARK

CHANGE-REQUEST

COMPONENT

ENVIRONMENT-SUPPORT-SYSTEM

MODELING-BENCHMARK-RESULT

PERFORMANCE-LOG-DATA

PERFORMANCE-PREDICTION-DATA

SECURITY-SYSTEM

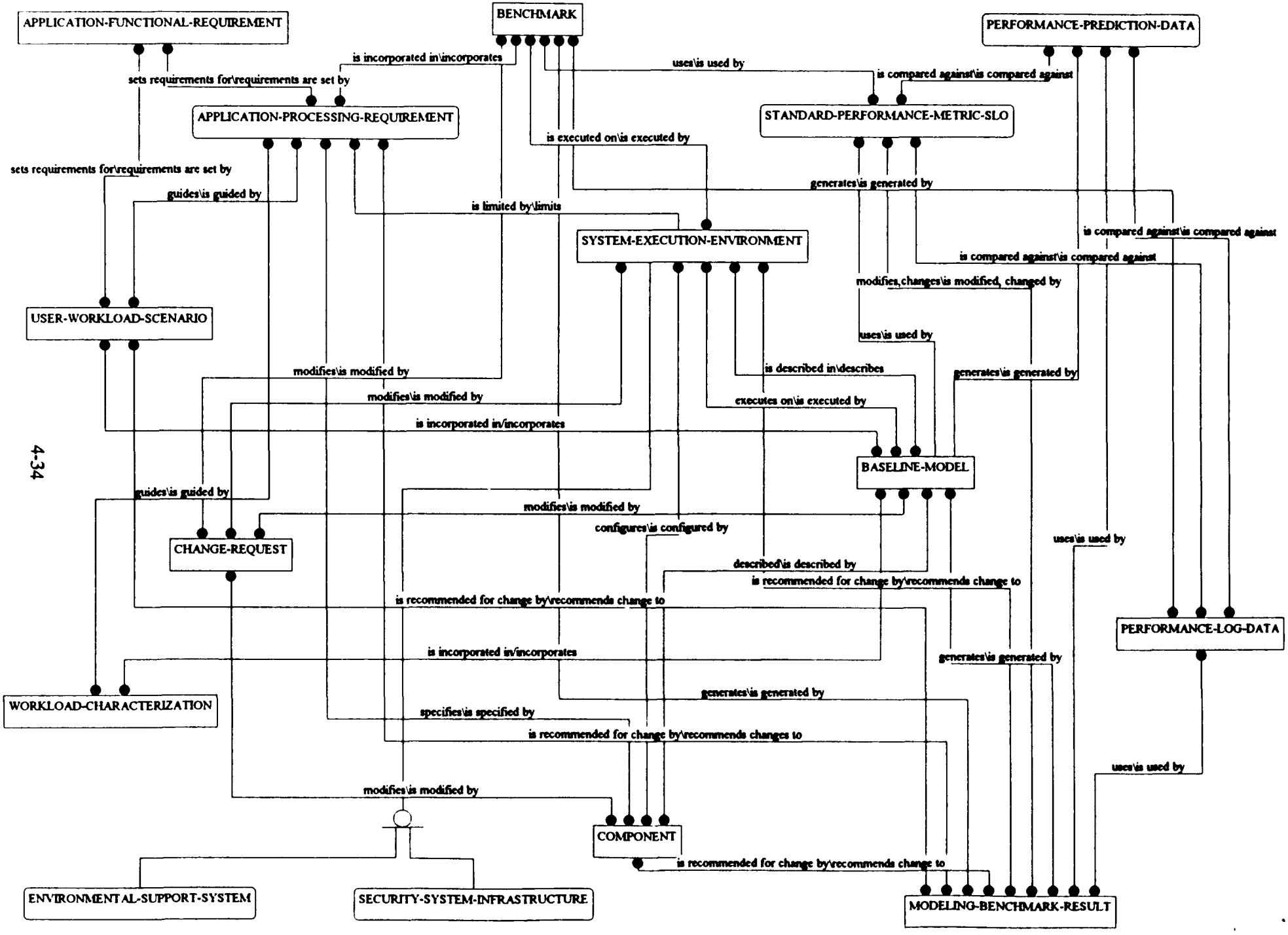
STANDARD-PERFORMANCE-METRIC-SLO

SYSTEM-EXECUTION-ENVIRONMENT

USER-WORKLOAD-SCENARIO

WORKLOAD-CHARACTERIZATION

DII/IS Capacity Management Generic "Template" Entity Relationship Model



Business Rules for Perform Capacity Management Function Generic "Template"

Every APPLICATION-FUNCTIONAL-REQUIREMENT
always sets requirements for zero, one or many WORKLOAD-CHARACTERIZATION

Every APPLICATION-FUNCTIONAL-REQUIREMENT
always sets requirements for zero, one or many
APPLICATION-PROCESSING-REQUIREMENT

Every APPLICATION-PROCESSING-REQUIREMENT
always is recommended for change by MODELING-BENCHMARK-RESULT

Every APPLICATION-PROCESSING-REQUIREMENT
always is guided by zero, one or many WORKLOAD-CHARACTERIZATION

Every APPLICATION-PROCESSING-REQUIREMENT
always are set by zero, one or many APPLICATION-FUNCTIONAL-REQUIREMENT

Every APPLICATION-PROCESSING-REQUIREMENT
always incorporates zero, one or many BENCHMARK

Every APPLICATION-PROCESSING-REQUIREMENT
always is limited by zero, one or many SYSTEM-EXECUTION-ENVIRONMENT

Every APPLICATION-PROCESSING-REQUIREMENT
always specifies zero, one or many COMPONENT

Every BASELINE-MODEL
always is modified by zero, one or many CHANGE-REQUEST

Every BASELINE-MODEL
always is described by zero, one or many COMPONENT

Every BASELINE-MODEL
always generates zero, one or many PERFORMANCE-PREDICTION-DATA

Every BASELINE-MODEL
always generates zero, one or many MODELING-BENCHMARK-RESULT

Every BASELINE-MODEL
always is modified by zero, one or many MODELING-BENCHMARK-RESULT

Every BASELINE-MODEL
always is used by zero, one or many STANDARD-PERFORMANCE-METRIC-SLO

Every BASELINE-MODEL
always describes zero, one or many SYSTEM-EXECUTION-ENVIRONMENT

Every BENCHMARK
always generates zero, one or many MODELING-BENCHMARK-RESULT

Every BENCHMARK
always generates zero, one or many PERFORMANCE-LOG-DATA

Every BENCHMARK
always is incorporated in zero, one or many APPLICATION-PROCESSING-REQUIREMENT

Every BENCHMARK
always is executed on zero, one or many SYSTEM-EXECUTION-ENVIRONMENT

Every BENCHMARK
always modifies zero, one or many CHANGE-REQUEST

Every BENCHMARK
always uses zero, one or many STANDARD-PERFORMANCE-METRIC-SLO

Every CHANGE-REQUEST
always modifies zero, one or many COMPONENT

Every CHANGE-REQUEST
always is modified by zero, one or many BENCHMARK

Every CHANGE-REQUEST
always modifies zero, one or many BASELINE-MODEL

Every CHANGE-REQUEST
always modifies zero, one or many SYSTEM-EXECUTION-ENVIRONMENT

Every COMPONENT
always is specified by zero, one or many APPLICATION-PROCESSING-REQUIREMENT

Every COMPONENT
always describes zero, one or many BASELINE-MODEL

Every COMPONENT
always is modified by zero, one or many CHANGE-REQUEST

Every COMPONENT
always is recommended for change by zero, one or many MODELING-BENCHMARK-RESULT

Every COMPONENT
always is configured by zero, one or many SYSTEM-EXECUTION-ENVIRONMENT

Every ENVIRONMENTAL-SUPPORT-SYSTEM
is a SYSTEM-EXECUTION-ENVIRONMENT

Every MODELING-BENCHMARK-RESULT
always is generated by zero, one or many BASELINE-MODEL

Every MODELING-BENCHMARK-RESULT
always is generated by zero, one, or many BENCHMARK

Every MODELING-BENCHMARK-RESULT
always recommends change to APPLICATION-PROCESSING-REQUIREMENT

Every MODELING-BENCHMARK-RESULT
always recommends change to zero, one, or many WORKLOAD-CHARACTERIZATION

Every MODELING-BENCHMARK-RESULT
always recommends change to zero, one, or many COMPONENT

Every MODELING-BENCHMARK-RESULT
always is used by zero, one or many PERFORMANCE-LOG-DATA

Every MODELING-BENCHMARK-RESULT
always is modified, changed by zero, one or many STANDARD-PERFORMANCE-METRIC-SLO

Every MODELING-BENCHMARK-RESULT
always recommends change to zero, one, or many SYSTEM-EXECUTION-ENVIRONMENT

Every MODELING-BENCHMARK-RESULT
always is used by zero, one, or many PERFORMANCE-PREDICTION-DATA

Every PERFORMANCE-LOG-DATA
always uses zero, one, or many MODELING-BENCHMARK-RESULT

Every PERFORMANCE-LOG-DATA
always is compared against zero, one, or many PERFORMANCE-PREDICTION-DATA

Every PERFORMANCE-LOG-DATA
always is compared against zero, one, or many STANDARD-PERFORMANCE-METRIC-SLO

Every PERFORMANCE-LOG-DATA
always is generated by zero, one, or many BENCHMARK

Every PERFORMANCE-PREDICTION-DATA
always generates zero, one or many BASELINE-MODEL

Every PERFORMANCE-PREDICTION-DATA
always is compared against zero, one or many STANDARD-PERFORMANCE-METRIC-SLO

Every PERFORMANCE-PREDICTION-DATA
always uses zero, one or many MODELING-BENCHMARK-RESULT

Every PERFORMANCE-PREDICTION-DATA
always is compared against zero, one or many PERFORMANCE-LOG-DATA

Every SECURITY-SYSTEM
is a SYSTEM-EXECUTION-ENVIRONMENT

Every STANDARD-PERFORMANCE-METRIC-SLO
always is used by zero, one or many BENCHMARK

Every STANDARD-PERFORMANCE-METRIC-SLO
always is compared against zero, one or many PERFORMANCE-LOG-DATA

Every STANDARD-PERFORMANCE-METRIC-SLO
always modifies, changes zero, one or many MODELING-BENCHMARK-RESULT

Every STANDARD-PERFORMANCE-METRIC-SLO
always uses zero, one or many BASELINE-MODEL

Every STANDARD-PERFORMANCE-METRIC-SLO
always is compared against zero, one, or many PERFORMANCE-PREDICTION-DATA

Every SYSTEM-EXECUTION-ENVIRONMENT
always configures zero, one or many COMPONENT

Every SYSTEM-EXECUTION-ENVIRONMENT
always limits zero, one or many APPLICATION-PROCESSING-REQUIREMENT

Every SYSTEM-EXECUTION-ENVIRONMENT
always is described in zero, one or many BASELINE MODEL

Every SYSTEM-EXECUTION-ENVIRONMENT
always is modified by zero, one or many CHANGE-REQUEST

Every SYSTEM-EXECUTION-ENVIRONMENT
always is recommended for change by zero, one or many
MODELING-BENCHMARK-RESULT

Every SYSTEM-EXECUTION-ENVIRONMENT
always is executed by zero, one or many BENCHMARK

Every WORKLOAD-CHARACTERIZATION
always is recommended by change by zero, one or many MODELING-BENCHMARK-RESULT

Every WORKLOAD-CHARACTERIZATION
always has its requirements set by zero, one, or many APPLICATION-FUNCTIONAL-REQUIREMENT

Every WORKLOAD-CHARACTERIZATION
always guides zero, one or many APPLICATION-PROCESSING-REQUIREMENT

Entity Pool for Mainframe/Host Environment

COMMUNICATION-LINK (MEDIA)

COMMUNICATION-NETWORK-COMPONENT

END-SYSTEM-PRESENTATION-RQMT

MAINFRAME/HOST

MAINFRAME-OPERATING-SYSTEM

NETWORK

PC-CLIENT-WORKSTATION-TERMINAL

PRIMARY-STORAGE (MAIN MEMORY)

PROTOCOL

SECONDARY-STORAGE (DASD & TAPE)

SECURITY-INFRASTRUCTURE

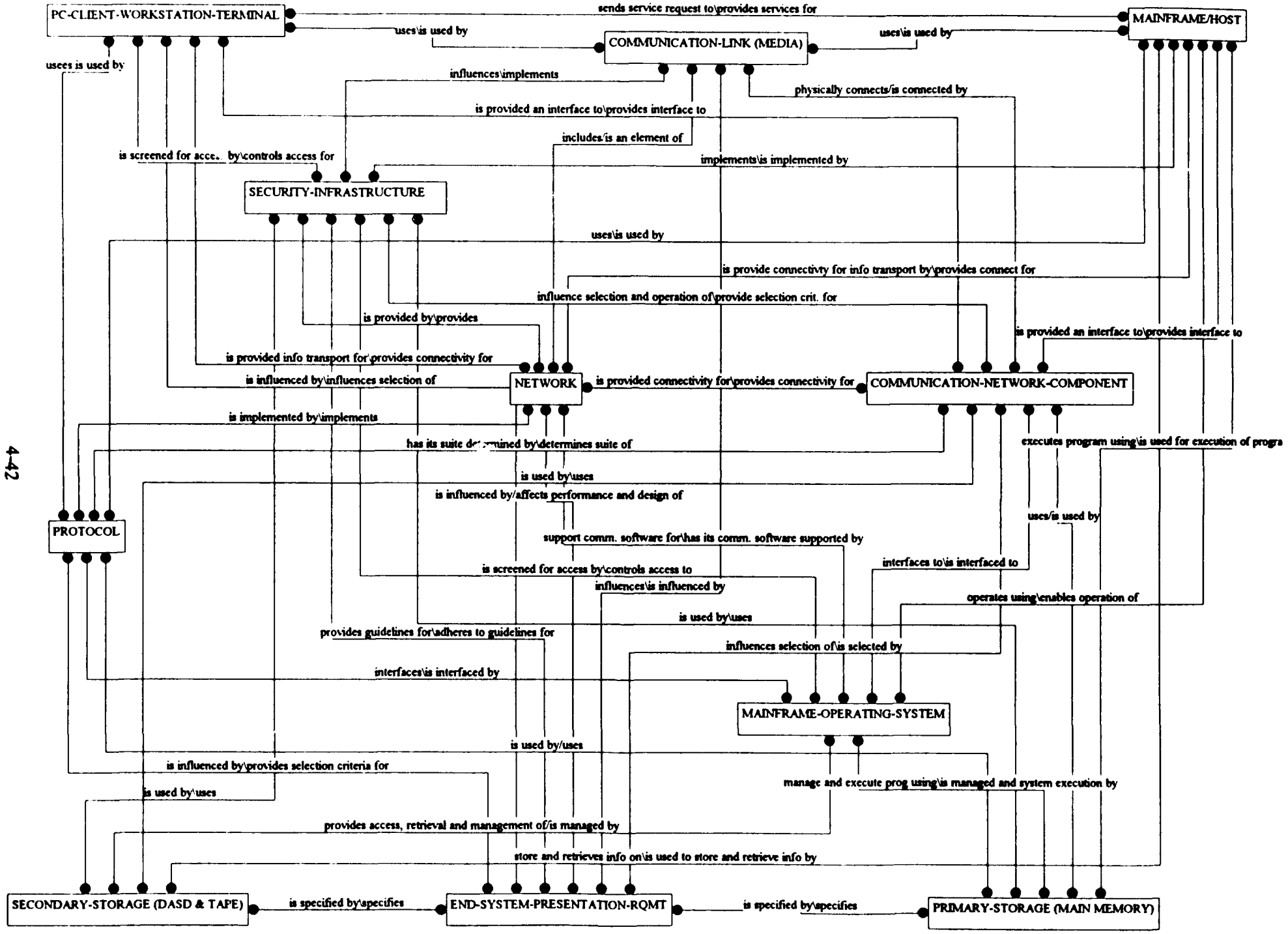
MAINFRAME COMPONENT	PC-CLIENT-WORKSTATION-TERMINAL	MAINFRAME/ HOST	MAINFRAME-OPERATING-SYSTEM	PRIMARY-STORAGE (MAIN MEMORY)	SECONDARY-STORAGE (DASD & TAPE)
PC-CLIENT-WORKSTATION-TERMINAL		sends service request to	x	x	x
MAINFRAME/ HOST	provides services for		operates using	executes program using	stores and retrieves info on
MAINFRAME-OPERATING-SYSTEM	x	enables operation of		manages and executes programs using	provides access retrieval and mgmt of
PRIMARY-STORAGE (MAIN MEMORY)	x	is used for execution of program by	is managed and provided system execution by		x
SECONDARY-STORAGE (DASD & TAPE)	x	is used to store and retrieve info by	is managed by	x	
SECURITY-INFRASTRUCTURE	controls access for	is implemented by	controls access to	uses	uses
PROTOCOL	is used by	is used by	is interfaced by	is used by	x
END-SYSTEM-PRESENTATION-RQMT	influences selection of	x	x	specifies	specifies
COMMUNICATION-NETWORK-COMPONENT	provides interface to	provides interface to	is interfaced to	uses	uses
COMMUNICATION-LINK (MEDIA)	is used by	is used by	x	x	x
NETWORK	provides connectivity for	provides connectivity for	has its communication software supported by	x	x

Table 4-1. Mainframe/Host Entity Environment Pool Matrix.

MAINFRAME COMPONENT	SECURITY-INFRASTRUCTURE	PROTOCOL	END-SYSTEM-PRESENTATION-RQMT	COMMUNICATION-NETWORK-COMPONENT	COMMUNICATION-LINK (MEDIA)	NETWORK
PC-CLIENT-WORKSTATION-TERMINAL	is screened for access by	uses	is influenced by	is provided an interface to	uses	is provided info transport for
MAINFRAME/ HOST	implements	uses	x	is provided an interface to	uses	is provided connectivity for info transport by
MAINFRAME-OPERATING-SYSTEM	is screened for access by	interfaces	x	interfaces to	x	supports communication software for
PRIMARY-STORAGE (MAIN MEMORY)	is used by	uses	is specified by	is used by	x	x
SECONDARY-STORAGE (DASD & TAPE)	is used by	x	is specified by	is used by	x	x
SECURITY-INFRASTRUCTURE		x	provides guidelines for	influences selection and operation of	influences	is provided by
PROTOCOL	x		is influenced by	has its suite determined by	x	is implemented by
END-SYSTEM-PRESENTATION-RQMT	aheres to guidance for	provides selection criteria for		influences selection of	influences	affects performance and design of
COMMUNICATION-NETWORK-COMPONENT	implements	determines suite of	is selected by		is connected by	provides connectivity for
COMMUNICATION-LINK (MEDIA)	is influenced by	x	is influenced by	physically connects		is an element of
NETWORK	provides	implements	is influenced by	is provided connectivity by	includes	

Table 4-1. Mainframe/Host Environment Entity Pool Matrix (Continued).

DII/IS Capacity Management Mainframe/Host Entity Relationship Model



Business Rules for Mainframe/Host Environment

Every PROTOCOL
always is incorporated in zero, one, or many PROTOCOL

Every SECURITY-INFRASTRUCTURE
always influence selection and operation of zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every SECURITY-INFRASTRUCTURE
always influences zero, one, or many COMMUNICATION-LINK (MEDIA)

Every SECURITY-INFRASTRUCTURE
always is provided by zero, one, or many NETWORK

Every SECURITY-INFRASTRUCTURE
always provides guidelines for zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every COMMUNICATION-LINK (MEDIA)
always includes zero, one, or many NETWORK

Every COMMUNICATION-NETWORK-COMPONENT
always is provided connectivity for zero, one, or many NETWORK

Every COMMUNICATION-NETWORK-COMPONENT
always physically connects zero, one, or many COMMUNICATION-LINK (MEDIA)

Every END-SYSTEM-PRESENTATION-RQMT
always influences selection of zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every END-SYSTEM-PRESENTATION-RQMT
always influences zero, one, or many COMMUNICATION-LINK (MEDIA)

Every END-SYSTEM-PRESENTATION-RQMT
always is influenced by zero, one, or many NETWORK

Every MAINFRAME-OPERATING-SYSTEM
always interfaces to zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every MAINFRAME-OPERATING-SYSTEM
always interfaces zero, one, or many PROTOCOL

Every MAINFRAME-OPERATING-SYSTEM
always is screened for access by zero, one, or many SECURITY-INFRASTRUCTURE

Every MAINFRAME-OPERATING-SYSTEM
always manage and execute prog using zero, one, or many PRIMARY-STORAGE (MAIN MEMORY)

Every MAINFRAME-OPERATING-SYSTEM
always provides access, retrieval and management of zero, one, or many SECONDARY-STORAGE (DASD & TAPE)

Every MAINFRAME-OPERATING-SYSTEM
always support comm. software for zero, one, or many NETWORK

Every MAINFRAME/HOST
always executes program using zero, one, or many PRIMARY-STORAGE (MAIN MEMORY)

Every MAINFRAME/HOST
always implements zero, one, or many SECURITY-INFRASTRUCTURE

Every MAINFRAME/HOST
always is provide connectivity for info transport by zero, one, or many NETWORK

Every MAINFRAME/HOST
always is provided an interface to zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every MAINFRAME/HOST
always operates using zero, one, or many MAINFRAME-OPERATING-SYSTEM

Every MAINFRAME/HOST
always store and retrieves info on zero, one, or many SECONDARY-STORAGE (DASD & TAPE)

Every MAINFRAME/HOST
always uses zero, one, or many COMMUNICATION-LINK (MEDIA)

Every MAINFRAME/HOST
always uses zero, one, or many PROTOCOL

Every PC-CLIENT-WORKSTATION-TERMINAL
always is influenced by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every PC-CLIENT-WORKSTATION-TERMINAL
always is provided an interface to zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every PC-CLIENT-WORKSTATION-TERMINAL
always is provided info transport for zero, one, or many NETWORK

Every PC-CLIENT-WORKSTATION-TERMINAL
always is screened for access by zero, one, or many SECURITY-INFRASTRUCTURE

Every PC-CLIENT-WORKSTATION-TERMINAL
always sends service request to zero, one, or many MAINFRAME/HOST

Every PC-CLIENT-WORKSTATION-TERMINAL
always uses zero, one, or many PROTOCOL

Every PC-CLIENT-WORKSTATION-TERMINAL
always uses zero, one, or many COMMUNICATION-LINK (MEDIA)

Every PRIMARY-STORAGE (MAIN MEMORY)
always is specified by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every PRIMARY-STORAGE (MAIN MEMORY)
always is used by zero, one, or many PROTOCOL

Every PRIMARY-STORAGE (MAIN MEMORY)
always is used by zero, one, or many SECURITY-INFRASTRUCTURE

Every PRIMARY-STORAGE (MAIN MEMORY)
always uses zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every PROTOCOL
always has its suite determined by zero, one, or many
COMMUNICATION-NETWORK-COMPONENT

Every PROTOCOL
always is implemented by zero, one, or many NETWORK

Every PROTOCOL
always is influenced by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every SECONDARY-STORAGE (DASD & TAPE)
always is specified by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every SECONDARY-STORAGE (DASD & TAPE)
always is used by zero, one, or many SECURITY-INFRASTRUCTURE

Every SECONDARY-STORAGE (DASD & TAPE)
always is used by zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every SECURITY-INFRASTRUCTURE
always is implemented by zero, one, or many MAINFRAME/HOST

Every SECURITY-INFRASTRUCTURE
always controls access for zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every SECURITY-INFRASTRUCTURE
always controls access to zero, one, or many MAINFRAME-OPERATING-SYSTEM

Every SECURITY-INFRASTRUCTURE
always uses zero, one, or many PRIMARY-STORAGE (MAIN MEMORY)

Every SECURITY-INFRASTRUCTURE
always uses zero, one, or many SECONDARY-STORAGE (DASD & TAPE)

Every COMMUNICATION-LINK (MEDIA)
always implements zero, one, or many SECURITY-INFRASTRUCTURE

Every COMMUNICATION-LINK (MEDIA)
always is influenced by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every COMMUNICATION-LINK (MEDIA)
always is connected by zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every COMMUNICATION-LINK (MEDIA)
always is used by zero, one, or many MAINFRAME/HOST

Every COMMUNICATION-LINK (MEDIA)
always is used by zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every COMMUNICATION-NETWORK-COMPONENT
always determines suite of zero, one, or many PROTOCOL

Every COMMUNICATION-NETWORK-COMPONENT
always provide selection crit. for zero, one, or many SECURIT- INFRASTRUCTURE

Every COMMUNICATION-NETWORK-COMPONENT
always is selected by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every COMMUNICATION-NETWORK-COMPONENT
always is interfaced to zero, one, or many MAINFRAME-OPERATING-SYSTEM

Every COMMUNICATION-NETWORK-COMPONENT
always provides interface to zero, one, or many MAINFRAME/HOST

Every COMMUNICATION-NETWORK-COMPONENT
always provides interface to zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every COMMUNICATION-NETWORK-COMPONENT
always uses zero, one, or many SECONDARY-STORAGE (DASD & TAPE)

Every COMMUNICATION-NETWORK-COMPONENT
always is used by zero, one, or many PRIMARY-STORAGE (MAIN MEMORY)

Every END-SYSTEM-PRESENTATION-RQMT
always influences selection of zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every END-SYSTEM-PRESENTATION-RQMT
always provides selection criteria for zero, one, or many PROTOCOL

Every END-SYSTEM-PRESENTATION-RQMT
always specifies zero, one, or many PRIMARY-STORAGE (MAIN MEMORY)

Every END-SYSTEM-PRESENTATION-RQMT
always is specified by/specifies zero, one, or many SECONDARY-STORAGE (DASD & TAPE)

Every END-SYSTEM-PRESENTATION-RQMT
always adheres to guidelines for zero, one, or many SECURITY-INFRASTRUCTURE

Every MAINFRAME-OPERATING-SYSTEM
always enables operation of zero, one, or many MAINFRAME/HOST

Every MAINFRAME/HOST
always provides services for zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every NETWORK
always is an element of zero, one, or many COMMUNICATION-LINK (MEDIA)

Every NETWORK
always implements zero, one, or many PROTOCOL

Every NETWORK
always affects performance and design of zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every NETWORK
always provides connect for zero, one, or many MAINFRAME/HOST

Every NETWORK
always provides zero, one, or many SECURITY-INFRASTRUCTURE

Every NETWORK
always provides connectivity for zero, one, or many COMMUNICATION-NETWORK-COMPONENT

Every NETWORK
always provides connectivity for zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every NETWORK
always has its comm. software supported by zero, one, or many MAINFRAME-OPERATING-SYSTEM

Every PRIMARY-STORAGE (MAIN MEMORY)
always is used for execution of program by zero, one, or many MAINFRAME/HOST

Every PRIMARY-STORAGE (MAIN MEMORY)
always is managed and system execution by zero, one, or many MAINFRAME-OPERATING-SYSTEM

Every PROTOCOL
always is incorporated in zero, one, or many SECURITY-INFRASTRUCTURE

Every PROTOCOL
always is interfaced by zero, one, or many MAINFRAME-OPERATING-SYSTEM

Every PROTOCOL
always uses zero, one, or many PRIMARY-STORAGE (MAIN MEMORY)

Every PROTOCOL
always is used by zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every PROTOCOL
always is used by zero, one, or many MAINFRAME/HOST

Every SECONDARY-STORAGE (DASD & TAPE)
always is managed by zero, one, or many MAINFRAME-OPERATING-SYSTEM

Every SECONDARY-STORAGE (DASD & TAPE)
always is used to store and retrieve info by zero, one, or many MAINFRAME/HOST

Entity Pool for Communications Network Environment

COMMUNICATIONS-LINK (MEDIA)

COMMUNICATIONS-NETWORK-COMPONENT

END-SYSTEM-PRESENTATION-RQMT

NETWORK

PC-CLIENT-WORKSTATION-TERMINAL

PRIMARY-STORAGE (INTERNAL MEMORY)

PROTOCOL

SECONDARY-STORAGE (WORKSTATION HARD DISK)

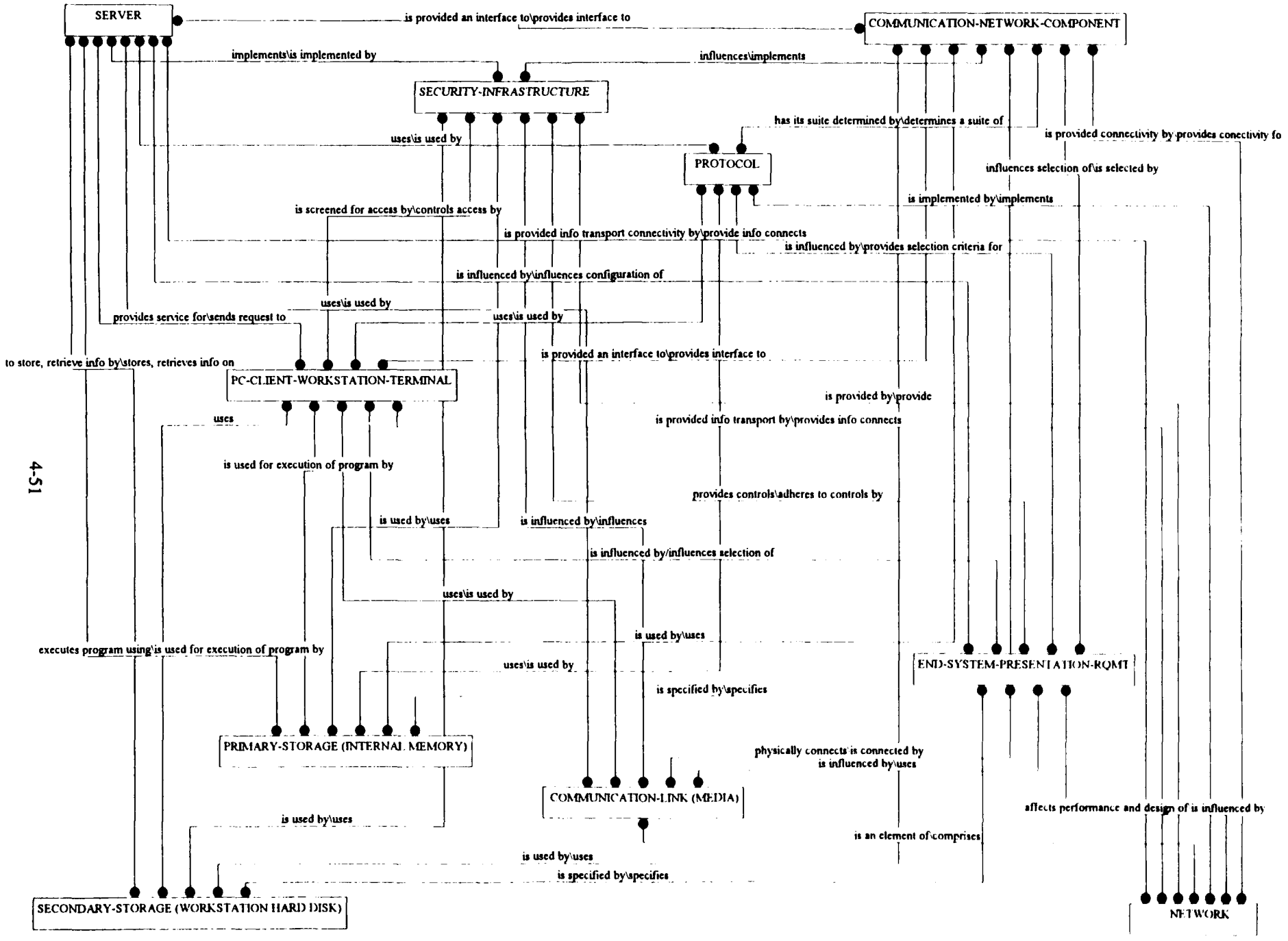
SECURITY-INFRASTRUCTURE

SERVER

Communications Network Component	PC-CLIENT-WORKSTATION-TERMINAL	SERVER	PRIMARY-STORAGE-(INTERNAL MEMORY)	SECONDARY-STORAGE (WORKSTATION HARD DISK)	SECURITY-INFRASTRUCTURE	PROTOCOL	END-SYSTEM-PRESENTATION-RQMT	COMMUNICATION-LINK (MEDIA)	NETWORK	COMMUNICATION-NETWORK-COMPONENT
PC-CLIENT-WORKSTATION-TERMINAL		sends request to	executes program using	uses	is screened for access by	uses	is influenced by	uses	is provided info transport by	is provided an interface to
SERVER	Provides services for		executes program using	stores and retrieves info on	implements	uses	is influenced by	uses	is provided connectivity for information transport by	is provided an interface to
PRIMARY-STORAGE (INTERNAL MEMORY)	is used for execution of program by	is used for execution of program by		x	is used by	uses	is specified by	x	x	is used by
SECONDARY-STORAGE (WORKSTATION HARD DISK)	is used by	is used to store, retrieve info by	x		is used by	x	is specified by	x	x	is used by
SECURITY-INFRASTRUCTURE	controls access by	is implemented by	uses	uses		x	provides controls for	influences	is provided by	influences
PROTOCOL	is used by	is used by	is used by	x	x		is influenced by	x	is implemented by	has its suite determined by
END-SYSTEM-PRESENTATION-RQMT	influences selection of	influences configuration of	specifies	specifies	adheres to controls by	provides selection criteria for		uses	affects performance and design of	influences selection of
COMMUNICATION-LINK (MEDIA)	is used by	is used by	x	x	is influenced by	x	is influenced by		is an element of	physically connects
NETWORK	provides connectivity for	provides connectivity for	x	x	provides	implements	is influenced by	comprises		is provided connectivity by
COMMUNICATION-NETWORK-COMPONENT	provides interface to	provides interface to	uses	uses	implements	determines suite of	is selected by	is connected by	provides connectivity for	

Table 4-2. Communication/Networks Environment Entity Pool Matrix.

DII/IS Capacity Management Communications Network Entity Relationship Model



Business Rules for Communications Network Environment

Every NETWORK
always is provided connectivity by zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every SECURITY-INFRASTRUCTURE
always implements zero, one, or many SERVER

Every SECURITY-INFRASTRUCTURE
always influences zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every SECURITY-INFRASTRUCTURE
always is influenced by zero, one, or many COMMUNICATIONS-LINK (MEDIA)

Every SECURITY-INFRASTRUCTURE
always is provided by zero, one, or many NETWORK

Every SECURITY-INFRASTRUCTURE
always is screened for access by zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every SECURITY-INFRASTRUCTURE
always is used by zero, one, or many PRIMARY-STORAGE (INTERNAL MEMORY)

Every SECURITY-INFRASTRUCTURE
always provides guidelines for zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every SERVER
always executes program using zero, one, or many PRIMARY-STORAGE (INTERNAL MEMORY)

Every SERVER
always is influenced by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every SERVER
always is provided an interface to zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every SERVER
always is provided info transport connectivity by zero, one, or many NETWORK

Every SERVER
always provides service for zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every SERVER
always uses zero, one, or many PROTOCOL

Every SERVER
always uses zero, one, or many COMMUNICATIONS-LINK (MEDIA)

Every PROTOCOL
always has its suite determined by zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every PROTOCOL
always is implemented by zero, one, or many NETWORK

Every PROTOCOL
always is influenced by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every PROTOCOL
always uses zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every COMMUNICATIONS-LINK (MEDIA)
always is an element of zero, one, or many NETWORK

Every COMMUNICATIONS-LINK (MEDIA)
always physically connects zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every END-SYSTEM-PRESENTATION-RQMT
always affects performance and design of zero, one, or many NETWORK

Every END-SYSTEM-PRESENTATION-RQMT
always influences selection of zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every END-SYSTEM-PRESENTATION-RQMT
always is influenced by zero, one, or many COMMUNICATIONS-LINK (MEDIA)

Every PC-CLIENT-WORKSTATION-TERMINAL
always is influenced by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every PC-CLIENT-WORKSTATION-TERMINAL
always is provided an interface to zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every PC-CLIENT-WORKSTATION-TERMINAL
always is provided info transport by zero, one, or many NETWORK

Every PC-CLIENT-WORKSTATION-TERMINAL
always uses zero, one, or many COMMUNICATIONS-LINK (MEDIA)

Every PRIMARY-STORAGE (INTERNAL MEMORY)
always is specified by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every PRIMARY-STORAGE (INTERNAL MEMORY)
always is used by zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every PRIMARY-STORAGE (INTERNAL MEMORY)
always is used for execution of program by zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every PRIMARY-STORAGE (INTERNAL MEMORY)
always uses zero, one, or many PROTOCOL

Every SECONDARY-STORAGE (WORKSTATION HARD DISK))
always is specified by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every SECONDARY-STORAGE (WORKSTATION HARD DISK))
always is used by zero, one, or many SECURITY-INFRASTRUCTURE

Every SECONDARY-STORAGE (WORKSTATION HARD DISK))
always is used by zero, one, or many COMMUNICATIONS-NETWORK-COMPONENT

Every SECONDARY-STORAGE (WORKSTATION HARD DISK))
always is used to store, retrieve info by zero, one, or many SERVER

Every SECONDARY-STORAGE (WORKSTATION HARD DISK))
always uses zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every NETWORK
always is influenced by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every NETWORK
always comprises zero, one, or many COMMUNICATIONS-LINK (MEDIA)

Every NETWORK
always implements zero, one, or many PROTOCOL

Every NETWORK
always provide zero, one, or many SECURITY-INFRASTRUCTURE

Every NETWORK
always provides info connects zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every NETWORK
always provide info connects zero, one, or many SERVER

Every SECURITY-INFRASTRUCTURE
always uses zero, one, or many SECONDARY-STORAGE (WORKSTATION HARD DISK))

Every SERVER
always is implemented by zero, one, or many SECURITY-INFRASTRUCTURE

Every SERVER
always stores, retrieves info on zero, one, or many SECONDARY-STORAGE (WORKSTATION HARD DISK))

Every PROTOCOL
always comprises zero, one, or many SECURITY-INFRASTRUCTURE

Every PROTOCOL
always is used by zero, one, or many SERVER

Every PROTOCOL
always is used by zero, one, or many PRIMARY-STORAGE (INTERNAL MEMORY)

Every COMMUNICATIONS-LINK (MEDIA)
always influences zero, one, or many SECURITY-INFRASTRUCTURE

Every COMMUNICATIONS-LINK (MEDIA)
always uses zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every COMMUNICATIONS-LINK (MEDIA)
always is used by zero, one, or many SERVER

Every COMMUNICATIONS-LINK (MEDIA)
always is used by zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every COMMUNICATIONS-NETWORK-COMPONENT
always determines a suite of zero, one, or many PROTOCOL

Every COMMUNICATIONS-NETWORK-COMPONENT
always is selected by zero, one, or many END-SYSTEM-PRESENTATION-RQMT

Every COMMUNICATIONS-NETWORK-COMPONENT
always implements zero, one, or many SECURITY-INFRASTRUCTURE

Every COMMUNICATIONS-NETWORK-COMPONENT
always provides interface to zero, one, or many SERVER

Every COMMUNICATIONS-NETWORK-COMPONENT
always provides interface to zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every COMMUNICATIONS-NETWORK-COMPONENT
always provides connectivity for zero, one, or many NETWORK

Every COMMUNICATIONS-NETWORK-COMPONENT
always uses zero, one, or many PRIMARY-STORAGE (INTERNAL MEMORY)

Every COMMUNICATIONS-NETWORK-COMPONENT
always uses zero, one, or many SECONDARY-STORAGE (WORKSTATION HARD DISK))

Every COMMUNICATIONS-NETWORK-COMPONENT
always is connected by zero, one, or many COMMUNICATIONS-LINK (MEDIA)

Every END-SYSTEM-PRESENTATION-RQMT
always influences selection of zero, one, or many PC-CLIENT-WORKSTATION-TERMINAL

Every END-SYSTEM-PRESENTATION-RQMT
always influences configuration of zero, one, or many SERVER

Every END-SYSTEM-PRESENTATION-RQMT
always provides selection criteria for zero, one, or many PROTOCOL

Every END-SYSTEM-PRESENTATION-RQMT
always specifies zero, one, or many PRIMARY-STORAGE (INTERNAL MEMORY)

Every END-SYSTEM-PRESENTATION-RQMT
always specifies zero, one, or many SECONDARY-STORAGE (WORKSTATION HARD DISK)

Every END-SYSTEM-PRESENTATION-RQMT
always adheres to guidelines for zero, one, or many SECURITY-INFRASTRUCTURE

Every PC-CLIENT-WORKSTATION-TERMINAL
always controls access for zero, one, or many SECURITY-INFRASTRUCTURE

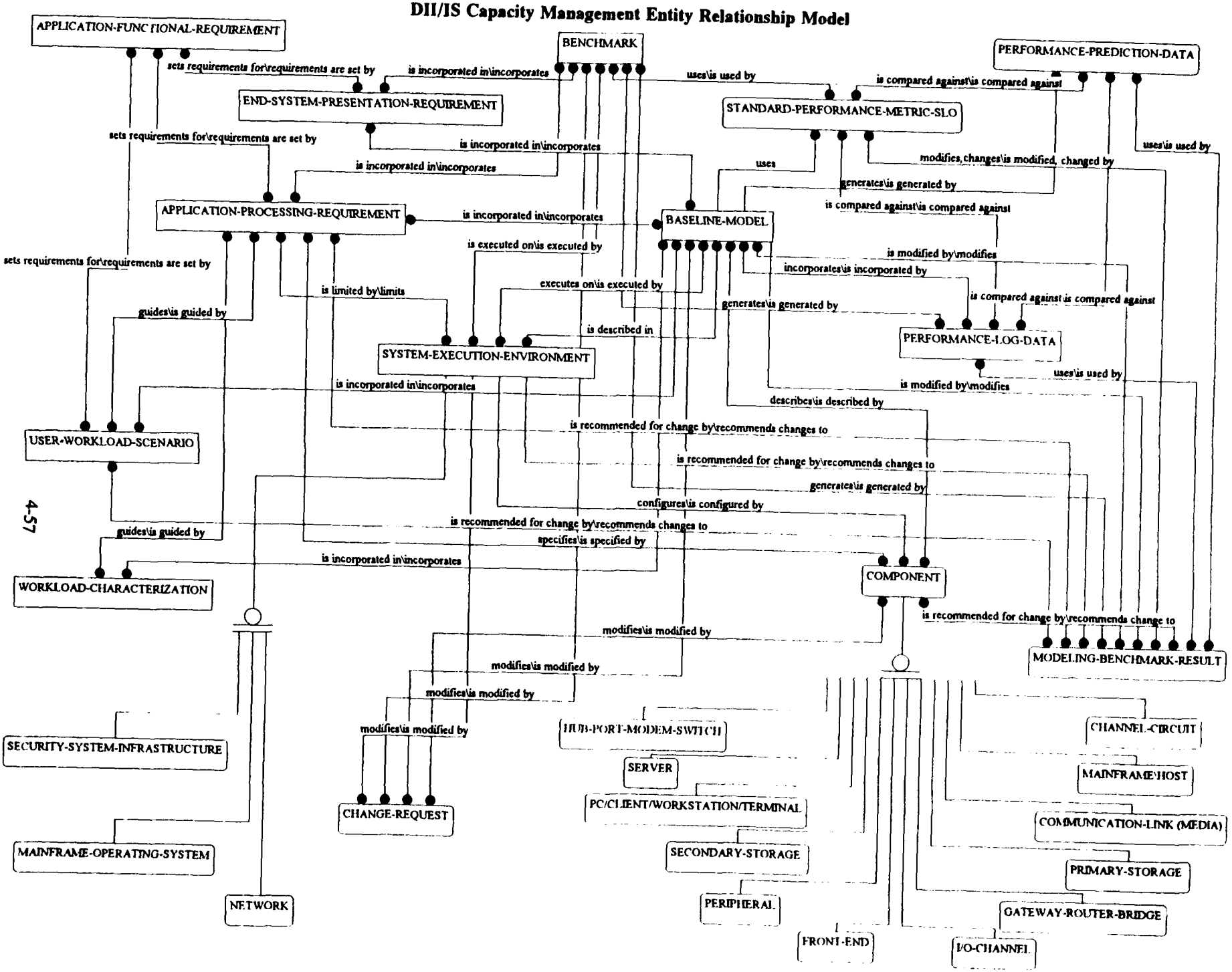
Every PC-CLIENT-WORKSTATION-TERMINAL
always sends request to zero, one, or many SERVER

Every PC-CLIENT-WORKSTATION-TERMINAL
always is used by zero, one, or many PROTOCOL

Every PRIMARY-STORAGE (INTERNAL MEMORY)
always is used for execution of program by zero, one, or many SERVER

Every PRIMARY-STORAGE (INTERNAL MEMORY)
always uses zero, one, or many SECURITY insert template model

DII/IS Capacity Management Entity Relationship Model



Performance Measurement Categories and Associated Metrics

The DII/IS components referenced in A3.1.1.1, Determine Components to be Measured can be grouped into three major categories, Mainframe (related to centralized processing environments), Communications Network (related to distributed processing environments), and Configurations. Mainframe components are organized into the following subcategories (see A3.1.1.1 node tree):

A3.1.1.1.1.1 Mainframe Host (CPU/Operating System)
A3.1.1.1.1.2 Primary Storage (Main Memory)
A3.1.1.1.1.3 Secondary Storage (DASD & Tape)
A3.1.1.1.1.4 PC/Client/Workstation/Terminal (CPU/Operating System)
A3.1.1.1.1.5 Front End (I/O)
A3.1.1.1.1.6 I/O Channel(s)
A3.1.1.1.1.7 Peripherals

Communications Network Components were segmented as follows (see A3.1.1.2 node tree):

A3.1.1.1.2.1 Server (CPU/Operating System)
A3.1.1.1.2.2 PC/Client/Workstation/Terminal (CPU/Operating System)
A3.1.1.1.2.3 Primary Storage (Internal Memory)
A3.1.1.1.2.4 Secondary Storage (Workstation Hard Disk Storage)
A3.1.1.1.2.5 Channels (Circuits)
A3.1.1.1.2.6 Gateways, Routers, Bridges
A3.1.1.1.2.7 Hubs, Ports, Modems
A3.1.1.1.2.8 Communication Links (Media)/Network/Bus Topology

Configurations, A3.1.1.1.3 were not further decomposed in this workshop.

The performance metrics referenced in A3.1.1.2, Establish Performance Metrics, were organized into the following broad categories (see A3.1.1.2 node tree):

A3.1.1.2.1 Capacity (Reserve, Available, Planned)
A3.1.1.2.2 Contention
A3.1.1.2.3 Error Rates/Detection/Correction
A3.1.1.2.4 Response Time
A3.1.1.2.5 Throughput
A3.1.1.2.6 Utilization
A3.1.1.2.7 Workload

Definitions for these metric categories are found in Appendix E, Terms.

The components were compared against the performance metric categories to determine the specific measurements needed for each component metric combination. The results of this analysis are presented in Tables 4-3 and 4-4, on pages 4-59 and 4-60 respectively.

A3.1.1.1 Determine Components to be Measured	A3.1.1.2 Establish Performance Metrics						
A3.1.1.1.1 Mainframe (Centralized Processing)	**A3.1.1.2.1 Capacity (Reserve, Available, Planned)**	**A3.1.1.2.7 Workload**	**A3.1.1.2.2 Contention**	**A3.1.1.2.3 Error Rates/Detection/ Correction**	**A3.1.1.2.4 Response Time**	**A3.1.1.2.5 Throughput**	**A3.1.1.2.6 Utilization**
A3.1.1.1.1.1 Mainframe Host (CPU/Operating System)	• Mips • spec marks/rates • clock speed (MHz)	• frequency • volume • type • jobs in mix • scheduling	• controller priority • CPU wait • I/O rate	• parity errors	• set of delay times •• security interfaces •• I/O rate •• accesses	• transactions per sec. • Mips	• % busy • wait time • CPU availability • I/O rate • channel balance
A3.1.1.1.1.2 Primary Storage (Main Memory)	• size • allocation • access speed • use • interleaving • # of cycles	• workload mix • type • application mix • volume	• paging rates • swapping rates • I/O rate • queuing delays	• parity errors	• process scheduling • paging rates • interrupts • page delay time • # page faults	• trace utilities • disk caching delays • disk I/O rate • page delay time • # page faults	• % memory used by a job, software application, etc • availability • I/O
A3.1.1.1.1.3 Secondary Storage (DASD & Tape)	• size • allocation • use • file mgt	• job allocation • type • volume • spooling	• file transfers • queue delays • queue length • file sharing • access delays	• parity • error codes (vendor) • error rate • corrupted files	• set of delay times •• latency •• access time	• data transfer rate • availability	• % busy • file structure • sectors used • data location • availability • bits/sec
A3.1.1.1.1.4 PC/Client/Workstation/Terminal (CPU/Operating System)	• Mips • spec marks/rates • clock speed (MHz) • internal RAM • memory transfer rate	• frequency • volume • application type • file location • transaction mix	• I/O rate • # of jobs in application mix running	• parity errors • format errors • communication errors	• set of delay times •• security •• polling •• network loads •• bottlenecks	• transactions/ sec. • file caching • # of jobs/sec • availability • Mips • traffic volume	• % busy • wait time • applications • LAN load
A3.1.1.1.1.5 Front End (I/O)	• spec marks/rates • Mips • buffer size • internal RAM • clock speed (MHz)	• volume of packets and instructions	• controller priority • # of channels • queueing delays	• % errors • parity	• # access on-line • queuing delays • I/O	• communication • I/O rates	• channel time • # of terminals • channel balance • availability
A3.1.1.1.1.6 I/O Channels	• priority • channel speed • # available	• volume	• I/O traffic • queue delays • queue length	• error rate • # of runt packets	N/A	• traffic blocks transferred	• % busy • availability
A3.1.1.1.1.7 Peripherals	• buffer size • lines per min • print files per min	• volume • type • job mix	• queue delays • queue length • buffer overload	N/A	N/A	• lines per time • unit/page/min.	• % busy • availability

Table 4-3. Establish Performance Metrics for Mainframe/Host Environment.

A3.1.1.1 Determine Components to be Measured	A3.1.1.2 Establish Performance Metrics						
A3.1.1.1.2 Communications Network (Distributed Processing)	**A3.1.1.2.1 Capacity (Reserve, Available, Planned)**	**A3.1.1.2.7 Workload**	**A3.1.1.2.2 Contention**	**A3.1.1.2.3 Error Rates/Detection/ Correction**	**A3.1.1.2.4 Response Time**	**A3.1.1.2.5 Throughput**	**A3.1.1.2.6 Utilization**
A3.1.1.1.2.1 Server/CPU Operating System	• internal RAM • spec marks/rates • clock speed (Mhz) • memory transfer rate (Mbps)	• transaction mix • frequency • volume • type • file location • spooling	• multitasking • # of jobs in application mix running • # of I/O's • PC's on-line	• communication errors • speed degradation • Mbps • protocol translations	• security • protocol conversion • path • topology • bottlenecks	• transmissions per sec • availability • I/O rates	• % busy • wait time • PC's on line • device accesses • buffer size
A3.1.1.1.2.2 PC/Client/ Workstation/Terminal CPU Operating System	• internal RAM • spec marks/rates • clock speed/Mhz • memory transfer rate (Mbps)	• frequency • volume • application type • file location • transaction mix	• server competitions • # of jobs in application mix running • hub configuration	• format errors • communication errors • parity errors	• security • traffic volume • polling • protocol conversion • bottlenecks	• traffic volume • transactions per sec • file caching • availability • Mips	• applications • % busy • wait time • LAN load
A3.1.1.1.2.3 Primary Storage (Internal Memory)	• size of RAM • allocation • conventional/extended • access speed	• type • volume • application size • transaction mix	• paging rate • queuing delays • swapping rate	• parity errors	• process scheduling • paging rates • interrupts	• trace utilities • disk catching delays • disk I/O rate	• % memory used by applications, etc
A3.1.1.1.2.4 Secondary Storage (Workstation/Hard Disk Storage)	• size • allocation • use • file mgt	• type • volume • spooling	• file transfers • file sharing • queuing delays • access delays • security	• error rate • corrupted files • parity • error codes (vendor)	• set of delays •• latency •• access time •• LAN load	• data transfer rates • availability	• % busy • sectors used • data location • file structure • bits per sec
A3.1.1.1.2.5 Channels (Circuits)	• channel speed • # available • # of primary alternative paths • bandwidth • media	• volume • resource use • I/O demand	• # of accesses • queue delays • polling • collisions • traffic	• noise • bit error rate • lost packets • retransmits • start/stop bits	• line speed • bandwidth • polling • priority	• bus topology • bandwidth • bus speed • digital or analog	• % busy • % resource usage • LAN load • peak load
A3.1.1.1.2.6 Gateways, Routers, Bridges	• # of ports • # of interfaces • speed (bits/sec)	• type (packets/cells frames) • volume • protocol translations	• traffic • # of users • protocol filtering • error corrections • retransmission rate	• traffic • error • frame errors • noise/spikes	• peer-to-peer • packets/sec • protocol filtering • bandwidth	• protocol conversions • bits/sec (measured) • packet length • packet size efficiency • transmission protocol	• packets/sec • multiplexing rate/time division • availability
A3.1.1.1.2.7 Hubs, Ports, Modems, Switches	• # of ports • # of interfaces • speed (bit/sec) • # of workstations • # of switches	• # of PC's accessed • type (optical, voice, etc) • volume	• # of workstations • protocol filtering • error correction • communication interfaces • retransmissions	• switch configurations • errors • noise/spikes	• peer-to-peer • communication interfaces • protocol filtering • Mbps/access	• access speed • data transfer rate • packet length/size • packet I/O rate	• % available • full/half duplexing speed
A3.1.1.1.2.8 Communication Links (Media) Network/Bus Topology	• bandwidth • protocol • standards • design • media	• type (voice, data, image • process name/identification • volume • analog/digital applications • packet I/O rate	• traffic load • LAN/WAN configuration • access speed • protocol conversion • broadcast storms	• bit error rate • attenuation • noise • addressing • alarms • frame errors	• store and forward rate • peer-to-peer • bus speed • Mbps • media	• traffic load • buffer size • availability • TDM/FMD (multiplexing)	• % availability • I/O load • protocol • bus speed

Table 4-4. Establish Performance Metrics for Communications Network Environment.

Capacity Management Reporting Requirements

The activity decomposition models for the TO-BE CM Function were analyzed to determine the primary reports generated from each activity. Twenty-five reports were identified and related to their source activities and the functional DII/IS areas they address. The reports are defined in Appendix C, ICOM Definitions. A representation of the discovered reporting requirements and their relationships to source activities and functional areas is presented in table 4-5, on page 4-62.

The reporting requirements were selected to represent a standardized set of reports applicable to both the Mainframe/Host (centralized processing) and Communications Network (distributed processing) environments. Further modeling and analysis of the entity content of these reports is necessary to establish the logical databases and their structure needed to provide efficient database administration to support the CM function. These reports are seen as integral to the successful implementation of a DoD-wide Capacity Management Function. Whether these reports are produced on a daily, weekly, or monthly frequency is up to organizational management.

However, these (and other reports desired) must be (1) standard in content and presentation format, (2) be produced from similar sources and databases (as appropriate), (3) be constructed to permit summary reports to be prepared for executive-level reporting, and (4) illustrate the issues that the Capacity Management Function needs to monitor.

As an aid to better understand the general type of reporting information that is contained in these reports, the following describes some typical categories of data collection:

- For example, performance measurement data should be collected on (1) performance bottlenecks; (2) service to users (in terms of system availability); (3) exception reports (for defined thresholds exceeded); and (4) workload characteristics (number of packets or transactions processed, I/O's used), etc.

- Examples of capacity planning report data needed concerns (1) systems capacity and reserve capacity used; (2) workload trends (in terms of transaction rates by user) and volumes; (3) workload processing (in terms of resource usage); (4) performance predictions (in terms of establishing acceptable limits, saturation levels of system components, etc.).

Capacity Management Reporting Requirements	Source Activity	Functional Area Affected					
		Accounting	Configuration	Operations	Performance	Planning	Security
1. AdHoc Performance Analyses	A415		X	X	X	X	
2. Alert Messages	A322			X	X		X
3. Application Design Change Recommendations	A43			X		X	
4. Capacity Plans	A42	X	X	X	X	X	X
5. CM Operating Costs	A12	X		X		X	
6. Comparative Analysis Feedback	A313			X	X	X	
7. Configuration Change Recommendations	A43		X			X	
8. Configuration Change Analysis Reports	A35	X	X	X	X		X
9. Customer Service Alternatives	A11			X	X		
10. Customer Feedback Information	A11, A12			X	X		
11. Executive Level Reports	A23	X	X	X	X	X	X
12. IT Rqmts Report	A42	X	X		X	X	
13. Network Communications Rqmts	A44	X	X	X	X	X	X
14. Performance Monitoring Exceptions	A323			X	X		
15. Performance Reports	A323	X	X	X	X	X	X
16. Performance Problem Report	A322		X	X	X		X
17. Periodic Reports	A23	X	X	X	X	X	X
18. Problem Resolution Report	A35			X	X		
19. Request for Support (Financial, Staffing, Training, etc)	A13	X		X		X	
20. Request for CDA CM Data/Workload Projections and Applications	A412, A33			X	X	X	
21. Resource Utilization Costs	A22, A23	X		X		X	
22. Rqmts for New Metrics/Measures	A311			X	X	X	
23. Security Capacity Utilization Reports	A23		X		X	X	X
24. SLA/SLO Feasibility	A11	X	X		X	X	
25. Specialized Performance Analysis Data	A33			X	X	X	

Table 4-5 Capacity Management Reporting Requirements Table

Section 5
Recommendations

Introduction

The workshop team envisions a new strategic direction for the DoD Capacity Management Function, and the re-engineering of component processes, that will impact all DoD Agencies and Services performing DII/IS activities. This visionary approach to Capacity Management was developed through the application of the DoD CIM Functional Process Improvement Initiative. The result of this effort will enable establishment of a Capacity Management Function that is critical and central to the accomplishment of DoD Information Management objectives.

The improvement opportunities presented herein are the result of extensive analysis conducted during the development of the activity and data models. The workshop team believes that these improvement opportunities are essential to the effective and successful implementation, and management of the Capacity Management Function across the DoD.

In addition to the primary recommendation for DoD to adopt the TO-BE Capacity Management Function as the standard process "template" for DoD, the workshop team discovered 14 Improvement Opportunities which are listed as follows:

1. Provide DII-Wide Management of the Capacity Management (CM) Function.
2. Provide an Effective Organizational Structure for Managing the CM Function.
3. Include CM in IRM Business Planning.
4. Acquire Standard Performance Software Tools from Vendors for DII/IS Components.
5. Provide Central Focal Point for CM Services.
6. Provide Better CM Coordination with CDAs, Users, and IPCs.
7. Collect, Organize, and Evaluate CM Costs.
8. Provide Adequate Funding, Training, and Staffing for CM.
9. Ensure Standard Reporting of CM Support Requirements.
10. Establish a Configuration Control Board.
11. Provide for Standard CM Documentation, Reporting, and Modeling Requirements.
12. Provide for DII-Wide Response-Time Measurements.
13. Provide for DII-Wide Performance Simulation and Capacity Predictions.
14. Provide for DII-Wide Network Component Measurement Capability.

The Improvement Opportunities identified by the Workshop Team, are described below. Explicit references to Activity Models are inSection 4, and issues affecting CM policy implementation are in Section 2.

Improvement Opportunities

Improvement Opportunity #1: Provide DII-Wide Management of the Capacity Management(CM) Function

Mapping to Activity Model: A0
References to Section 2: "Issues Affecting CM Policy Implementation":

(1) Roles and Responsibilities
(6) Centralized Management Control and Distributed Execution
(7) Implementation Support

GOAL:

(1) Establish a Capacity Management Steering Group for coordination of CM issues affecting the DII Information System environments (e.g., Megacenters, networks, communications, and base-level installations, etc.).

(2) Ensure centralized control and distributed execution of the CM Function Throughout DoD to provide better management of collective and "local" CM issues and services.

(2) Develop a centralized control and distributed execution management implementation strategy which will create a centralized CM Function in DoD, and leverage the currently existing CM Function capabilities in each Service and Agency.

DEFICIENCY:

(1) There is currently no formal centralized function (e.g., CM Steering Group) for the coordination of CM issues affecting all DII/IS configurations across the DoD.

(2) The CM programs which currently exist are not implemented in a consistent manner within the Services and Agencies, and are not managed by a DoD-wide central organization.

RECOMMENDATION:

(1) Create a CM Steering Group at the DISA executive level. This group will be composed of senior level managers representing Megacenters, CDAs, networks, communications, and base-level installation CM Functions. Functional areas, as well as user communities, will be represented. The Steering Group will ensure that all appropriate organizations will have the opportunity to participate in the CM process.

(2) The CM Steering Group will be responsible for overall direction of the CM Group. Responsibilities will include: setting and implementing policy, promulgating

standards and procedures, establishing reporting requirements, identifying and coordinating security requirements that affect system performance, and preparing DoD level strategic CM plans. The group will also be responsible for evaluation of costs and acquisition issues that affect the CM Function.

(3) Leverage current capabilities by giving execution authority to the Services and Agencies for their respective sites and workloads. In this way, current CM programs (e.g., in DLA at DSAC, in the Air Force at Wright Patterson AFB, etc.) are preserved and continue to deal with the sites and workloads that they each know best.

(4) The central group would bring each program into compliance with the requirements of the central program. This approach preserves current skills and knowledge and provides a measure of reassurance to the Services and Agencies that their CM concerns and issues are dealt with by analysts who fully understand their problems.

Concept of Use:

The Capacity Management (CM) Steering Group is a cooperative function that oversees the promulgation and enforcement of CM standards, methodologies, and procedures. These include: procedures, data collection, storage management, capacity planning and performance monitoring/tuning areas of DII Information Systems environment (IPCs, Megacenters, CDAs, etc). The CM Steering Group also sets standards, defines DoD level reporting requirements, coordinates preparation of management level strategic capacity plans, etc. It provides centralized control and distributed execution of the CM Function through DoD-wide CM coordination of Capacity Management activities for the DII.

Within this concept of use, the CM Steering Group function would reside at the DISA Executive level. It would be composed of senior managers who represent DISA, DISO, DISN, each Megacenter, CDAs, and base-level military installations. The Steering Group would meet on a periodic (e.g., quarterly) basis to resolve agenda items, and provide direction on issues, to the DII Information Systems community over which it presides.

Improvement Opportunity #2: Provide an Effective Organizational Structure for Managing the CM Function.

Mapping to Activity Model: A0
References to Section 2: "Issues Affecting CM Policy Implementation":

(5) Organizational Structures
(6) Centralized Management Control and Distributed Execution
(7) Implementation Support

GOAL: (1) Define CM as a major function of the DII, and place this function at an appropriate level (e.g., division) within DoD IS organizations to ensure effective implementation of the CM Function.

(2) Staff the CM Function at all IPCs at a level adequate to perform the CM Function on a par with other major functional areas of the IPC.

DEFICIENCY:

(1) Currently, the CM Function is not always implemented at an organizational level that will ensure effective implementation.

(2) The CM Function often does not have adequate numbers of personnel, nor personnel with correct skills, to ensure effective implementation of the CM Function.

RECOMMENDATION:

(1) Identify elements of DoD organizational structures that perform CM activities, and ensure that they are structured to permit standard integration of the CM Function DoD-wide. Further, this will foster effective management of individual organizational CM practices in a unified manner.

(2) The CM Function at all IPCs should be adequately staffed by full-time practitioners at an organizational level on a par with the other major functional areas of the IPC.

(3) Elevate the CM Function to an organizational level in the IPC that will ensure credible information is provided to decision makers that is more responsive to their needs.

Improvement Opportunity #3: Include CM in IRM Business Planning

Mapping to Activity Model: A0
References to Section 2: "Issues Affecting CM Policy Implementation":
(9) Life-Cycle Design and Development

GOAL: (1) To Integrate CM in the Agency and Departmental IRM planning process.

(2) Establish a process to allow CM to participate in the development of long-range IRM business plans.

DEFICIENCY:

(1) Currently, CM management is often unaware of larger IPC, Agency, or DoD IS business planning issues. By not having a complete understanding of IRM business requirements, the CM Function is not as effective as it should be.

(2) The CM Function is not typically integrated into the IRM planning process.

RECOMMENDATION:

(1) Involve CM management more directly in the enterprise business planning process including short and long-range planning, acquisitions, budget development,cost analyses, etc.

(2) Provide a process by which CM is involved in all elements of the IRM Business Planning Process which may affect the performance or planning of information Systems.

Improvement Opportunity #4: Acquire Standard Performance Software Tools From Vendors for DII/IS Components

Mapping to Activity Model: A3112, A42
References to Section 2: "Issues Affecting CM Policy Implementation":

(2) Standards
(3) Reporting
(8) Baseline DII/IS Models

GOAL: To provide performance measurement capabilities and system utilization tools for all components that comprise the DII architecture.

DEFICIENCY:

(1) Performance measurement software is often not available for all components of the DII/IS environment.

(2) Integrated network performance measurement tools are needed across DoD heterogenous network environments.

(3) There is no continuous performance measurement data collection process across networks. There is no data collection activity analogous to mainframe data collection processes (e.g., RMF and SMF data collection routines on an IBM mainframe), in which performance and usage data is continuously collected and saved in database files for later use. This basic data collection is required to support routine performance and utilization reporting, trend analysis and other normal capacity management activities.

(4) Current network measurement tools are vendor, platform, and architecture specific, and do not enable interoperable performance measurements.

The following presents some examples of current vendor, platform, and architecture specific tools and the components they measure:

- For SNA - Netview Performance Monitor (NPM), Net/Master and NetSpy
- For IP Router Networks - NetCentral, NetExpert,
- For Ethernet LANs - Network General Sniffer and HP Network Advisor
- For FDDI optical data networks - Spectrum Network Management System
- For T1 Communication Backbones - AT&T Comsphere System

Although the goal is for the DII to migrate to an "open systems" interconnection environment, there are no tools that provide an interoperable measurement capability for these end-to-end heterogenous networks . Further, existing tools do not provide for aggregation of measurement data into a collective and meaningful view of a system being measured.

RECOMMENDATION:

(1) Request that vendors provide standard performance measurement software that will enable the analysis of performance and capacity utilization for interoperable components in the DII/IS (end-to-end) environment. This software will permit more accurate peer-to-peer and end-to-end performance analysis.

(2) Request that vendors develop and provide standard performance measurement software to enable collection of performance data across DII/IS configurations (PC-to-mainframe) . This software will permit uniform performance reporting for all DII/IS environments.

(3) Develop a DoD standard performance specification for performance measurements for vendor compliance across all DII/IS components.

Improvement Opportunity #5: Provide Central Focal Point For CM Services

Mapping to Activity Model: A11
References to Section 2: "Issues Affecting CM Policy Implementation":
(1) Roles and Responsibilities

GOAL: Establish a more effective interface for providing CM support services with all requestors (IPC, CDA, Megacenter, User Community, etc.) for problem identification and management of CM issues.

DEFICIENCY:

(1) There is no central point of contact within the CM Function where CM support requests, support requirements and other tasking is serviced.

(2) There is no formal IPC Help Desk interface to external offices (requestors) for project management activities associated with the CM Function, to provide liaison and feedback on performance issues.

(3) Often skill levels of IPC personnel who now perform "Help Desk" functions, are inadequate to interpret problems or assign problems to the correct IPC functional area for action.

RECOMMENDATION:

(1) Establish a formal point of contact for the CM Function to review, analyze, and assign requests for support in order to effectively satisfy to receive support requirements, and requests in the most cost effective manner.

(2) Provide adequate training for Help Desk personnel concerning CM functional activities, to enable them to more effectively screen requests for CM Services.

(3) Ensure that the "Help Desk" for the CM Function becomes the "front door" where liaison and feedback on support are provided to external organizational elements.

(Note: This recommendation has been incorporated into the **A1 Manage Service** model. However, the issues discussed here still require resolution.)

Improvement Opportunity #6: Provide Better CM Coordination With CDAs, Users, And IPCs.

Mapping to Activity Model: A11
References to Section 2: "Issues Affecting CM Policy Implementation":

(1) Roles and Responsibilities
(5) Organizational Structures

GOAL:

(1) Ensure that Functional Descriptions (FDs) contain well-defined, meaningful and measurable, performance objectives and metrics to enable the CDAs to write more resource-efficient application programs.

(2) Establish a user interface with the CDA Community to provide timely resource requirement information on current and new applications or system designs.

(3) Establish a process by which the CM Function is included as a formal coordinator of all Service Level Agreements (SLAs) and Service Level Objectives (SLOs).

DEFICIENCY:

(1) Often software/program application code is not written to make efficient use of system resources, which results in added cost for system utilization to the user.

(2) Functional Descriptions (FD) have poorly defined performance objectives and workload requirements. This leads to inadequate achievement of Service Level Objectives.

(3) Often CDAs and/or Functional Activity Proponents do not provide timely resource requirements to the CM Function. Then, time and resources cannot be made available without "crash" efforts.

(4) Frequently SLAs/SLOs are not developed or coordinated with the CM Function. This results in requirements to meet performance objectives that may not always be obtainable. Further, the feasibility of accomplishing SLOs is not always known.

RECOMMENDATION:

(1) Review system performance utilization of applications to determine more efficient methods of executing user programs that can result in reduced cost to the user.

(2) Establish a Software Performance Engineering program to ensure that resource estimates are provided for as major milestones in the application or system design development life-cycle.

(3) Ensure that customers and CDAs provide FDs that contain well-defined performance objectives and workload estimates. The CM staff should be a part of the performance objective development process.

(4) Ensure that no new application, or major change to an existing application is installed without first providing the performance staff, CDA, etc., with resource estimates and/or benchmarks. (With the new prototyping development methodology available, this information should be more readily available.)

(5) Ensure a process is in place to allow the CM Function to review, coordinate, and determine feasibility of achieving the SLAs/SLOs during the development process.

Improvement Opportunity #7: Collect, Organize, and Evaluate CM Costs

Mapping to Activity Model: A13, A2
References to Section 2: "Issues Affecting CM Policy Implementation":
(4) Cost Accounting

GOAL: (1) Evaluate the costs associated with the CM Function to promote quality processes that result in cost savings, and document the cost of doing business.

(2) Establish a CM cost recovery system (i.e., Fee-For-Service) to permit collection of performance and memory utilization, and other cost data.

DEFICIENCY:

(1) There is no consistent collection and reporting of performance and other direct cost data that will demonstrate the cost and quality of CM functional activities.

(2) There is no effective or standard process for the collection of resource utilization data that will permit cost evaluation and reporting.

RECOMMENDATION:

(1) Ensure a process is in place to generate cost data on elements of the CM Function that will provide a "big picture" of the cost of doing business. These data can be used to derive levels of efficiency, and provide input to evaluations of the quality of CM activities.

(2) Establish a database that will provide data on capacity utilization, etc., and that will be useful in measuring usage of system resources. This will provide input in determining the cost of capacity (e.g., memory, used disk space, I/Os, security overhead, etc.) in relation to performance and use, or loss of, available capacity.

(3) Develop and implement a cost recovery system (i.e., Fee-For-Service) that will permit accumulation of resource utilization and other cost data (e.g., capacity utilization, I/Os, security overhead, CPU busy, and direct labor hour reporting, etc.).

Improvement Opportunity #8: Provide Adequate Funding, Training, and Staffing for CM

Mapping to Activity Model: A13
References to Section 2: "Issues Affecting CM Policy Implementation":
(10) Staffing Requirements
(11) Training

GOAL: (1) Ensure that sufficient levels of staffing, skills training, and funding are provided to ensure effective execution of the CM Function at operational levels.

(2) Identify and define formal job descriptions and skill sets required to perform the CM Function for all components of the DII/IS. This includes job descriptions for positions in network, communication and PC-client/server areas, etc.

DEFICIENCY:

(1) There are insufficient levels of skills, staffing, training, and funding made available to support CM Functions.

(2) There are no standard or consistent position descriptions for CM Functions within or between the Services and Agencies of the DoD.

RECOMMENDATION:

(1) Provide adequate training and funding for development of personnel skills needed to perform the CM Function.

(2) Ensure adequate CM personnel staffing levels exist at all IPC, CDA, and base-level installations.

(3) Identify skill sets and requirements for all positions that are necessary to manage and perform activities associated with capacity management, performance measurements, capacity planning, modeling, etc.

(4) Develop formal, standard, and consistent job descriptions, that are approved by upper-management for the performance of CM Functions across the DII/IS.

Improvement Opportunity #9: Ensure Standard Reporting of CM Support Requirements

Mapping to Activity Model: A13
References to Section 2: "Issues Affecting CM Policy Implementation":

(3) Reporting
(4) Cost Accounting

GOAL: Establish a process for collecting needed CM support requirements (e.g., financial, staffing, training, contracts, etc.), and developing an overall process to support standard reporting.

DEFICIENCY:

(1) Often there does not exist a standard process for collection and reporting of support requirements that are needed for effective and fiscally sound management of the CM Function.

(2) CM Function support reporting requirements are inconsistent or are not standardized across the DoD.

(3) The CM Function support requirements are not currently identified or budgeted to provide for a successful implementation and continuation of this CM Function.

RECOMMENDATIONS:

(1) Establish a formal standard process for collection and reporting of CM Functional support requirements that includes financial, personnel, training and contractual support, etc.

(2) Identify short- and long-range requirements that must be funded to support the ongoing CM Function. This should occur on a periodic (e.g., quarterly) basis.

(3) Establish the personnel, training, contract support and funding requirements necessary to implement the CM function in the new Megacenter environment, as well as, at CDAs, IPCs, base-level military installations, etc.

Improvement Opportunity #10: Establish a Configuration Control Board

Mapping to Activity Model: A0
References to Section 2: 'Issues Affecting CM Policy Implementation":

(1) Roles and Responsibilities
(5) Organizational Structures
(6) Centralized Management Control and Distributed Execution

GOAL: Establish a Configuration Control Board (CCB) structure to issue policy and guidance for managing changes to the DII architectural configuration.

DEFICIENCY:

(1) There is no centralized control for managing configuration changes to the DII.

(2) There is no formal approach, process, or standards for managing and implementing IS configuration changes across the DII.

RECOMMENDATION:

(1) Establish a Configuration Control Board to provide policy, guidance, and oversight of changes to the DII.

(2) The CCB should develop and issue configuration management policy and overall standards and review processes to provide structure for managing changes to DII architecture.

(3) The CCB should also provide the direction and guidance for implementing DII configuration and change management procedures.

(4) This board should be composed of senior managers who represent all affected Services and Agencies of the DoD, and including C3I.

Improvement Opportunity #11: Provide for Standard CM Documentation, Reporting, and Modeling Requirements

Mapping to Activity Model: A2, A3, A4, A5
References to Section 2: "Issues Affecting CM Policy Implementation":

(2) Standards
(3) Reporting
(8) Baseline DII/IS Models

GOAL: Establish standard documentation procedures, reporting requirements, and modeling procedures for DoD-wide CM activities.

DEFICIENCY:

(1) There are no standard and consistent DoD-wide documentation and reporting procedures for the CM Function.

(2) There is no standard approach for documenting and reporting activities of the CM Function for all elements of the DII/IS.

(3) There is no capability to capture the "big picture" of all collective CM Function activities across the DII/IS.

(4) There are no standard modeling practices, requirements, or procedures for CM activities DoD-wide.

RECOMMENDATION:

(1) Establish standard requirements and frequencies for documenting and reporting CM functional activities (e.g., performance measurements, reserve capacity, resource utilization, etc.), DoD-wide.

(2) Reports should enable the preparation of a "big picture" (e.g., available and reserve capacity, resource utilization, workload growth forecasts, staffing requirements, cost data, etc.) of the CM Function across the DoD.

(3) Establish standard modeling information requirements and procedures so that data can be collected and merged in order to model composite DII/IS environments, and prepare comparative reports.

(Note: A table of recommended reports for CM is presented in Table 4-5 page 4-62. Further a standard approach to modeling has been incorporated into the A5 Activity model.)

Improvement Opportunity #12: Provide for DII-Wide Response-Time Measurements

Mapping to Activity Model: A3
References to Section 2: "Issues Affecting CM Policy Implementation":

(2) Standards
(8) Baseline DII/IS Models

GOAL: Develop the capability to measure response-times for all components of the DII from PC-to-Mainframe (end-to-end) including mainframe/host computers, networks, and communications environments.

DEFICIENCY:

Currently, the differences in the performance measures and non-standard performance specifications from vendors of DII/IS components (e.g., in Mainframes, Networks, and Communications) preclude the accurate measurement of end-to-end response time. This is due to the lack of interoperability of many DII/IS components, which limits measurement capabilities for system response-time in DoD heterogeneous environments.

RECOMMENDATION:

(1) Define requirements, and obtain software for performance measurement capabilities that apply to DII/IS components (from vendors or government sources) which will permit interoperable response-time measurement and data-collection capabilities for all DII components, PC-to-Mainframe (end-to-end), regardless of protocols used.

(2) Enable measurement of response-times for any combination of DII components world-wide. Combinations may include: (1) mainframe-to-mainframe, (2) mainframe-to-network, (3) network-to-client/server, and (4) communications modes and media (e.g., Front-End-Processors, T1/T3 lines, FDDI backbones, SONET, ATM, satellites, mobile, etc.).

(3) Provide performance measurement software that will permit monitoring and measurement of all types of networks. One element of the required software is the Simple Network Management and Protocol (SNMP) for TCP/IP operations that must be present in all applicable network components.

An example of the performance measurements that are needed for capturing PC-to-Mainframe (end-to-end) response-time, are shown in Figure 2-2 Peer-to-Peer Propagation Delay Response-Time Measurements. Since PC-to-Mainframe measurements are difficult (if not impossible) in current DII/IS configurations, this figure provides an example of how we might measure total PC-to-Mainframe response-time using a peer-to-peer measurement construct.

Improvement Opportunity #13: **Provide for DII-Wide Performance Simulation and Capacity Predictions**

Mapping to Activity Model: A4, A5
References to Section 2: "Issues Affecting CM Policy Implementation":

(8) Baseline DII/IS Models
(9) Life-Cycle Design and Development

GOAL: To establish a "what-if" simulation capability for modeling performance, and developing capacity predictions, for new or proposed changes to a DII/IS configuration.

DEFICIENCY:

Currently few capabilities exist to model and predict the performance of alternative configurations for the DII/IS Capacity Management Function. **The Plan Capacity** (A4) and **Maintain Capacity Management Models** (A5) activities of CM are not typically used in the communications/network environment. Performance predictions and their relationship with SLOs are mostly confined to the mainframe environment. If we are to perform effective and efficient capacity planning for communications/network environments, we will have to provide modeling capabilities for all DII/IS environments.

RECOMMENDATION:

(1) Establish the capability to realistically and accurately simulate "what if " modifications to any element of the DII/IS configuration. This will allow performance prediction of selected configurations for capacity planning, including evaluation of potential configurations and user workload/application scenarios, and adding new networks.

(2) Establish the capability to be comprehensive enough to include all modeling capabilities needed for PC-to- mainframe environments, including communication systems and network topologies.

(3) Require vendors to provide modeling/simulation "what is" software that can be used for producing and presenting performance and capacity predictions of new or proposed changes to any DII/configuration.

Improvement Opportunity #14: Provide for DII-Wide Network Component Measurement Capability

Mapping to Activity Model: A3
References to Section 2: "Issues Affecting CM Policy Implementation":

(2) Standards
(9) Life-Cycle Design and Development

GOAL: Ensure that DII network and communications components have standard, interoperable, and protocol-independent measurement capabilities.

DEFICIENCY:

(1) Currently network components are often protocol-dependent and not interoperable. This is caused by proprietary protocols and other vendor-specific software that do not adhere to common performance measurement standards. Often these components can not be made interoperable. When they can be, this often requires additional costs and time to be expended in obtaining vendor modifications and/or additions to their products, procurement of third party interface software, and additional testing and adjustments to baseline network environments to accommodate these components.

(2) As Megacenters and DII configurations evolve, and legacy systems are replaced, there are no formal standards, or centralized control in the DoD to ensure that all hardware and software architectures, system components, and protocols are interoperable and measurable and will enable capacity and performance measurements to be performed. Further, and to make measurements more difficult, much of the difficulty in measuring network performance is due to the heterogenous non-interoperable nature of legacy systems and architectures.

RECOMMENDATION:

(1) Establish and enforce standards, and require vendor certification for the measurement of network components that are to be configured into communication systems and networks. Specifically, newly proposed components should be required to meet interoperable performance measurement standards, hardware and software protocols and interface standards.

(2) All new start initiatives for the DII/IS should be based on appropriate standards and architectures that support and provide for end-to-end (e.g., "open systems") performance measurement capabilities.

(3) The DoD should initiate a partnership with industry, through conferences and other available meetings, to describe and solicit vendor capabilities that will meet the requirements stated herein.

Appendix A
IDEF Reader's Guide

This appendix contains excerpts from the "Modeling for Managers"[1] course material provided by D. Appleton Company, Inc.

A.1 IDEF0 Activity Models

The aim of the IDEF0 activity modeling technique is to support the specification of positive changes in business processes as well as the discovery and documentation of data requirements from the process perspective.

The activity modeling technique, known as IDEF0, resulted from the Air Force's Integrated Computer Aided Manufacturing (ICAM) program and is recognized by the Air Force as an important technique for modeling activities. The technique has been adopted because of its flexibility and widespread use throughout business, industry, and government.

A completed activity model graphically depicts the specific steps, operations, and information needed to perform an activity. Models also show how specific activities are related to one another.

A.1.1 Activities

An activity is a named process, function, or task that occurs over time and has recognizable results. Although activities are performed within functional areas of an organization, it is important that they are defined independent of any functional area. The tendency to model the organization structure rather than its processes should be avoided. In a diagram, the activity is represented by a rectangular box with the verb phrase that describes the activity. Examples of activities are depicted in Figure A-1.

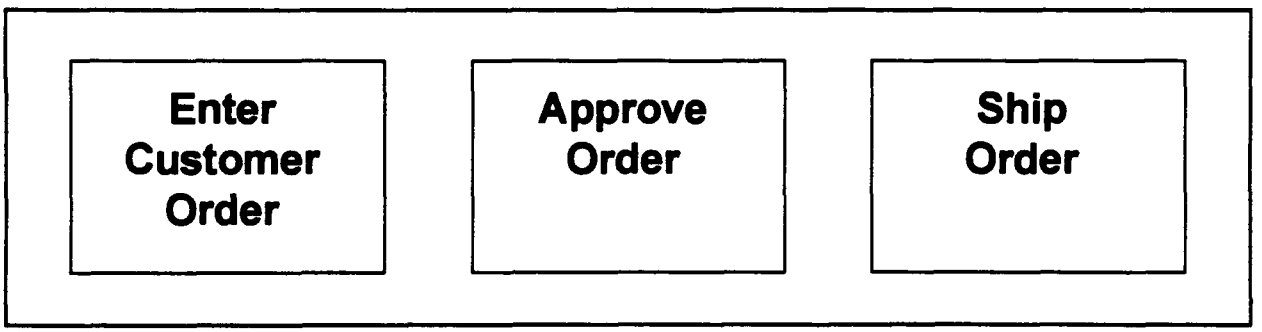
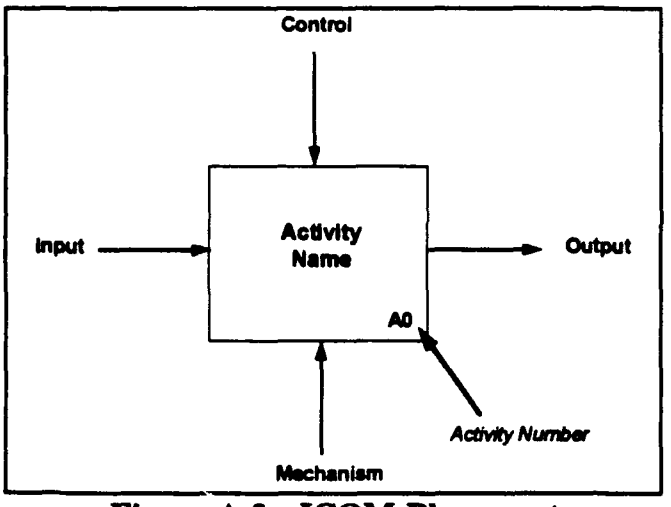


Figure A-1. Activity Examples

[1] D. Appleton Company, Inc. *Business Modeling for Managers.* Manhattan Beach, CA, 1990.

A.1.2 ICOMs

The term ICOM refers collectively to the group of information flows between activities which have one of four roles in the activity:



Input - Information or material used to produce the output of an activity;

Control - Information or material that constrains or controls an activity;

Output - Information or material produced by or resulting from the activity; and,

Mechanism - Usually people, machines, or systems that perform the activity.

Figure A-2. ICOM Placement

The particular role of an ICOM is identified by the position of its arrow in relation to the activity box. The placement of ICOMs in relation to an activity is illustrated in Figure A-2.

A.1.3 Context Diagrams

A context diagram is a single diagram which illustrates the highest level activity and its information or materials. The context diagram shows an activity being explored with its associated ICOMs. Since the technique is hierarchical, this activity represents the entire subject being modeled. The "viewpoint" and purpose of the model are typically stated on the bottom right hand side of the diagram. Figure A-3 depicts an example of a context diagram, using the activity "Process Order". The activity depicted in the context diagram is typically numbered A0.

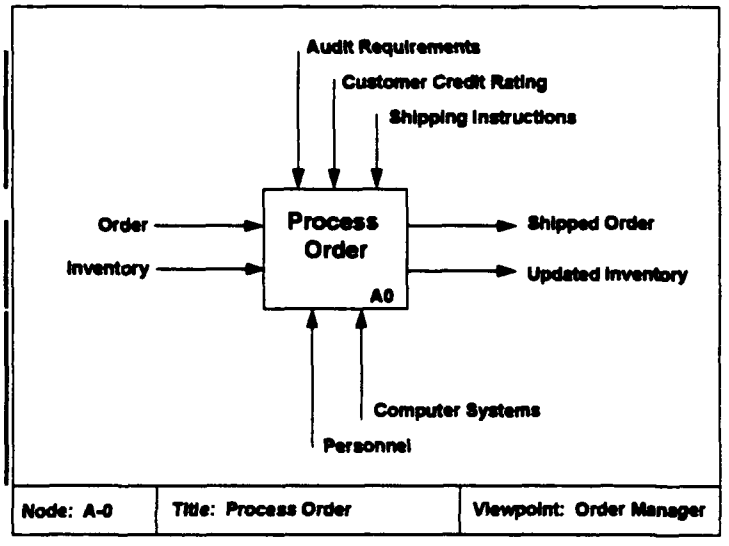


Figure A-3. Context Diagram

A.1.4 Node Trees

A node tree shows the activities, without their ICOMs, on a single hierarchical diagram for easy reference. Each node, or dot, on the tree represents an activity. Each arc, or line, from one activity to the next lower level activity represents a decomposition relationship. The structure shows the activities and subactivities within the model.

Figure A-4 depicts a node tree for the major activity Process Order. This activity was decomposed into three major subactivities. Activity A2, Approve Order, has been further decomposed into four subactivities.

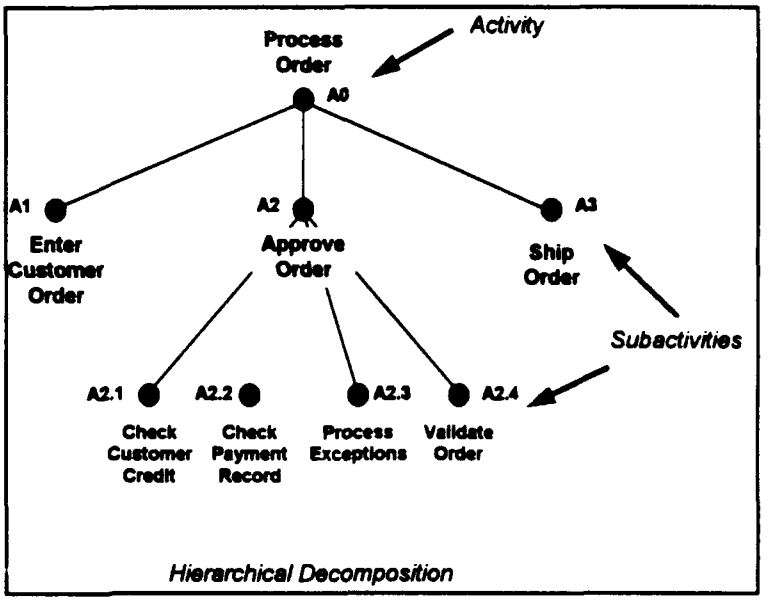


Figure A-4. Node Tree Example

A.1.5 Decomposition Diagrams

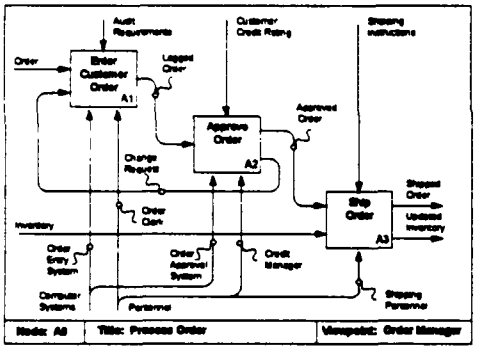


Figure A-5. Decomposition Diagram

Each activity on the diagram may be depicted in more detail, or decomposed, on a separate, lower level diagram referred to as a decomposition diagram. Unlike a node tree, the decomposition diagram depicts only one level of activities within the hierarchy. A decomposition diagram contains all the child activities of the parent activity. The decomposition diagram allows a complex activity to be broken down into smaller, simpler, more detailed activities. As a general rule, each decomposition diagram should contain at least three and no more than six activities.

A.1.6 ICOM Glossary

In addition to the diagrams, a complete ICOM glossary is necessary to fully convey a common understanding of the model. Each ICOM should be defined in terms of its use and intent with respect to the model. ICOM definitions should be independent of the ICOM role in relation to an activity, as an ICOM may have a different role on different activities.

A.1.7 Activity Descriptions

To aid in communicating the activity model to people unfamiliar with the IDEF0 technique, we typically provide a detailed activity description of each activity box represented by the model. These descriptions detail the ICOMs of the activity as well as other activities affected by the outputs. The activity description should be able to stand alone as a means for communicating the same information as the model.

A.1.8 Activity Model Uses

There are several uses of activity models such as:

- **AS-IS Models** - The AS-IS model communicates a consensus view of the current processes and ICOMs and is often used as a discussion tool to identify improvement opportunities and to assess changes from the implementation of new processes;

- **TO-BE Models** - The TO-BE models represent the desired activities and associated ICOMs based on the implementation of improvement projects against the AS-IS Baseline;

- **Data Discovery** - Data elements of interest to the enterprise may be extracted from an examination of the ICOMs of an activity model. These data elements can then be used when specifying transactions that are eventually used to automate the process;

- **Activity Based Costing Framework** - Activity models provide a basis for analyzing costs in ABC analysis. The decomposition of activities to a very low level allows the application of specific costs to activities. We can then aggregate these costs to analyze the activities according to the actual impact they have on the enterprise's costs; and,

- **Benchmarking Tool** - Benchmarking is an activity-based analysis tool for examining "world-class" processes in order to replicate some of the elements in similar processes. By describing the activities in common terms, it becomes simple to discuss the opportunities for improvement based on the benchmark model.

A.2 IDEF1X Data Models

This section provides a context for reading and understanding IDEF1X semantic data models. It is not intended to be an instruction manual in the techniques of building such models. Rather, it is intended to specify the basic components of a semantic data model and their interpretation.

IDEF1X has proven to be a useful and powerful tool for modeling a conceptual schema. IDEF1X models define data in a fully normalized structure, which allows an initial model to be extended without altering the initial set of entities, relationships, and attributes. IDEF1X models are also being used to automatically generate database designs and data integrity control logic. IDEF1X provides a full set of semantic modeling capabilities while maintaining the "economy of concepts" associated with basic Entity-Relationship modeling.

A.2.1 Components

The IDEF1X modeling techniques include a set of modeling semantics, graphic syntax for representing the semantics, rules for modeling, modeling procedures, and documentation formats. An IDEF1X model can be described as a set of graphic diagrams representing real or abstract objects, their characteristics or attributes, and their relationship to one another. Data model diagrams are refined into three different levels of detail:

- Entity-Relationship, the least detailed level;
- Key-Based, the next level of detail where keys and other constructs are added; and,
- Fully Attributed, the most detailed data model level that includes all non-key data.

A glossary that defines the entities and attributes used in the diagrams is created to support each set of models. Detailed written descriptions of the manner in which data relates to other data, called Business Rules, are also developed from the models.

A.2.2 Entity Semantics

An "entity" represents a set of real or abstract things (people, objects, places, events, states, ideas, pairs of things, etc.) which have common attributes or characteristics and are of interest to the organization. An individual member of the set is referred to as an "entity instance."

In key-based and fully attributed models, a distinction is made between two types of entities. An entity is "identifier-independent" or simply "independent" if each instance of the entity can be uniquely identified without determining its relationship to another entity. An entity is "identifier-dependent" or simply "dependent" if the unique identification of an instance of the entity depends upon its relationship to another entity.

An entity is represented as a box as shown in Figure A-6. If the entity is identifier-dependent, then

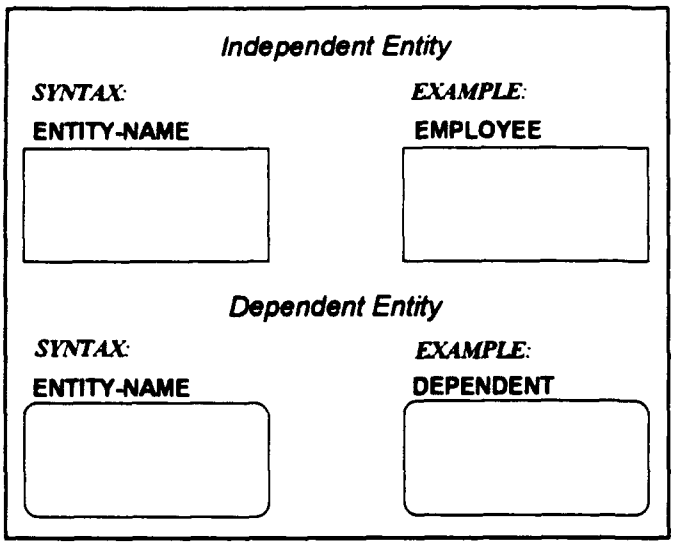


Figure A-6. Entity Syntax

the corners of the box are rounded. Each entity is assigned a unique name that is placed above the box. The entity name is a noun phrase (a noun with optional adjectives and prepositions) that describes the set of things the entity represents. The noun phrase is singular, not plural. Abbreviations and acronyms are permitted only where necessary; however, the entity name must be meaningful and consistent throughout the model. A formal definition of the entity and a list of synonyms or aliases must be defined in the model glossary. Although an entity may be drawn in any number of diagrams, it only appears once within a given diagram.

A.2.3 Non-Specific Relationship Semantics

In key-based and fully attributed IDEF1X models, all associations between entities must be expressed as specific binary relationships. However, in the initial development of a model, it is often helpful to identify "non-specific relationship" between two entities. These non-specific relationships are refined in later development phases of the model. Entities introduced to resolve non-specific relationship are sometimes called "intersection" or "associative" entities.

A non-specific relationship, also referred to as a "many to many relationship", is an association between two entities in which each instance of the first entity is associated with zero, one, or many instances of the second entity and each instance of the second entity is associated with zero, one, or many instances of the first entity. For example, if an employee can be assigned to many projects and a project can have many employees assigned, then the connection between the entities EMPLOYEE and PROJECT can be expressed as a non-specific relationship.

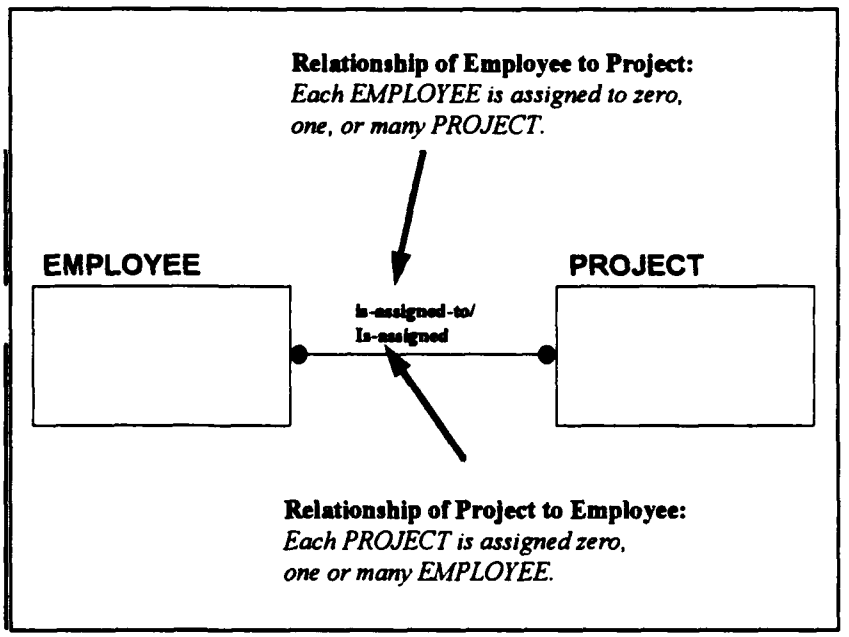


Figure A-7. Non-Specific Relationship Syntax

A non-specific relationship is depicted as a line drawn between the two associated entities with a dot at each end of the line. See Figure A-7. A non-specific relationship is named in both directions. The relationship names are expressed as a verb ore verb phrase placed beside the relationship line and separated by a slash, "/".

A.2.4 Connection Relationship Semantics

A "specific connection relationship" is an association or connection between entities in which each instance of the parent entity is associated with zero, one, or more instances of the child entity, and each instance of the child entity is associated with exactly one instance of the parent entity. For example, a specific connection relationship would exist between the entities EMPLOYEE and DEPENDENT, if an EMPLOYEE Has zero, one, or more DEPENDENT and each DEPENDENT instance is associated with a single EMPLOYEE.

The connection relationship may be further defined by specifying the cardinality of the relationship. That is, the specification of how many child entity instances may exist for each parent instance. Within IDEF1X, the following relationship cardinalities can be expressed:

1. Each parent entity instance may have zero, one or more associated child entity instances.

2. Each parent entity instance must have at least one or more associated child entity instances.

3. Each parent entity instance can have none or at most one associated child instance.

4. Each parent entity instance is associated with some exact number of child entity instances.

If an instance of the child entity is identified by its association with the parent entity, then the relationship is referred to as an "identifying relationship". For example, if one or more tasks are associated with each project and tasks are only uniquely identified within a project, then an identifying relationship would exist between the entities PROJECT and TASK. That is, the associated project must be known in order to uniquely identify one task from all other tasks. (Also see Foreign Keys Semantics.)

If every instance of the child entity can be uniquely identified without knowing the associated instance of the parent entity, then the relationship is referred to as a "non-identifying relationship". For example, although an existence-dependency relationship may exist between the entities EMPLOYEE and DEPENDENT, EMPLOYEEs may be uniquely identified by its key set without identifying the associated DEPENDENT instances.

A specific connection relationship is depicted as a line drawn between the parent entity and the child entity with a dot at the child end of the line. The default child cardinality is zero, one or many. A "P" (for positive) is placed beside the dot to indicate a cardinality of one or more. A "Z" is placed beside the dot to indicate a cardinality of zero or one. If the cardinality is an exact number, a positive integer number is placed beside the dot. See Figure A-8.

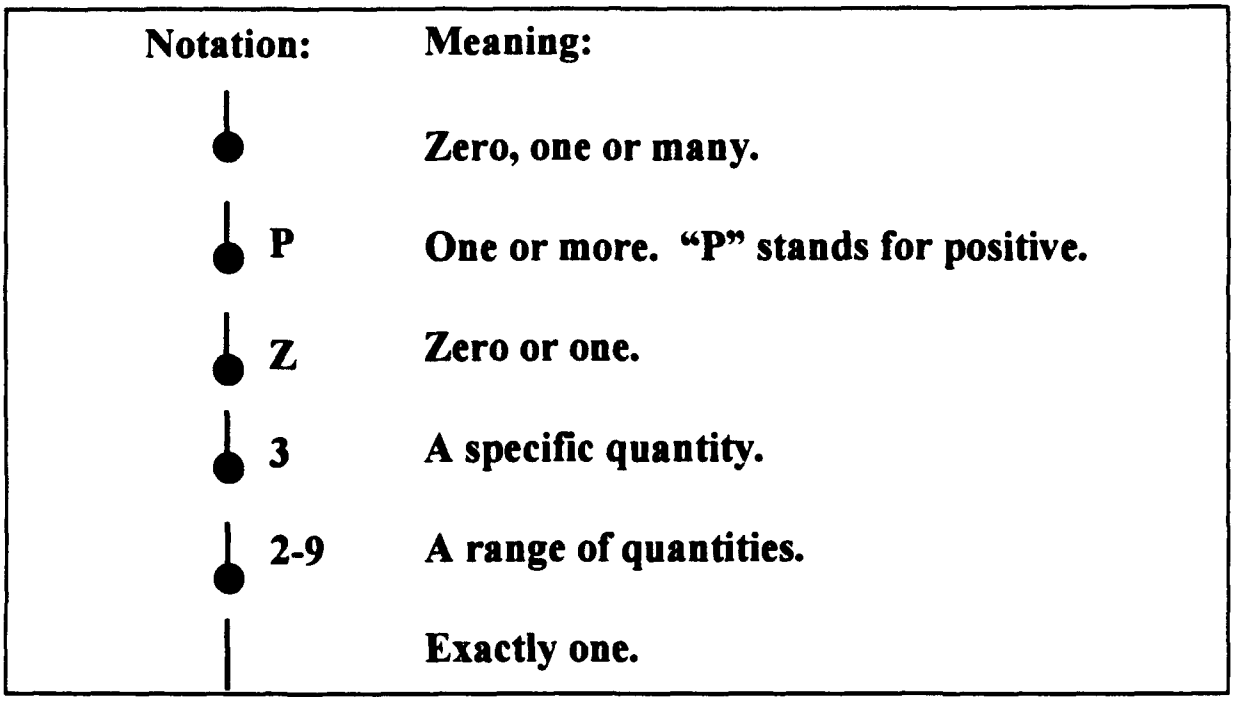


Figure A-8. Relationship Cardinality Syntax

A solid line depicts an identifying relationship between the parent and child entities. See Figure A-9. If an identifying relationship exists, the child entity is always an dependent entity, represented by a rounded corner box, and the primary key attributes of the parent entity are also inherited primary key attributes of the child entity. (Also see Foreign Keys Semantics).

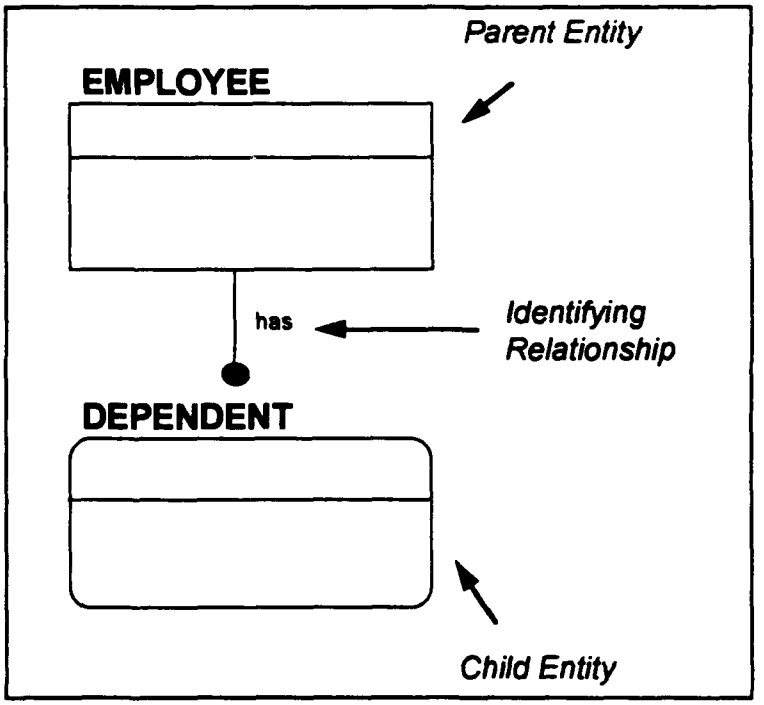


Figure A-9. Identifying Relationship Syntax

The parent entity in an identifying relationship will be independent unless the parent entity is also the child entity in some other identifying relationship, in which case both the parent and child entity would be identifier-dependent. An entity may have any number of relationships with other entities. However, if the entity is a child entity in any identifying relationship, it is always shown with rounded corners, regardless of its role in the other relationships.

A dashed line depicts a non-identifying relationship between the parent and child entities. See Figure A-10. Both parent and child entities will be identifier-independent entities in a non-identifying relationship unless either or both are child entities in some other relationship

which is an identifying relationship.

A relationship is a verb or verb phrase placed beside the relationship line. The name of each relationship between the same two entities must be unique, but the relationship names need not be unique within the model. The relationship name is always expressed in the parent- to-child direction, such that a sentence can be formed by combining the parent entity name, relationship name, cardinality expression, and child entity name.

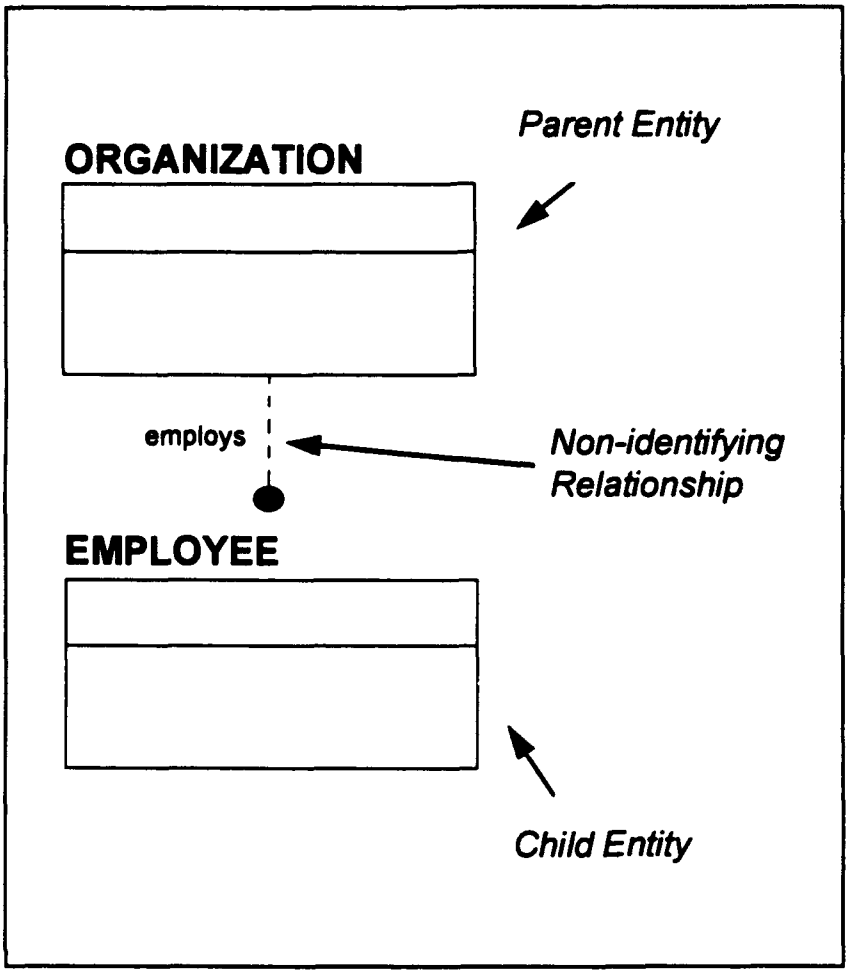


Figure A-10. Non-Identifying Relationship Syntax

For example, the statement "A project consists of one or more tasks" could be derived from a relationship showing PROJECT as the parent entity, TASK as the child entity with a "P" cardinality symbol, and "Consists-of" as the relationship name. Note that the relationship must still hold true when stated from the reverse direction, although the child to-parent relationship is not named explicitly. From the previous example, it is inferred that "a task is part of exactly one project."

A.2.5 Categorization Relationship Semantics (Category Entities)

Entities are used to represent the notion of "things about which we need information." Since some real world things are categories of other real world things, some entities must, in some sense, be categories of other entities. For example, suppose employees are something about which information is needed. Although there is some information needed about all employees, additional information may be needed about salaried employees that is different from the additional information needed about hourly employees. Therefore, the entities SALARIED-EMPLOYEES and HOURLY-EMPLOYEES are categories of the entity EMPLOYEE. In an IDEF1X model, they are related to one another through a categorization relationship.

Category entities for a generic entity are always mutually exclusive. That is, an instance of the generic

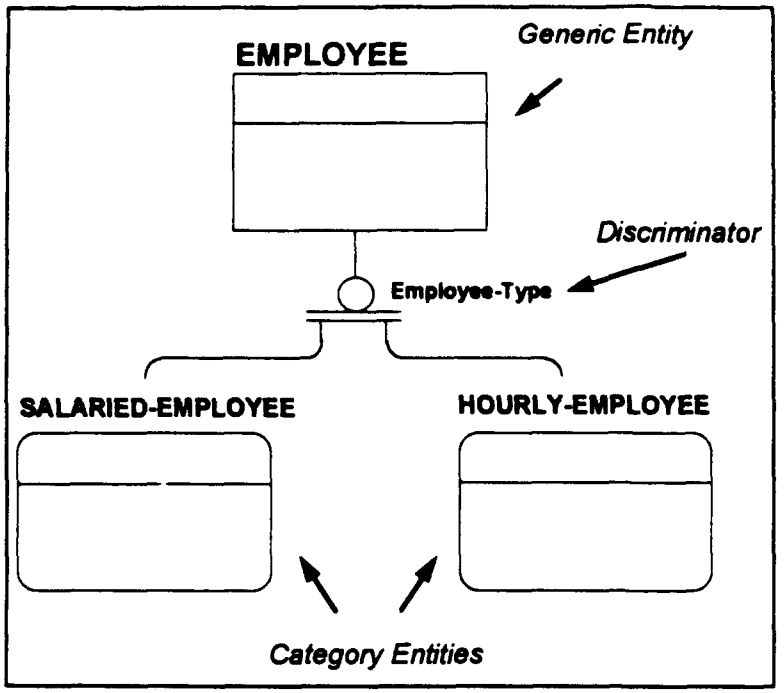


Figure A-11. Category Relationship Syntax

entity can correspond to the instance of only one category entity. In the example, this implies that an employee cannot be both salaried and hourly.

An attribute in the generic entity instance determines to which of the possible category entities it is related. This attribute is called the "discriminator" of the categorization relationship. In the example, the discriminator might be named EMPLOYEE-TYPE. The name of the generic entity attribute used as the discriminator is written beside the circle.

Category entities are also always identifier-dependent. See Figure A-11. The generic entity may be either independent or dependent.

A.2.6 Attribute Semantics

An "attribute" represents a type of characteristic or property associated with an entity. An "attribute instance" is a specific characteristic of an individual member of the set. An attribute instance is defined by both the type of characteristic and its value, referred to as an "attribute value." An instance of an entity, then, must have a single specific value for each associated attribute. For example, EMPLOYEE-NAME and EMPLOYEE-BIRTH-DATE may be attributes associated with the entity EMPLOYEE, and could have the attribute values of "Mary Jones" and "February 27, 1953."

An entity must have an attribute, or set of attributes, whose values uniquely identify every instance of the entity. These attributes form the "primary-key" of the entity. For example, the attribute EMPLOYEE-IDENTIFIER might serve as the primary key for the entity EMPLOYEE, while the attributes EMPLOYEE-NAME and EMPLOYEE-BIRTH-DATE would be non-key attributes.

Within an IDEF1X model, every attribute is owned by only one entity. In addition to attributes "owned" by the entity, an attribute may be "inherited" by the entity through a specific connection or categorization relationship in which it is a child or category entity. For example, if every employee is assigned to a department, then the attribute DEPARTMENT-NUMBER could be an attribute of EMPLOYEE which migrates through the relationship of the entity EMPLOYEE to the entity DEPARTMENT. The entity DEPARTMENT would be the owner of the attribute DEPARTMENT-NUMBER.

Only primary key attributes may be inherited through a relationship. The attribute DEPARTMENT-NAME, for example, would not be an inherited attribute of EMPLOYEE if it was not part of the primary key for the entity DEPARTMENT.

Each attribute is identified by a unique name expressed as a noun or noun phrase that describes the

characteristic represented by the attribute. The noun phrase is singular, not plural and should end with a class word. Class words are those descriptors that indicate what type of values should "fit" in the attribute. Class word examples include "DATE", "TYPE", "IDENTIFIER", "NAME" and "QUANTITY". The attribute name must be meaningful and consistent throughout the model. A formal definition of the attribute and a list of synonyms or aliases must be defined in the model of glossary. Attributes are shown by listing their names, one line per attribute, inside the associated entity box.

A.2.7 Primary Key Semantics

The Primary Key of an entity is one or more attributes, whose value uniquely identifies every instance of the entity. For example, the attribute PURCHASE-ORDER-NUMBER may uniquely identify an instance of the entity PURCHASE-ORDER. A combination of the attributes ACCOUNT-NUMBER and CHECK- NUMBER may uniquely identify an instance of the entity CHECK.

Attributes which define the primary key are placed at the top of the attribute list within an entity box and separated from the other attributes by a horizontal line. See Figure A-12.

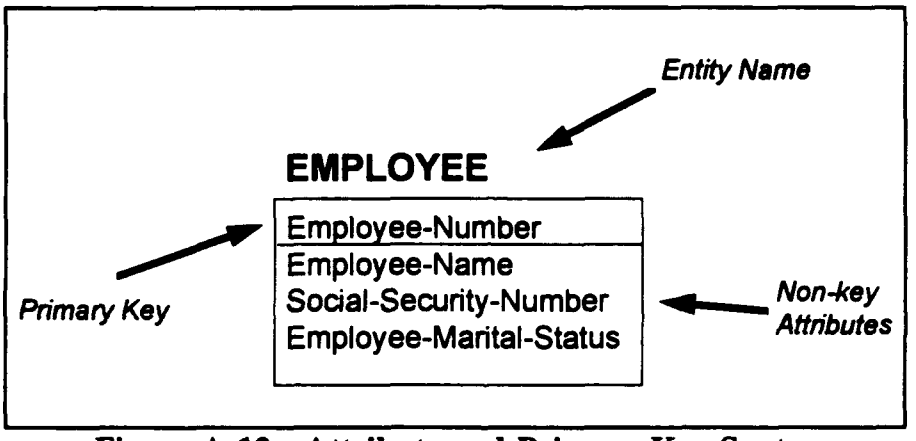


Figure A-12. Attribute and Primary Key Syntax

2.8 Foreign Key Semantics

If a specific connection or categorization relationship exists between two entities, then the key attributes of the parent or generic entity migrate to the child or category entity. These inherited attributes are referred to as "Foreign Keys." for example, if a connection relationship exists between the entity EMPLOYEE as a parent and the entity DEPENDENT as a child, then the primary key attributes of EMPLOYEE would be inherited attributes of the entity DEPENDENT. In this example, illustrated in Figure A-13, the parent key attribute, EMPLOYEE-NUMBER, would migrate to the child entity DEPENDENT. An inherited attribute may be used as either a portion or total primary key, alternate key, or non-key attribute within an entity.

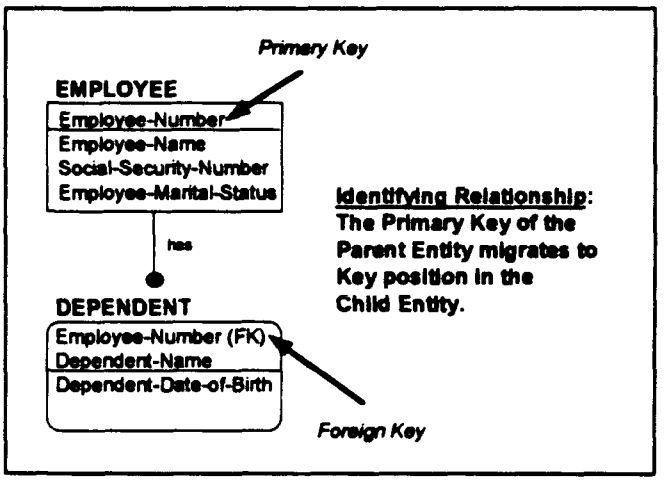


Figure A-13. Key Migration in Identifying Relationships

A foreign key is shown by placing the names of the inherited attributes inside the child entity box and by following each with the letters "FK" in parentheses, i.e., "(FK)". If the inherited attribute belongs to the primary key of the child entity, it is placed above the horizontal line and the entity is drawn with rounded corners to indicate that the identifier (primary key) of entity is dependent upon an attribute inherited through a relationship. If the inherited attribute does not belong to the primary key of the child entity, it is drawn below the line. See Figure A-14.

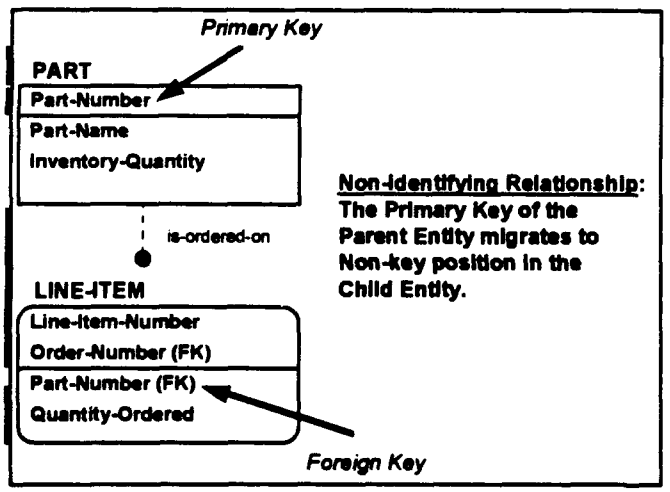


Figure A-14. Key Migration in Non-Identifying Relationships

In a categorization relationship, both the generic entity and the category entities represent the same real-world thing. Therefore, the primary key for all category entities is inherited through the categorization

relationship from the primary key of the generic entity. For example, if SALARIED-EMPLOYEE and HOURLY-EMPLOYEE are category entities and EMPLOYEE is the generic entity, and the attribute EMPLOYEE-NUMBER is the primary key for the entity EMPLOYEE, it would also be the primary key for the category entities SALARIED-EMPLOYEE and HOURLY-EMPLOYEE.

A.2.9 Role Named Relationships

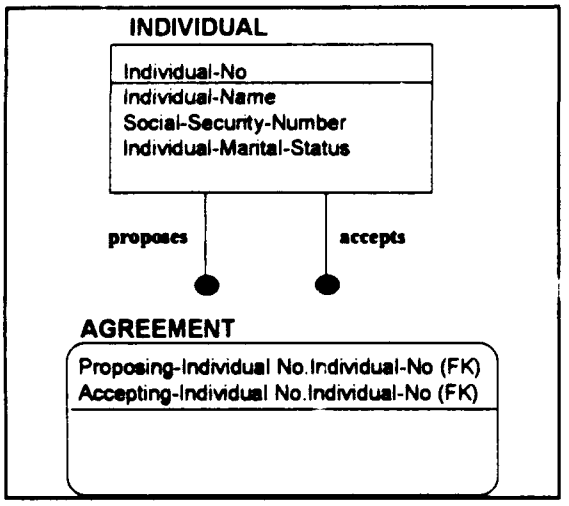


Figure A-15. Role Named Relationships

In some cases, a child entity may have multiple relationships to the same parent entity. The primary key of the parent entity would appear as inherited attributes in the child entity for each relationship. For a given instance of the child entity, the value of the inherited attributes may be different for each relationship, i.e. two different instances of the parent entity may be referenced. When a single attribute is inherited more than once, a "role name" is assigned to each occurrence. Role names are shown in the child entity as a prefix followed by a period (".") in front of each attribute in the role. For example, an instance of INDIVIDUAL may propose an agreement, and another instance of INDIVIDUAL accept that agreement. The instance of AGREEMENT would require the INDIVIDUAL-NUMBER that uniquely identifies both instances of INDIVIDUAL. This example is depicted in Figure A-15.

A.2.10 Creating IDEF1X Data Models

The following depicts a generalized flow in the development of IDEF1X data models.

Step 1 - Entity Definition
A candidate entity pool and definitions are developed as the first step in modeling. Additional entities will be added throughout the modeling process and the definitions will be refined.

Step 2 - Relationship Definition
The next step is identification of a preliminary set of relationships between the candidate entities. The model glossary is expanded to include relationships as well as entity definitions. The primary output of this Step is one or more entity-relationship level diagrams. At this stage of modeling, all entities are shown as square boxes, no attributes are shown, and non-specific (many-to-many) relationships are permitted.

The entity-relationship data model provides a stepping stone to the final, fully attributed data model. Since model building is a top-down approach, the entity-relationship model represents the broadest level to be considered in a data modeling project. It is useful at the planning level because it helps define initial business statements that represent constraints in the environment. It also aids in defining and validating data requirements.

The entity-relationship data model allows you to focus on some of the details at a time -- in this case, entities and their relationships --rather than having to deal with a large amount of detail (characteristics of the objects and relationships) at once. The result is a reasonably digestible amount of information, which facilitates good data modeling.

Step 3 - Key Definitions
The objectives of Step 3 are to refine non-specific relationships, define key attributes for each

entity, migrate primary keys to establish foreign keys, and validate relationships and keys. The primary result of this step is one or more key-based model diagrams. The key-based model depicts primary, alternate, and foreign key attributes. Non-key attributes may not be shown, as desired. A key-based model distinguishes between dependent and independent entities and between identifying and non-identifying relationships. Role names and path assertions are also specified. Non-specific (many-to-many) relationships are not allowed at this level.

At the key-based level, the focus is on identifying the key attributes -- those characteristics and properties of the data that uniquely identify one entity instance from another. The key-based data model is a more precise representation of the data in the environment. The concept of key attributes is introduced as a more rigorous test for identifying real entities. Foreign keys are used to validate the identified relationships and to ensure that they make sense. A key-based data model may be used to begin the integration of a topical view with a broader view.

Step 4 - Attribute Definition

The final state of modeling is attribution. The objectives of this step are to define non-key attributes, establish attribute ownership, and validate and refine the data structure. The result of Step 4 is one or more fully attributed model diagrams, a completed glossary of entity, relationship, and attribute definitions and narrative statements of the modeled business rules.

Step 5 - Model Integration

Fully attributed data model views can be merged to provide a neutral, integrated data model of a specified subject area. This model then becomes the definition of conceptual schema. Since it contains all the attributes of the specified entities, it provides a complete and descriptive view of the data in the modeling subject area, thereby resolving any ambiguity that may have existed at the other levels. Although view integration can actually be done at each of the three data model levels, it is the fully attributed view that is the most useful in moving an organization to an integrated systems environment.

Because the fully attributed data model is a stable, non-redundant, integrated view of data, databases designed from this perspective are flexible and have lengthy life cycles. This is because they are based on stable data structures rather than processes that frequently change.

Appendix B
Activity Descriptions

This section provides detailed definitions of all Capacity Management activities identified in the Activity Models. Definitions are tailored to the modeling context used in this workshop.

A0 Perform Capacity Management

The Capacity Management (CM) Function is composed of five primary activities: **Manage Service, Provide Information, Manage Performance, Plan Capacity, and Maintain Capacity Management Models**. The CM Function provides a structured framework for managing the performance of Information Systems, networks, and communications resources (PC-to-Mainframe) to ensure that: (1) resources are sufficient and available to meet defined user service-level objectives and capacity requirements, (2) resource utilization is cost-efficient, effective, and well- managed, (3) performance is monitored, measured, and evaluated to ensure maintenance of required performance levels, and (4) workload forecasts are made, reserve capacity is available, and all security requirements are met.

Manage Service is concerned with providing support for customer requirements, providing project management and tracking, and establishing support requirements for CM activities.

Provide Information is comprised of three activities for acquiring data, administering data, and providing routine reporting.

Manage Performance conducts performance measurements, monitors performance, performs benchmarking, conducts problem diagnosis, and resolves problems.

Plan Capacity is comprised of four major activities for capacity analysis, capacity planning, change management recommendations, and the development of network/communication interface requirements.

Maintain Capacity Management Models has three major activities for certifying baseline models, building new models, and validating these models.

These models include hardware and software configuration models, performance prediction models, workload configuration models, capacity models, and any other "model" that may be generated and/or used by the CM Function. For example, some models may be used to perform "what if" performance prediction. Models produced by configuration management will also be used by the Capacity Management Function

A1 Manage Service

Manage Service is comprised of three main activities: **Provide Requirements Support**, **Provide Project Management**, and **Establish Support Requirements**. **Manage Service** can best be described as a "front door" of the CM Function. It provides an interface to the Information Processing Center (IPC), Central Design Activity (CDA), or other management structures for providing support for performance or capacity planning issues in meeting user requirements and service level objectives, as well as, performance measurement or modeling activities.

These CM support requirements, etc., are determined by a specific organizational element (e.g., CDA/IPC, application division, communications and/or network divisions, etc., with the assistance of the CM staff as pertains to performance and feasibility issues), or customer service unit that works with the CM staff, to ensure user support requirements (e.g., service level objectives, etc.) can be met, and that user objectives are meaningful and measurable.

The primary purpose of the Manage Service function is to ensure that all measures, configuration changes, performance software, version upgrades, network and communications requirements are registered (logged in) in the on-line project management and tracking systems, analyzed for feasibility, and forwarded for entry into the on-line project management tracking system where they will eventually be submitted to the appropriate CM area in the form of a work assignment.

A11 Provide Requirements Support

The interface to the DII/IS Capacity Management function that provides "help desk" liaison and feedback on performance measurement and forecasting activities to a requestor (e.g.Megacenter). In addition, this activity also registers the request, determines the feasibility, and passes the request for input to the on-line project management system for further action.

A111 Register Request

Records the CM/CDA requirement, configuration change request, and help desk problem into a requirements support registration log. This registered request is then provided for input to the on-line project management and tracking system.

A112 Determine Feasibility of Request

Determines the feasibility of executing the Service Level Objectives (SLO) by performing a preliminary analysis of stated specifications, standards, resource and performance requirements, etc. This includes a review for completeness, and identification of performance metrics and resources required for servicing the request within a specified time frame. This provides the basis for performing a feasibility analysis by the **Manage Performance** Activity (A3).

A113 Provide Support Liaison

Provides a focal point "front door" to the CM Function. This includes working with the CDA's, IPCs, etc, to provide performance requirements support (as appropriate) for current and future needs.

A12 Provide Project Management

Accepts all requests (projects) for CM services (including requests for feasibility analysis), assigning work to the appropriate areas for action, developing project plans, timelines and reporting CM operating costs. All projects and related tasks will be tracked through an on-line project management system.

A121 Perform Project Planning

Translates service requirements (SLOs) into project action plans, and enters all requests for services into a project management system. All projects are tracked throughout execution to completion. Access to the status of each project is available on-line for IPC and CDA personnel.

A122 Perform Requirements Analysis

Performs a review of project plans and develops work assignments for the appropriate CM functional area that will execute the support requirement. Data for preparing CM operating cost reports are prepared in this function.

A123 Schedule Projects

Develops a time schedule (milestones) for executing each project tasked to the CM Function, and tracks this schedule using an on-line project management system.

A13 Establish Support Requirements

Collects support requirements (e.g. staffing and training needs, financial needs, hardware/software requirements, etc.) needed to sustain the CM Function and develops the overall CM request for support to management. These requirements will cover all areas of the CM Function.

A131 Prepare Financial Support Rqmts

Reports the financial resources (e.g., funding, etc.) needed by the CM staff to perform the CM Function. This includes the funds necessary to support staffing, training, contracts, etc. This report translates the financial support requirements into a formal request to higher management (e.g., Megacenter, IPC, CDA, etc.).

A132 Establish Staff Support Rqmts

Establishes the personnel resources required by the CM staff to perform the CM Function. This includes a position description of the type of skill set required for each functional position in the CM Function, with supporting information such as skill levels, ratio of on-board personnel vs. positions required, etc.

A133 Establish Training Support Rqmts

Identifies short-range and long-range training requirements necessary to support the CM Function. This includes a description of the CM staff training requirements necessary for the successful execution of work assignments.

A134 Establish Contractual Support Rqmts

Determines the contractual support (e.g., consultant staff, performance staff, network and communications staff, equipment, maintenance, software support, vendor services, etc.) required to perform the CM Function.

A2 Provide Information

Provide Information is the area of CM that maintains a central CM information/DII/IS model database. The Provide Information activity provides information for the generation of standard and ad hoc reports, and cost information on resource utilization for CM performance and planning activities for the information system environment. It also provides a central source (e.g., CM information/DII/IS model database) for the maintenance, distribution, or reporting of CM information. This activity collects data/model information received from all performance and capacity planning activities, and works in conjunction with the **Manage Service** Activity (A1). This Activity also receives tasking from the **Manage Service** Activity (A1) and transfers the tasking information into an on-line project management and tracking system.

A21 Acquire Data

Collects and screens (e.g., tests for invalid records, missing records, etc.) data necessary to enable the analysis of performance and services provided.

A22 Administer Data

Ensures the data collected is valid, complete, comprehensive, accurate, and represents all operational activities.

A23 Provide Routine Reporting

Documents the achievement level of performance activities against defined service level objectives. Provides periodic reports to various levels of internal and external management.

A3 Manage Performance

Measures, evaluates, and reports on information system performance to assess current performance levels. Identifies and recommends adjustments that are designed to improve performance. This activity provides input to the **Plan Capacity** Activity (A4) to determine future capacity requirements. It also performs problem diagnosis and resolution.

A31 Measure Performance

Retrieves/collects and analyzes data to determine performance levels of all systems and components (e.g., mainframes, communication systems, networks). Measurements include system utilization, memory storage, disk usage, bandwidth and channel capacity, detected faults, addressing errors, bit-error rates, etc.

A311 Establish Measurement Plan

Defines the goals and objectives for measuring specific components of the DII/IS configuration. This includes (1) identification of systems and components to be measured , (2) performance targets and thresholds to be met, and (3) specific metrics to be used to measure achievement of performance objectives. The plan includes a determination of which specific tools and data extraction or manipulation routines are needed to perform the measurements.

Any performance exceptions received from **Determine Performance Exceptions** Activity (A322) must be must be corrected prior to producing performance management reports from Activity **Generate Performance Reports** (A323).

Performance exceptions for incomplete, unclear, or insufficient measurement data may be caused by erroneous measurements or measurement criteria. These criteria must be corrected prior to producing performance management reports from **Generate Performance Reports** Activity (A323).

A3111 Determine Components to be Measured

Determines the DII/IS system, mainframe, network, and communications components to be measured, as well as, the capability of measuring each component. Components to be measured are those that reflect system performance, or have an impact (direct or peripheral) on the system being measured. They will form the basis for measuring any system or component of the DII/IS configuration.

A3112 Establish Performance Metrics

Determines the performance measurement criteria (i.e., metrics) that are used, or are appropriate, to represent the performance of the system components previously identified and being measured. Since there can be more than one measurement criterion for a specific component, it is necessary to establish comprehensive and representative sets of metrics for each component, and to ensure that metrics are established to measure the performance of all DII/IS system components.

A3113 Identify Performance Targets and Thresholds

To foster accurate analysis of system components, by identifying specific target goals, and acceptable thresholds, to ensure efficient and effective performance and operations. These targets and thresholds for the measured components collectively must support organizational performance goals and objectives, user SLOs, and warfighter mission requirements.

A312 Retrieve Selected Data

To support the performance measurement process, by ensuring that sufficient data, of an adequate level of detail, is captured and stored for retrieval upon demand. This requires the use of data collection routines and software for monitoring and measuring the performance of all system components. The data collected must be stored in a compatible and accessible format.

A313 Conduct Performance Measurement

Conducts specific performance measurements on components of the DII/IS environment using established and related metrics . These systems or component measurements (e.g., memory utilization, CPU busy, bandwidth capacity, response-time, port/hub contention, query delays, etc.) and associated metrics, will cover mainframe, communications, and network configurations. The established criteria used must ensure that comparative analyses can reveal whether or not the system or component is performing at acceptable levels (e.g., meeting SLOs, established targets and thresholds, etc.).

A32 Monitor Performance

Monitors actual performance levels against defined target objectives. This activity identifies performance problem exceptions for action and resolution. Performance exceptions may also be caused by: incomplete, unclear, or insufficient measurement data. These exceptions are fed back to Activity **Establish Measurement Plan** (A311) for further action. Exceptions to measurements or measurement criteria must be corrected prior to producing performance management reports.

A321 Compare Performance with Targets and Thresholds

Receives performance measurement data, and identified components, metrics, targets and thresholds from the **Conduct Performance Measurement** Activity (A313), and compares these measurements against established performance objectives (i.e., targets and thresholds). Examples of performance data include: utilization, response time, transaction processing rates, data transfer rates, I/O throughput, device availability, bit-error rates, bus speed, millions of instructions per second (MIPS), etc.

The measurement data is compared against the SLOs, vendor component specifications for performance levels of DII/IS components and systems, etc., to produce a performance comparison report.

A322 Determine Performance Exceptions

Identifies exceptions where actual components and systems (collections of DII/IS components) have exceeded performance measurement thresholds. For example, if the threshold SLO for user response time is two seconds, any measurement of response time greater than two seconds would be viewed as an exception. Performance exceptions may also be caused by: incomplete, unclear, or insufficient measurement data or other criteria. These exceptions are fed back to the **Establish Measurement Plan** Activity (A311) for further action. These exceptions to measurements or measurement criteria must also be corrected prior to producing performance management reports.

A323 Generate Performance Reports

Generates reports on a variety of issues relating to the comparison of performance measurements. These reports will document how well actual established targets and thresholds are met for components measured. This activity also provides exception reports that assess incomplete component measurements, or incidents when anomalies have occurred during the measurement process, or have not provided sufficient data to perform a comparative analysis.

A33 Perform Benchmarking

Performance testing of a system configuration, component, or application environment that evaluates and measures performance against standards, performance metrics, vendor specifications, etc. Further, benchmarks can be run against hardware/software components or applications that execute on a DII/IS environment. A benchmark provides an evaluation or comparison of performance tests for information systems and/or application programs based upon specific criteria and standards. This activity is performed in order to better understand and predict performance results and impacts on an operational DII/IS environment.

An example of benchmarking could be the evaluation of the workload of one mainframe or network environment to determine the sizing requirements and other criteria. This benchmark might be used to evaluate the potential for transfer of an application to another environment and to ensure the same or better level of service can be maintained.

A34 Conduct Problem Diagnosis

Evaluates and diagnoses performance exceptions and identified problems (e.g., user complaints to Help Desk), to ensure satisfactory resolution and achievement of service-level objectives. Problem diagnosis is passed to the **Conduct Problem Resolution** Activity **(A35)** for action.

A35 Conduct Problem Resolution

Evaluates reported problems/preliminary diagnoses. This involves developing and evaluating alternative solutions (including costs), and recommending corrective actions that should be taken to bring performance levels and services provided up to acceptable levels of performance.

A4 Plan Capacity

Determines and recommends adequate resources to meet future workloads and satisfy SLOs. Analyzes projected workloads, system utilization, and reserve capacity. Based on this information, generates short and long term capacity plans and provides input to the Configuration Management Function. This activity also develops adequate plans to ensure that performance and capacity requirements (including components and configurations) are identified, which will aid in disaster recovery and backup in the event of catastrophic disruption of operations.

A41 Analyze Capacity

Predicts performance of user requirements and projected workloads against baseline and alternative hardware/software configurations to satisfy service level objectives. This includes analyzing projected workloads and reserve capacity, and based on that information, forecasting the resources required to support future workloads.

A411 Establish Analysis Approach

Clarifies the study requirements and planning as to how the study will be conducted. This activity also identifies modeling parameters, performance modeling activities to produce the approach for proceeding with the modeling effort.

A412 ID User Workload Projections

Translates user workload projections into modeling parameters required to perform a capacity planning study. Works with forecast information to ensure that the forecast is as representative and accurate as possible.

A413 Modify Workload Modeling Parameters

Modifies the appropriate baseline model parameters (e.g., workload transaction arrival rates) to reflect the forecasted changes.

A414 Perform Modeling Modification Analysis

An iterative process of model modification and evaluation in order to evaluate various study scenarios, determine causes of hardware saturation, evaluate various hardware options, etc. This is the core of the capacity planning study.

A415 Conduct Performance Prediction Impact Analysis

Analyzes performance predictions for alternative modeled scenarios and their impacts on DII/IS configurations. This Activity provides information on capacity requirements, performance analysis, projected costs, and modeling shortfalls and results.

A42 Develop Capacity Plans

Prepares a formal planning report which describes and documents the results of the capacity study. This document spells out all of the steps taken in conducting the capacity analysis, all assumptions made, timelines, alternatives, conclusions and recommendations.

The plan addresses: forecasting of workload changes, changes in workload arrival rates for existing workload; resource profiles, transaction volumes, user counts, etc., for new workloads; or estimates of changes in the resource profile of an existing workload. This could also include both application workloads and system software components.

The plan also addresses disaster recovery and backup planning contingencies to ensure that performance capabilities and capacity are available in the event of catastrophic disruption of operations.

A43 Develop Change Recommendations

Recommends changes to information systems which may precipitate changes to the baseline configuration. The changes will be documented in accordance with Configuration Control Board (CCB) guidelines.

A44 Develop Network Communication Interface Requirements

This activity communicates workload predictions, capacity, and performance requirements affecting network capacity for DII/IS environments. This information will enable effective end-to-end Capacity Management. These requirements are the by-product of capacity planning studies. Any area of the DII/IS environment may be affected by these requirements, and may include such system loads as: interactive transaction volumes, print volumes, bandwidth requirements, packet transmission requirements, etc.

A5 Maintain Capacity Management Models

Reviewing, refining, creating, archiving and cataloging models of current DII/IS environment(s) that can be used for performance evaluation and capacity planning studies. Current Capacity Management models of the DII/IS will be available to provide input for comparative evaluations and development alternatives. The establishment of current DII/IS baseline models is accomplished on a periodic basis (e.g., monthly, quarterly, etc.).

A51 Certify Baseline DII/IS Models

Evaluates how accurately baseline models reflect changes in the current DII/IS environment. Analysis reveals what changes, if any, are required to the baseline models.

A52 Build Baseline DII/IS Models

Creates a new baseline model to refine or replace an existing archived model. This process is used when the baseline model no longer reflects the current DII/IS environment.

A53 Validate Baseline DII/IS Models

Compares the predicted outcomes of newly created baseline models against actual measurements and criteria obtained from the DII/IS environment. Invalid models are sent back to the **Build Baseline DII/IS Models** Activity (A52) for modification.

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Appendix C
ICOM Definitions

This section defines the primary information requirements needed to support the capacity management function. These requirements are expressed as ICOM (Inputs, Controls, Outputs and Mechanisms). These definitions represent specifc processes used in the models, and may be used differently outisde of the CM Function context.

AdHoc Performance Analysis

Performance modeling studies performed by Capacity Management personnel in response to requests by performance management.

Alert Messages

Messages to operational Information Processing Center (IPC) management to alert them that a threshold has been or is on the verge of being exceeded. These thresholds can apply to: Central Processing Unit (CPU), Direct Access Storage Device (DASD), or number of users logged on.

Application for Benchmarking

An information system component or software program that is evaluated against a set of hardware/software criteria and/or architectures using a standard test environment and standard performance measurements.

Baseline Model

A modeling representation of a specific system to include the configurations of baseline DII Information Systems and components (including computers, communications, and networks). These models include hardware and software configurations, performance prediction models, workload characterizations, etc. These models also form the basis for documenting DII/IS components and system configurations in a standard manner for any organization's inventory, system design, or network topology. They form the "baseline" from which other modeling activities occur, and are the starting point for **Plan Capacity** Activity (A4). The models may be created within the CM Function or provided by other sources (e.g., configuration management).

Baseline Configuration

A detailed description (i.e., schematics, specifications, components, etc.) of the configuration for the current DII/IS environment that is maintained by the Capacity Management (CM) Function or organization. These descriptions are updated on a regular basis (e.g. monthly, quarterly) to ensure a current data base for maintenance of the baseline models.

Benchmark Results

Measurements that provide an evaluation or comparison of performance tests on information systems and/or application programs which are based upon specific criteria or standards.

Benchmarks

A specific set of hardware/software criteria, programs, and/or system architectures using a standardized test environment and standardized performance measurements (e.g., a computer program which executes a pre-determined set of instructions intended to model various types of workloads such as Whetstone and Dhrystone benchmarks.)

Budget

Allocated money amounts proposed for implementation of a capacity plan.

CM Data/Models

(1) **CM Data**

Data retrieved from the CM information/configuration model database. The CM information/configuration model database contains performance data collected from various software monitoring facilities, system traces, and benchmark results. (e.g., component utilization, bandwidth, DASD response time, etc.)

(2) **CM Models**

DII/IS environment models retrieved from the CM information/configuration model database. The baseline models are generated from the **Maintain Configuration Models** Activity (A5).

CM Operating Costs

The cost of performing the CM Function for a designated time interval (monthly, yearly, etc.). These costs include: salary costs, software costs, machine costs, etc. The information in these reports provide details and summaries of costs necessary to ensure efficient and effective CM function activities.

CM Function Funding

The approved budgeted funds that are available for executing the CM Function.

CM/CDA Rqmts

(1) **CM Requirements**

Capacity requirements generated from sources other than the Central Design Activity (CDA). (e.g., a request to bring another 1000 users on-line to provide access to an application).

(2) **CDA Requirements**

User requirements that are transformed into design specifications for new applications or modifications of existing applications.

Capacity Plans

Formal reports that describe and document results of capacity studies. These documents spell out all of the steps taken in conducting a capacity analysis, all assumptions made, timeliness, alternatives, rationale, conclusions, and recommendations for satisfying service level agreements/objectives and customer requirements. These plans are in accordance with Information Resource Management (IRM) planning directives & policy, and support the IRM planning process.

Change Request Work Assignment

Analysis to be conducted by the performance management staff to assess the impact of a proposed configuration change. This includes on-line communication requests, new system configurations, etc.

Collected Data

Raw performance data (e.g., component utilization, bandwidth, DASD response time, etc.) and other CM data that has been captured, stored and made available for use by the CM Function.

Comparative Analysis Feedback

The results of analyses that reveal comparisons of performance measurements for Defense Information Infrastructure/Information Systems (DII/IS) components against defined metrics and targets. Inconsistent, inappropriate and/or incomplete set of metrics for measuring components will be revealed in this analysis. This analysis will show whether the criteria must be altered to ensure more credible performance measurement results. The feedback provides the Comparative Analysis Feedback report for the operations, performance and planning functional areas.

Configuration Change Analysis Report

Documentation on the results of an analysis by the performance management staff on the impact or feasibility of a configuration change request. The report is submitted to the Configuration Control Board (CCB) for further action.

Configuration Change Recommendations

A recommendation to change the baseline configuration (e.g. hardware, system software, etc) to improve its performance capability to meet capacity planning workload projections submitted to data center configuration management for review and action.

Configuration Change Request

Request to make a change in the baseline configuration. The change request will be documented and controlled in accordance with the CCB policy and guidelines.

CCB Approval

An action by the CCB that approves changes to the DII/IS configuration. This is a requirement for any change proposed to any DII/IS configuration. (If approval is not granted, the recommended change will not be installed.)

Contract Vehicles

These are contracts available to provide timely procurement capabilities for information technology resources required to support the CM Function. There are a variety of contract vehicles that can be used, as well as, procurement processes. Most of these vehicles have limitations on dollar or quanity amounts, bidding processes, etc.

Contractors

Private sector representatives and other government agency personnel who assist in conducting CM Functions.

Design Change Recommendations

Recommendations to change the performance characteristics of an software application design based on analysis of its performance. These recommendations are provided to the IPC's, CDA's, or appropriate developers for consideration.

DoD CM Technical Personnel

Personnel included in the following categories:

- Communications (e.g., long-haul, Fiber Distributed Data Interface (FDDI), Asynchronous Transfer Mode (ATM), etc.) personnel
- Local Area Network/Wide Area Network (LAN/WAN/Client Server) personnel
- Mainframe personnel
- Network (e.g., Systems Network Architecture (SNA), etc.) personnel

DoD Support Personnel

DoD personnel who provide support functions (e.g., acquisition, budget, business management, economic analysis, etc.) to the CM Function.

Executable Model

A DII/IS component or system model whose modeling parameters have been changed/modified to represent all aspects and characteristics of a projected new or changed workload. When this model is processed (executed), forecasts of DII/IS component utilizations and levels of performance will be generated.

Executive Level Reports

Reports that are prepared for senior-level officials (e.g. Defense Information Services Organization (DISO), Defense Information Systems Agency (DISA), Deputy Assistant Secretary of Defense (Information Management) DASD (IM), Command, Control, Communications and Intelligence (C3I), etc.) that preside over the CM Function for all DII systems. These reports contain summarized information that present a concise discussion of major CM Functions, as is required or requested. Areas of discussion may include:

- performance utilization
- current and reserve capacity
- workload growth
- throughput evaluation
- number of user requests for service
- number of problems encountered
- issues that need resolution: procurement requirements, security concerns, staffing concerns, funding concerns, etc.

These reports may be provided on a daily, weekly, monthly or other frequency, as required.

Facilities and Equipment

The resources that support CM staff in performing the CM Function. These resources include: computer systems, hardware, software, networks, communication capabilities, tools, test equipment, etc.

Feedback Information

Information to the CDA community and data center management providing such information as how well service level objectives are being met, the status of actions being taken by CM to resolve, problems, problem resolutions, etc. The feedback information report is produced for the operations and performance functional areas.

Forecasted Capacity Rqmts

The results, after performing capacity analysis, that represent customer or system workload projections, presented as resource requirements satisfying performance criteria.

Help Desk CM Problem

A problem submitted to the help desk which is referred to performance management for resolution.

Identified Components

The physical and/or logical hardware and software devices (i.e., computers, networks, and communication elements) of a DII/IS configuration, which are to be measured and analyzed for efficient and effective performance.

Identified Components & Metrics

The aggregate of identified components (e.g., physical an/or logical hardware and software), and the measurement criteria (i.e., metrics) applied to the components for purposes of analysis. This information is used to identify performance targets and thresholds.

Information/Reports

Processed CM data which is stored, and formatted into various reports made available for use by distribution.

IT Projections

Data and/or forecasts of developments in technology (e.g., hardware design, software functionality, networking, communications, etc.) that may provide feasible alternatives to satisfy Information Technology requirements.

IT Requirements

Statement of functional requirements needed to satisfy new information systems, networking, or communication, Information Technology (IT) requirements. These requirements are prepared by the Capacity Planning Function. They typically specify as necessary to (1) reduce costs, (2) improve system performance, (3) take advantage of new technology, and (4) provide new technology to permit cost-effective upgrades, or support procurements for moving towards Open Systems Interconnection (OSI) configurations. These requirements are shown in a report that may affect several functional areas of CM activity.

Measured Performance

Actual system measurements for a specified system interval recorded in a performance report.

Measurement Approach

Procedures, computer performance evaluation methods, and criteria used for measuring and analyzing system performance. This could include a determination of specific tools and data extraction routines and guidelines needed to perform these measurements. Identified components, metrics, thresholds, and targets.

Model for Validation

A newly built or refined model of a DII/IS environment (e.g., workloads, applications, hardware components, system components, networks, communications, etc.) that is presented for validation by comparing its modeling results with actual performance measurements.

Modeling Analysis Approach

Information explaining the approach to take and the CM Data and CM Models required for proceeding with a modeling effort. The modeling methodology is determined from the evaluation of a request for a performance modeling analysis study.

Modeling Request

Requests for performance modeling analysis studies submitted to the Capacity Planning staff by the performance management staff.

Model Results

The modeling analysis result(s) obtained after conducting a series of iterative modeling "executions" to evaluate the impacts of various DII/IS configuration scenarios. These scenarios may include such study areas as: hardware saturation, configuration change options, application software modifications, etc. A study scenario could also include the analysis of the impact of a projected new or changed workload on a current baseline DII/IS environment. The model results show how the performance of a specific configuration will impact the environment being modeled.

Modeling Shortfalls and Results

Indicators that show defects in the performance prediction modeling parameters that must be adjusted to ensure that credible results are obtained from the **Conduct Performance Prediction Impact Analysis** Activity (A415). These results provide feedback information on the shortfalls encountered (e.g., incomplete workload specifications, incompatible metrics, etc.), and adjustments that are needed to modify prediction parameters.

Network/Communications Capacity

The limits on transfer speed (bandwidth) and the amount of information that can flow through the logical and physical network communication channels (e.g. how many devices may be connected in the current operating environment within current constraints, and maintain effective performance levels

Network/Communications Rqmts

The impact requirements to on-line communications network interfaces and activities as they affect the system environment being measured.

Non-validated Model

A model of the DII/IM environment or an application whose predicted outcome results did not match actual performance measures. It must either be modified after further analysis or discarded.

On-line Computing/Communications Rqmts

The type, number, and connectivity required for remote terminals/communication interfaces connected to information system resources (e.g., mainframes, networks, communications paths) via input/output channels, ports, and hubs, front-end processors, etc.

Performance Comparisons

The process of comparing measured performance level with respective target performance levels. This process identifies acceptable performance levels, as well as conditions of unacceptable (i.e., Performance Reports).

Performance Data

Historical performance measurement data that are passed to the CM information/configuration model database. The data is produced in the **Manage Performance** Activity (A3) as a result of compartment or system evaluation activities.

Performance Exceptions

Performance conditions identified as not acceptable in the process of performance comparison.

Performance Information

A collection of reports generated by the **Manage Performance** Activity (A3). Reports include: Performance Reports and Performance Monitoring Exceptions.

Performance Measurements/Target Objectives

(1) **Performance Measurements**

Standard measures of performance (e.g., utilization, response time, throughput, millions of instructions per second (MIPS)) of DII/IS components that are available for use in a configuration.

(2) **Target Objectives**

Standard measures of performance (e.g., utilization, response time, throughput, millions of instructions per second (MIPS)) of DII/IS components that are used as thresholds for identifying performance levels.

Performance Monitoring Data

Performance measurement data generated by system monitoring facilities that measures the performance of hardware component utilization, bandwidth, DASD response time, etc. This data is the foundation for DII/IS component and system performance evaluation analysis.

Performance Monitoring Exceptions

Performance measurement data generated by system monitoring facilities that measure the deviation of component and system performance levels from established performance measurements/target objectives.

Performance/Fault Problem

Problems identified which adversely impact the effectiveness and performance of the DII Information System environment (e.g., mainframe, network, or communications). These problems may range from: insufficient memory, insufficient bandwidth (capacity), a channel, hub or port imbalance, or resource utilization that exceeds design thresholds, etc.

Areas addressed include fault detection and monitoring, error detection and correction, trouble shooting performance exceptions, monitoring alarms and problem indicators, and taking corrective actions. These problems provide the basis for preparing Performance Problem reports for the configuration, operations, performance, and security functional areas.

Performance Reports

Computer generated reports, describing the performance of an operational system on such topics as: CPU utilization, channel utilization, response time, fault isolation, alarm detection, network performance, etc. These reports are used by the accounting, configuration, operations, performance, planning and security functional areas.

Periodic Reports

Routine reports (daily, weekly, monthly, annually, etc.) provided to management (e.g., data center managers) covering such things as data center performance planning, etc. (e.g., a daily report detailing performance for utilization measurements the prior day).

Policy/Guidance, Standards, Planning, Security, Reporting Rqmts and Quality Controls

Policies and guidance governing information technology practices that provide direction and setting standards for operation and management of DoD Data Centers.

Problem Diagnosis

The results of data collection and analysis activities that provide indications of possible causes for specific problems. The diagnosis (indicators) may require further evaluations, including trend analysis, etc., to further isolate problem causes and provide effective solutions.

Project Plans, Project Plan Work Assignments

(1) **Project Plans**

Formal descriptions of actions that detail the tasks, schedules, milestones, and resources needed to perform CM Functions. These actions can include: a configuration change, performance evaluation, customer/CDA requirements analysis, workload forecasting, modifications to baseline models, etc.

(2) **Project Plan Work Assignments**

Formal taskings resulting from project planning analysis, that assign work to designated CM Functional Activities.

Projected Costs

Hardware costs associated with a capacity plan, detailing dollar amounts required at specific dates within a planning horizon.

Recommendations

The results of CM analysis which include:

(1) Performance tuning (e.g., changes to disk data set placement, CPU workload placement and scheduling, and to system files, etc.).

(2) Recommendations to acquire (generate) performance measurements which are currently not available but required for performing "end-to-end" Performance Analysis.

(3) Options developed by the Manage Service and Plan Capacity activities that are fed back to the user representatives to ensure performance complies with service level agreements or can satisfy new requirements.

Recommended Adjustments to Environment

Any adjustment (to software, hardware, or system parameters) recommended as a solution to a performance problem. These adjustments can include performance tuning recommendations (e.g., workload balancing, data set placement, operation scheduling, modifications of bandwidth capacity, etc.) in response to encountered problems.

Registered Requests

A request for CM services (e.g. CDA requirements) which has been received by the **Manage Service** Activity(A1) logged into the project planning system, and routed to the appropriate CM Functional Area.

Registration Status

The status of a registered customer request pertaining to task completion by the CM Function.

Reimbursable Rates

Rates that are set by management to foster recovery of costs (i.e., fee-for-service) associated with providing services and applications processing to the user community. These are standard rates that provide reflections of the "cost of doing business", and are therefore useful as a basis for estimating future capacity planning costs when measured against projected cost estimates of resources required.

Request for CM Services

A request to the CM Function to review, analyze and act upon requests/requirements from customers. This also includes problems/concerns from the IPC help-desk.

Request for CDA/CM Data/Workload Projections and Applications

(1) **CDA/CM/Data/Workload Projections**

Request for application oriented capacity planning data to include workload intensity, resource consumption profiles, and performance requirements, etc.

(2) **Applications Data**

Information needed to further clarify the characteristics of the operational baseline.

Request for Model Change

A request to revise or create a baseline configuration model because the current baseline model does not reflect the current environment.

Request for Retrieval of Performance Data

A request to provide specific performance data extracted from the CM information/configuration model database.

Request for Support (Financial, Staffing, Training, Contracts, etc.)

Request by CM management for support in order to accomplish the CM Function. Areas of support include financial, staffing, training, travel, contractor services, hardware and software tools, etc.

Request to Collect Data

A request to acquire additional data (e.g., performance, planning, workload forecasts, etc.) that must be collected, verified, validated, and checked for completeness in order to be useful to perform the CM Function.

Resource Utilization Cost

Costs associated with recovery (e.g. fee-for-service), for CM services and operations, as well as providing financial support data for the customer. The Resource Utilization Cost report is provided for the accounting, operations, and planning functional areas. Costs are accumulated on the utilization of IS resources. These costs are used as a basis for cost recovery. (I.E., fee-for-service, operations, as well as, providing financial support data for customer billing, and IM and CM management.

Retrieved Data

Data provided from the CM information/configuration model database.

Rqmts for New Metrics/Measures

Requests for metrics/measures, not currently available, which are required for accurate performance measurement of an Information System Environment. The Requirements for New Metrics/Measure report is provided for the operations, performance, and planning functional areas.

Security Capacity Utilization Reports

These reports are produced on a regular basis (e.g., weekly) for capacity planning and performance measurement activities. The reports contain information that show various performance measures (e.g., I/O's, percentage of memory usage, etc.) concerning the impact on the system of implementing security software programs and hardware interfaces. Through these reporting data, the CM Function can derive the cost (from performance data) in dollars of: (1) the cost processing of capacity usage, and (2) the impact security measures have on system performance. Reports should contain appropriate levels of detail to illustrate and document both cost and performance data. Summarized versions of these reports should be provided to senior management. The basis for these reports is derived from accounting information in a **cost-recovery system** that displays (security) memory utilization as an "application", which is interpreted into costing data through a cost-recovery algorithm.

Service Alternatives

Hardware and/or software alternatives to service the requirements. The Service Alternatives report is provided to the operations and performance functional areas.

SLA/SLO

(1) **SLA (Service Level Agreement)**

A written agreement between the provider of services and some element of the user community to describe and document user services required, performance expectations, and responsibilities which are agreed upon to satisfy customer requirements. The parties to these agreements normally include the user community, CDA, and the information systems center. These agreements describe what will be accomplished along with the schedule and priority for producing the desired result. They form the basis for establishing service level objectives.

(2) **SLO (Service Level Objective)**

Service level measurement thresholds against established performance metrics that are agreed upon by the data processing function staff and its users as being necessary for DII/IS components and systems.

SLA/SLO Feasibility

A determination that specific SLO(s) in an SLA contain meaningful and measurable performance indicators. Provides the SLA/SLO Feasibility report for the accounting, configuration, performance, and planning functional areas.

SLA/SLO Feasibility Decision Data

The results of analysis performed by the CM Function used to support IM management decisions in negotiating SLA(s). They are used by the CM Function and the customer to make decisions on the feasibility of measuring and achieving the SLO(s).

Service Level Exceptions

Incidents detected by CM performance monitoring where information system performance failed to meet established service level objectives (SLOs).

Specialized Performance Analysis Data

The results of performing special performance measurements that are used to support detailed and non-routine performance analysis (e.g., trace data, program execution snapshots, etc). These reports affect areas of operations, performance, and planning.

Support Rqmts for Maintaining Configuration Models

Required resources (e.g., funding, staffing, training, tools. facilities, etc.) needed by the CM staff to develop, refine, and maintain baseline configuration models.

Support Rqmts for Managing System Performance

Required resources (e.g., funding, staffing, training, tools. facilities, etc.) needed by the CM staff to measure, monitor, analyze, evaluate, optimize, and report IS performance.

Support Rqmts for Planning Future Capacity

Required resources (e.g., funding, staffing, training, tools. facilities, etc.) needed by the CM staff to analyze capacity requirements, forecast workload, and develop capacity plans.

Support Rqmts for Providing Information

Required resources (e.g., funding, staffing, training, tools. facilities, etc.) needed by the CM staff to acquire, administer, provide data, and perform routine reporting.

System Security Rqmts

Requirements for installed hardware/software components of security programs that must be used to eliminate or minimize (IAW appropriate security levels) the risk of unauthorized access to an IS or potential for malicious manipulations of data files.

A well managed security program ensures that the overhead costs of security implementations can be derived, and that secure-systems interfaces effectively provide measures of the impact of security measures on system performance. The guidance for implementation of security measures are promulgated by a variety of government regulations, and cover all aspects (PC to mainframe) of the DII/IS environment.

Vendor Pricing & Specifications

(1) **Vender Pricing**

Price list of all vendor hardware/software services (purchased, leased and/or maintained). This data is used to provide input for CM cost estimates.

(2) **Vendor Specifications**

Performance specifications of all vendor hardware/software products. Specifications can include: performance specifications, tuning measurements and practices, system management, propagation delays, maintenance specifications, operational criteria, etc..

Warfighter/Peacetime Mission Rqmts

Interfaces and capacity requirements necessary to support warfighting missions. Capacity requirements will significantly increase peak processing loads during wartime missions, thus reducing reserve capacity.

Workload Projections

The result of analyses and modeling activities of future user application workload projections and associated workload resource utilization levels. These projections assist in **Plan Capacity** Activity (A4) analyses to predict and support future system/resource requirements.

Appendix D
Entity Definitions

This section provides detailed definitions for the principle collection of data used in the CM Function data models.

APPLICATION-FUNCTIONAL-REQUIREMENT

Data contained in an original or modified Functional Description (FD), prepared by the functional activity proponent, which describes the specifications for development of a program application. (This also includes such features as on-line access).

APPLICATION-PROCESSING-REQUIREMENT

The collection of data describing the computing requirements (e.g., software call sequence, program and file size, and security, etc.) identified by a user to satisfy the application functional requirement. They support functional requirements, user workloads, access requirements, and other information services requested.

BASELINE-MODEL

A representation of a current computing and communication network configuration, to include the utilization of hardware resources, the transaction volumes of workloads being processed and the response time, and throughput of the workloads used as the starting point for capacity planning analysis.

BENCHMARK

A specific set of hardware/software criteria, programs, and/or system architectures using a standardized test environment and standardized performance measurements (e.g., a computer program which executes a pre-determined set of instructions intended to represent various types of workloads such as batch, on-line, interactive, etc.).

CHANGE-REQUEST

A request to change the Defense Information Infrastructure/Information Systems (DII/IS) baseline configuration or an application to analyze the impact on performance and capacity for a given IS system configuration. These changes which can come from the Information Processing Center (IPC), vendors, users, Configuration Control Board (CCB), and include: changes to vendor component specifications, operating systems, performance metrics, etc.

CHANNEL-CIRCUIT

In data communications a means of 2-way communications between two points, consisting of transmit and receive channels.

COMMUNICATION-LINK (MEDIA)

The physical components (e.g., twisted pair, optical fiber, coaxial cable, etc.) through which information is transmitted and that is used to provide connectivity within and between networked components.

COMPONENT

Devices or collection of devices comprising a DII/IS architecture. Examples of devices include hardware, software, networks, communications, etc.

END-SYSTEM-PRESENTATION-RQMT-(PRESENTATION-MEDIA)

The requirements for the devices used for the presentation of information (e.g., data, imagery, voice, radio, etc.) to the end user. Media devices may be of a variety of design and functionality including: a PC screen, optical display, stored images, video, multi-media display, voice capability, etc.

ENVIRONMENTAL-SUPPORT-SYSTEM

The executive software (e.g., operating system, transaction processing system, etc.) and associated hardware controlling elements that provide for the logical management of a computer or communications network system in the execution of its function. This also includes security interfaces, memory management, system supervisory activities, program execution, etc.

FRONT-END

In a **Mainframe Environment** a communications processor that connects input/output (I/O) communications channels on one end, to the mainframe/host on the other. It transmits and receives messages, assembles and disassembles packets, and detects and corrects errors. It is sometimes synonymous with a communications controller, although the latter is usually not as flexible.

In a **Network Environment** the communications processor that provides the input/output (I/O) mechanism between two or more networked devices (e.g., client/server). In a local area network, this function is distributed to each workstation so that the user can interact with other networked devices.

GATEWAY-ROUTER-BRIDGE

Gateway

In distributed computing environments, a device that performs protocol conversions between two different types of networks. A gateway has its own computer processor and memory.

Router

In communications, a device that reads the destination address of a data packet, determines the connect path for transmission according to internal tables, and forwards the packet to a station on a remote network. It is used in complex networks where there are many pathways among users.

Bridge

A communications device that is used to transfer data between two networks that use the same communications method and addressing structure. Some bridges - known as "learning bridges" contain tables that contain destination address of stations on the "local" network; otherwise, packets are passed to remote networks.

HUB-PORT-MODEM-SWITCH

Hub

A central switch device that is the collection point for a number of (workstation) lines in a star topology. Hubs may be passive or "intelligent", and may contain electronics which can boost signal strength, monitor activity, etc.

Port

A path (i.e., point of exit or entry) that may connect a data channel to a front-end processor (FEP), serial ports connected to communications lines and modems, etc. Serial and parallel ports on personal computers (PCs), are external outlets for plugging in communications lines, modems, and printers.

Modem

A device (an abbreviation for a "modulator-demodulator device) that adapts a computer to a telephone line. It is used to transmit digital signals over an analog transmission system. The common dial-up modem speed is 2400 bps., although 9600 bps is very popular too, and much faster.

Switch

A device that provides a physical processor and the digital side of communication facility. In emerging technology, switching hubs may be used to implement high-speed packet switching in asynchronous transfer mode (ATM), Ethernet, and FDDI networks.

I/O-CHANNEL

Input/output (I/O) high-speed copper wire or optical fiber pathways between the central processing unit and the control units of peripheral devices, DASD, tape drives, servers, etc.

MAINFRAME/HOST

The classic "glasshouse" computer environment, consisting of one or more medium-to-large scale computers capable of handling several thousand on-line terminals or workstations, hundreds of

megabytes of primary storage, and hundreds of gigabytes of disk storage (secondary storage). This component is primarily known as the central processing unit (CPU).

MAINFRAME-OPERATING-SYSTEM

The operating system is a master software control program that runs the computer. It resides in memory at all times. All application programs, communications links, etc., must interface with the operating system. Also known as the system "executive" or "supervisor", it performs job control management, task management, data management, device management and interfaces with the security function.

MODELING-BENCHMARK-RESULT

Measurements that provide an evaluation or comparison of performance tests of information systems and/or application programs which are based upon specific criteria or standards.

NETWORK

A physical and logical communications infrastructure that facilitates information interchange between systems and applications. This includes the physical configuration of the devices and the communications media that connects the devices (i.e., topology). Network architectures typically conform to standards, such as Ethernet, Fiber Distributed Data Interface (FDDI), Open System Interconnection (OSI), etc. Use of standards can ensure interoperability between networks.

Networks are typically classified by size, architectural design, and geographical scope. Classifications include: Local Area Networks (LANs), Backbones, Wide Area Networks (WANs), and Metropolitan Area Networks (MANs).

PC-CLIENT-WORKSTATION-TERMINAL

Any terminal or personal computer or access device that provides input and output capabilities between a host and a user. Some workstations can run one program at a time, while others can run more than one at a time (multi-tasking). The capability of the workstation is based on its memory size, disk capacity and processor speed.

PERFORMANCE-LOG-DATA

Data that is collected by the systems accounting and resource management monitoring facilities of the computing and communications networking system that is used to prepare reports, monitor performance of DII/IS components and systems.

PERFORMANCE-PREDICTION-DATA

Performance data generated by a configuration model showing predicted utilization, service, and performance of DII/IS components and systems.

PERIPHERAL

Any hardware device connected to a computer, such as a monitor, keyboard. printer, plotter, graphics tablet, scanner, joy stick, etc.

PRIMARY-STORAGE

The computer's workspace where all operating system, program execution, and data processing takes place in memory. Operating system instructions, program instructions, and data manipulation activities all occur in memory. All initialization programs are permanently resident in memory.

PRIMARY-STORAGE (INTERNAL MEMORY)

Primary-Storage in a PC-Client-Workstation-Terminal

PRIMARY-STORAGE (MAIN MEMORY)

Primary-Storage in a Mainframe/Host.

PROTOCOL

A strictly defined procedure and message format that allows two or more systems to communicate over a physical transmission medium. Each layer of a protocol performs a specific function, such as routing, end-to-end reliability, and connectivity. "Local Area Networking," Matthew G. Naugle. McGraw-Hill, 1991.

SECONDARY-STORAGE

Devices used to store, manipulate, and retrieve data (e.g., magnetic disk, magnetic tape, optical disk, etc). In client/server architectures a server is often used as a disk drive for access to files, etc.

SECONDARY-STORAGE (DASD & TAPE)

Secondary-Storage in a Mainframe/Host.

SECONDARY-STORAGE (WORKSTATION HARD DISK)

A Secondary-Storage area resident in a PC-Client-Workstation-Terminal.

SECURITY-SYSTEM-INFRASTRUCTURE

The installed hardware/software components and infrastructure for security programs that must be used to eliminate or minimize (IAW appropriate security levels) the risk of unauthorized access to an IS or potential for malicious manipulations of data files.

A well managed security program ensures that the overhead costs of security implementations can be determined, and that secure systems interfaces effectively provide measures of the impact of security measures on system performance. The guidance for implementation of security measures are promulgated by a variety of government regulations, and cover all aspects (PC to mainframe) of the DII/IS environment.

SERVER

A computing device (usually not associated with a mainframe environment) that is a combination of hardware and software used to provide specific services to other devices (clients) in a shared networked environment. Services may include: E-mail, file storage, communications, etc. These devices can be used as: File Servers, Mail Servers, Print Servers, Communication Servers, etc.

STANDARD-PERFORMANCE-METRIC-SLO

Standard measures used to assess the performance (e.g., utilization, response time, throughput, million of instructions per second (MIPS), etc.) of a component. The results can be used to evaluate system performance against achievement of service-level objectives (SLO).

SYSTEM-EXECUTION-ENVIRONMENT

A computer and/or communications network system configuration and its components that comprise the execution environment. It is used to execute the required workload, provide on-line access paths between users and their applications/databases, and process program applications.

USER-WORKLOAD-SCENARIO

The data necessary to identify user workload requirements in terms relevant to the CM Function, and in turn, produce a model of the user's workload. The data includes such things as number of transactions, peak processing periods, number of users (total and concurrent), and number of terminals to be connected to the system, etc.

WORKLOAD-CHARACTERIZATION

The specification of the user application workload to be processed on a computing environment in terms of amount of data to be processed, type of data, frequency of processing, mix of applications during a selected time period, amount of memory and resources required, etc. [The specification also includes such things as number of transactions, peak processing periods, number of users (total and concurrent), and number of terminals to be connected to the system, etc.]

Appendix E
Terms
Capacity Management

These terms represent specific technical and organizational terminology used in this report. The terms may have different meanings outside the Capacity Management (CM) context.

Backbone

A communication path that is used to connect multiple networks together. An example is a fiber optic cable using FDDI technology within a building.

Base-level

(1) A military installation that has Information Systems that operate under local management and control.

(2) Not part of a Megacenter's logical or physical computer configuration.

Capacity

The capability (as defined by a vendor or standard) of a computer or system to deliver acceptable levels of service to satisfy user workloads and service-level objectives. Capacity is generally measured in terms such as: MIPS, bandwidth, bytes, transactions and I/O processing, workload volume, etc. Categories include reserve, available, and planned capacity.

Capacity Management

A structured framework for managing Information Systems, Networks, and Communications resources (PC-to-Mainframe). The Capacity Management (CM) Function is comprised of five primary activities: Manage Service, Provide Information, Manage Performance, Plan Capacity, and Maintain Capacity Management Models. The CM Function provides a structured framework for managing the performance of Information Systems, network, and communications resources (PC-to-Mainframe) to ensure that: (1) resources are sufficient and available to meet defined user service-level objectives and capacity requirements, (2) resource utilization is cost-efficient, effective, and well-managed, (3) performance is monitored, measured, and evaluated to ensure maintenance of required performance levels, and (4) workload forecasts are made, reserve capacity is available, and all security requirements are met.

Central Design Activity (CDA)

The activity within the DoD that translates user requirements into design requirements and application code for subsequent processing and inclusion in DII/IS environments.

Client Server Architecture

The architecture in which the client is the requesting machine (PC or workstation) and the server is the supplying machine (LAN file server, mini or mainframe). The client provides the user interface and performs some or most of the application processing. The server maintains the databases and processes requests from the client to extract data from or update the database. The server also controls the application's integrity and security. "The Computer Glossary," Alan Freedman. AMACOM, 1993.

CM Information/Configuration Model Database

A database (either on DASD or magnetic tape) where all CM collected and retrieved data, and all benchmarks and configuration data/models are kept for future reporting requirements or modeling efforts.

Configuration Control Board (CCB)

A board composed of technical and management representatives who recommend approval or disapproval of proposed changes to the DII/IS baseline configuration. The board also recommends approval or disapproval of proposed waivers and deviations from a DII/IS current approved baseline documentation.

Contention

The competition for available resources. Contention arises when two or more devices attempt to use a single resource at the same time.

Cost-Recovery

A Fee-For-Service approach of receiving payment for services provided, in which customers of an information system environment are charges for their use (consumption) of resources and services. The charge for this service is based on the rates that attribute costs for defined levels of usage. A cost-recovery (charging) system consists of two major components: "rate-setting" and "billing". (see also: "Fee-For-Service".)

Data Loss

The occurrence of partial or incomplete transmission of data from one device to another.

Error Rates

A measure of the effectiveness of a communications channel. It is the ratio of the number of erroneous units of data to the total number of units of data transmitted.

Fee-For-Service

A method of gaining reimbursement for services provided by charging customers (e.g., of an information system) for the use or consumption of services or resources. (See also: "Cost-Recovery")

Information Processing Center (IPC)

(1) One of the various terms used to define a place (e.g., building) where large computer systems are located. IPC's may also function as a data processing center (DPC), information technology facility (ITF), data processsing installation (DPI), information systems center (ISC), computer center, or data center.

(2) An organizational grouping set of personnel, hardware, software, and physical facilities, whose primary function of which is the operation of information systems, and providing services, to a user community.

(3) A logical or physical collection of IPC's, which may also include communications and network topologies and systems that the DoD has described as a "megacenter". (See also: "Megacenter")

Information Technology (IT)

The hardware and software used in connection with Government information, regardless of the technology involved, (e.g., computers, telecommunications, micrographic, etc).

Megacenter

One of (currently 16) a number of planned large DoD IPC's that will provide all the information systems, communications and networking services for the DoD's computer processing requirements/needs.

Propagation Delay

The time it takes for a transaction or packet to be processed and forwarded by a single device.

Regional Processing Center (RPC)

A consolidated computer installation and its supporting organization that provides computer processing, data storage, data communication, computer liaison support and other related services to users.

Response Time

The time interval between a request and a reply from a client/workstation and a host/server. In data communications, response time includes transmission time to the computer, processing time at the computer, and transmission time back to the originating device.

Security

The area dealing with all the aspects of defining security practices, and methods of implementing security controls, to ensure that appropriate levels of security are maintained. This includes management practices, providing hardware and software capabilities , protocols (e.g., Simple Network Management Protocol (SNMP 2), etc., that will enable system controls, limit access, and prevent unauthorized use or manipulation of communications and networking environments.Specific types of information to be communicated, normally classified as one of the following: voice, video, imagery, or data.

Throughput

The number of transactions or jobs processed by a computing or communications/network component per unit of time.

Utilization

The performance characteristics that indicate the level of usage of a component or system. It is a measure of the amount of time a component or system is actively used to the total amount of time it is available. Excessive levels of utilization may impact the speed with which work is processed, as well as cause contention between components.

Workload

The characterization of work to be processed on a computer or network component. This includes transaction volumes, type, frequency, resource utilization requirements, etc. The size and characteristics of specific workloads impact the performance and utilization of a system and components.

Terms
Corporate Information Management
Functional Process Improvement

These terms are the specific references to Corporate Information Management (CIM) terminology used in this report.

Activity Based Costing (ABC)

An accounting technique that allows an enterprise to determine the actual costs associated with each product and service produced by that enterprise without regard to the organizational structure of the enterprise.

Activity Model

A graphic representation of a business process that exhibits the activities that make up the business process to any desired level of detail. An activity model reveals the interactions between activities in terms of inputs and outputs while showing the controls placed on each activity and the types of resources assigned to each activity.

AS-IS Model

A model that represents the current state of the organization modeled, without any specific improvements included.

Business Process Improvement Program (BPIP)

The application of one or more related business processes enabling an enterprise to improve the value of its products and services while reducing resource requirements. The results of a successful BPIP are productivity and quality improvements. A business case or action plan is a required deliverable for all BPIP actions. A BPIP may or may not include Business Process Redesign actions.

Business Process Redesign

The action of analyzing AS-IS activity and rule models with the intent to construct a TO-BE activity and rule model that will yield potential improvements in the performance of the business process.

Context Diagram

Represents a single activity of the subject being modeled.

Corporate Information Management (CIM)

A DoD program designed to reduce costs and increase effectiveness through analysis of business processes. The main focus of the initiative is on management methods, and its primary objective is business process improvement.

Data Model (Business Rule Model)

A graphical representation of an organization's information and data assets expressed in terms of entities and relationships. Relationships are also called business rules because they enable or constrain business actions. Data models, like activity models, have As-Is and To-Be representations.

Decomposition Diagram

A more detailed, lower level diagram representing the insides of the parent activity box.

Entity Relationship Model

The result of applying the business rule/data modeling technique. It is a graphic or structured narrative representation of the data meanings and business rules in an organization.

Functional Economic Analysis (FEA)

A methodology for analyzing and evaluating alternative business process changes and/or information system investments and management practices. Within DoD, FEA is a business case.

ICOM - Inputs, Controls, Outputs, Mechanisms

The acronym for the roles for data or material on an activity model. ICOMs are represented by arrows that interconnect activity boxes. They are named using a noun or noun phrase.

> **Input** - Data or material used to produce an output of an activity.
>
> **Control** - Data that constrain or regulate the activity. Controls regulate the transformation of inputs into outputs.
>
> **Output** - Data or materials produced by or resulting from the activity. It must include the input data in some form.
>
> **Mechanism** - Usually people, machines, or existing systems that provide energy to, or perform the activity.

IDEF - Integrated Definition Language

A modeling technique designed to capture the processes and structure of information in an organization.

IDEF0

An activity, or behavior, modeling technique.

IDEF1X

A rule, or data, modeling technique.

Node Tree

A node tree is a type of activity diagram. An activity and its decompositions are displayed in a hierarchial manner. No ICOMs are shown on a node tree. Since activity diagrams and their decompositions are represented on many pages in a model, a node tree can be used to overview a model. They are also useful for trying out different decomposition strategies before drafting activity diagrams.

Non-value Added Activity

Work performed in connection with the production of a desired product or service for which a customer is not willing to pay.

TO-BE Model

Models that are the result of applying improvement opportunities (from the Baseline modeling effort) to the current (AS-IS) business environment. These TO-BE models represent how future and improved processes should occur.

Value Added Activity

Work performed in connection with the production of a desired product or service, for which a customer is explicitly or implicitly willing to pay.

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Appendix F
Acronyms

AFB	Air Force Base
ATM	Asynchronous Transfer Mode
bps	bits per second
C3I	Command, Control, Communications, & Intelligence
CCB	Configuration Control Board
CDA	Central Design Activity
CIM	Corporate Information Management
CM	Capacity Management
CONUS	Continental United States
CPU	Central Processing Unit
DASD	Direct Access Storage Device
DASD (IM)	Deputy Assistant Secretary of Defense/Information Management
DASD (IS)	Deputy Assistant Secretary of Defense/Information Systems (Now DASD/IM)
DASD (P&R) ITR	Deputy Assistant Secretary of Defense (Plans and Resources), Information Technology Resources
DII	Defense Information Infrastructure
DII/IS	Defense Information Infrastructure/Information Systems
DISA	Defense Information Systems Agency
DISA/JIEO/CIM	Defense Information Systems Agency/Joint Interoperability & Engineering Organization/Center for Information Management
DISN	Defense Information Systems Network
DISO	Defense Information Services Organization
DITSO	Defense Information Technology Services Organizations (now DISO)
DLA	Defense Logistics Agency
DMRD	Defense Management Report Decision
DoD	Department of Defense
FDDI	Fiber Distributed Data Interface
FD	Functional Description
IAW	In Accordance With
IM	Information Management
I/O	Input/Output
IPC	Information Processing Center
IRM	Information Resource Management
IS	Information Systems
IT	Information Technology
LAN	Local Area Network
MAJCOM	Major Command
MAN	Metropolitan Area Network
MB	MEGABYTE
Mbps	Megabits per second
MIPS	Millions of Instructions Per Second
MTBF	Meantime Between Failures
OSD	Office of the Secretary of Defense

OSI	Open Systems Interconnection
RMF	Resource Measurement Facility
RPC	Regional Processing Center
SLA	Service Level Agreement
SLO	Service Level Objective
SMF	Systems Management Facility
SNA	Systems Network Architecture
SONET	Synchronous Optical Network
TCP/IP	Transmission Control Protocol/Internet Protocol
WAN	Wide Area Network

Acronyms
Corporate Information Management
Functional Process Improvement

ABA	Activity Based Analysis
ABC	Activity Based Costing
BPI	Business Process Improvement
BPIP	Business Process Improvement Program
CIM	Corporate Information Management
ERD	Entity Relationship Diagram
FEA	Functional Economic Analysis
FPI	Functional Process Improvement
FPIP	Functional Process Improvement Program (DoD 8020.1-M)
ICOM	Input, Control, Output, Mechanism; Roles for data or material on an activity
IDEF	Integrated Definition Languages
IDEF0	IDEF Activity Modeling Technique
IDEF1X	IDEF Data/Business Rule Modeling Technique

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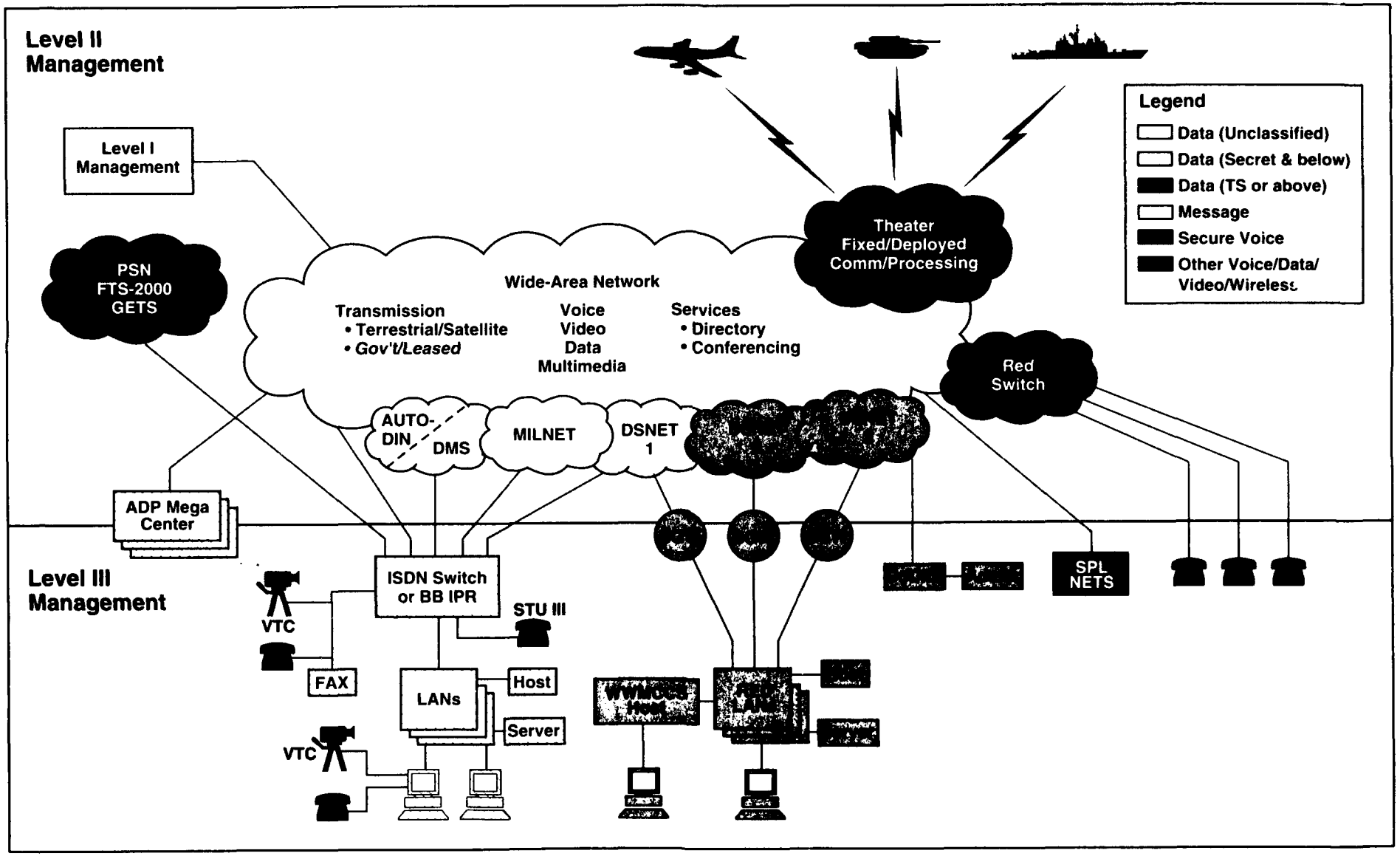
Appendix G
Defense Information Infrastructure (DII) Concept

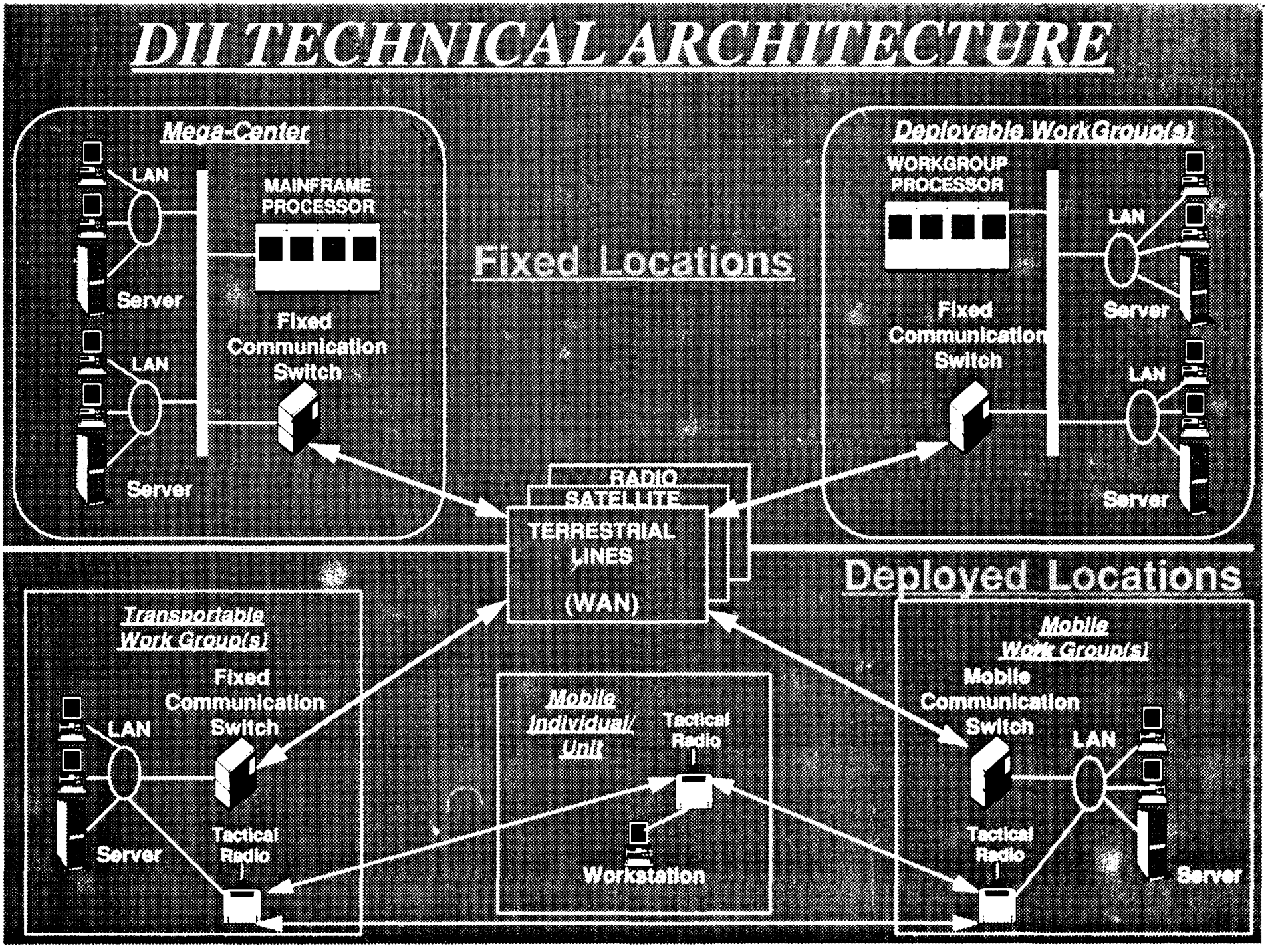
Defense Information Infrastructure

Objective Architecture Overview-1998



Concept

1 February 1993


DII TECHNICAL ARCHITECTURE
Mega-Center
LAN
MAINFRAME PROCESSOR
Server
Fixed Communication Switch
LAN
Server
Deployable WorkGroup(s)
WORKGROUP PROCESSOR
LAN
Fixed Communication Switch
Server
LAN
Server
Fixed Locations
RADIO
SATELLITE
TERRESTRIAL LINES
(WAN)
Deployed Locations
Transportable Work Group(s)
Fixed Communication Switch
LAN
Server
Tactical Radio
Mobile Individual/ Unit
Tactical Radio
Workstation
Mobile Work Group(s)
Mobile Communication Switch
LAN
Tactical Radio
Server

Appendix H
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