

**Final
Model Business Case Report
for the
OSD CALS IWSDB PROJECT**

An MVP Joint Venture

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PREFACE

The Integrated Weapon Systems Database (IWSDB) is a concept many parties espouse without understanding it. Models are necessary to convey a concept from one party to another. Making an IWSDB a reality requires development of various, commonly understood models, understood between Department of Defense (DoD) and its contractors, among contractor teams, among weapon system managers, and among Continuous Acquisition and Life-cycle Support (CALs) or Electronic Commerce/Electronic Data Interchange (EC/EDI) technology suppliers. One such model, the IWSDB business case, depicts the economic arguments necessary for making underlying investments supporting the storage, manipulation, and transmission of data supporting weapon system functional processes. The IWSDB business case is actually a collection of models depicting functional processes, technical architectures, cost projections, information relationships, action plans, and economic projections of investment cash requirements and risks. The IWSDB business case, much like its Functional Economic Analysis (FEA) counterpart developed under the Corporate Information Management (CIM) Initiative, *provides insight for making decisions about change* rather than packaged recommendations, and is much more focused on program outcomes than on program inputs.

This document describes the IWSDB business case and what it comprises. The descriptions are the basis for continued work developing an initial IWSDB business case template. This template will help weapon system management visualize what the IWSDB business case is about, eventually leading to detailing the IWSDB business case process, perhaps through a guidebook similar to the one that accompanies the FEA process. Conceptual issues and clarifications must be addressed along the way, and many of these issues are displayed throughout the following text within shaded boxes or side-bars.

This report is intended to present the concepts, methods, and approaches to be used in the development of and possible inclusion in official guidance. As such, the activity and process improvement scope has been limited to those areas within the current budget planning horizon and for which both the activities and cost are well defined and applicable to any weapon system. It is envisioned that subsequent efforts will provide guidance for the incorporation of technical process improvement and risk reduction initiatives that provide cost improvements outside the immediate planning horizon.

A basic premise of the approach is the establishment of programmatic goals and objectives including performance improvements, reduced risk, etc. and that alternatives that fail to meet these established objectives are excluded from consideration. Thus, the Business Case documents activities and costs for alternatives that achieve established goals and objectives. Costs, the extent to which goals and objectives are exceeded, and other relevant information are then arrayed in a comparative format for presentation to the decision maker. No recommendation is made, and no attempt to quantify subjective criteria is deemed appropriate.

1.0 INTRODUCTION

The purpose of this report is to put forth the authoring team's position on the contents and scope of the IWSDB business case. The sections in this report will contain the following information:

- **2.0 Background** - This section sets the context for the IWSDB business case and describes the concept of the IWSDB. This section also explains strategies to make IWSDB business case methods and tools available more quickly.
- **3.0 Defining an IWSDB Business Case** - From this section, the reader will understand both the reason for the IWSDB business case analysis as well as the major contents of the business case.
- **4.0 Building the IWSDB Business Case Foundation** - This section contains the key concepts that make the IWSDB business case different from other "trade-off studies" or economic analyses. This section presents the reader with a possible architecture and a specific set of capabilities for an IWSDB. The reader will be introduced to the role of the IWSDB Weapon System Technical Data Operation, the concept of cost drivers, activity cost analysis, action plans, and risk.
- **5.0 Building the Business Case** - This section contains the major steps in formulating an IWSDB business case. This section is not a description of "how to" assemble a business case, but a description of the contents.
- **6.0 Transitioning to Implementation** - This section presents major considerations in achieving the TO-BE environment put forth in the IWSDB business case analysis. This section is not part of the business case, but rather is to be used as information that must be considered when developing action plans to migrate to the TO-BE environment. From this section, the reader will learn the characteristics and barriers of successful implementation for advanced technologies.

2.0 BACKGROUND

Weapon system data play a key role in influencing the cost, flexibility, mission readiness, and operational effectiveness of weapon systems. A well-conceived IWSDB can contribute to the improvement of these performance measures by providing an effective means of integrating and using weapon system data across the weapon system life-cycle.

What is an IWSDB?

IWSDB is a concept that embodies the principle of data access as opposed to data delivery. Under this principle, data is created and maintained in a shared environment where authorized users of the data are provided access rather than copies that must be kept current through the life-cycle. As the life-cycle proceeds, various activities supporting the Weapon System will obtain source information from the IWSDB and contribute to its contents as the source data is modified or new data is created. This concept is logically presented in Figure 2.0-1. In the figure, data domains of generic Weapon System life-cycle functions are represented by circles inside the IWSDB domain. The IWSDB business case examines the extent to which this ideal representation can be economically implemented and the technical alternatives available for its implementation.

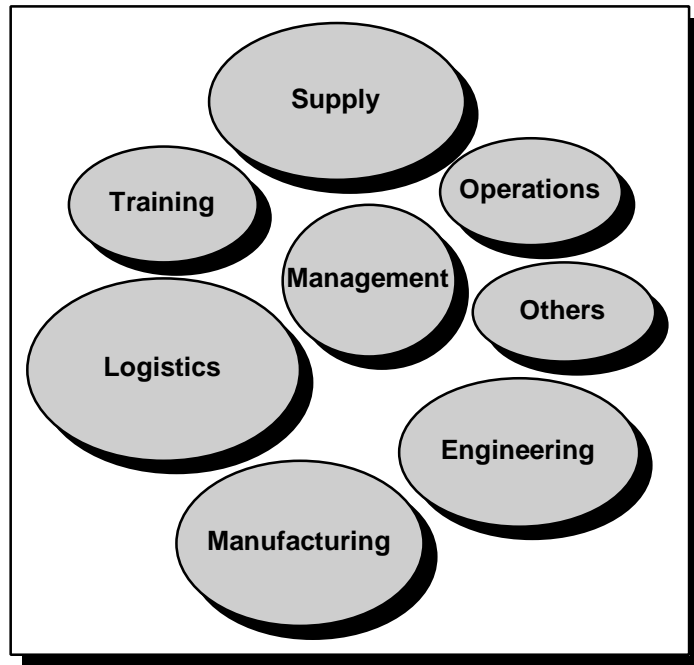


Figure 2.0-1 IWSDB Data Domains

Under existing Office of the Secretary of Defense (OSD) policy and guidance, the Program Manager (PM) is responsible for establishing the IWSDB. It should be noted that the PM is responsible for the acquisition, storage, maintenance, and dissemination of Weapon System Technical Data and that implementation of an IWSDB is an alternative means of satisfying these existing responsibilities.

The successful deployment of an IWSDB is possible only if the requirements for it are well understood and a suitable (cost effective) design and implementation approach are defined. These design and implementation responsibilities rest largely in the hands of the weapon system program office that establishes these and other key elements of a data strategy. Data strategy decisions made during the acquisition phase of the program typically lock in the technology and costs associated with the subsequent phases.

Requirements, alternatives, solutions, costs, and benefits are all functions of the type of program in question, its life-cycle phase, and its acquisition, operations, and maintenance strategies. To deal with these issues in the proper context requires a business case approach. A properly

constructed business case includes an analysis of issues larger than the individual program it is associated with. For example, the IWSDB for an individual weapon system will ultimately come in contact with the IWSDBs of other weapon systems as the data from many programs is used in the execution of materiel management, depot maintenance, and other key life-cycle processes.

Past studies calling themselves “business cases” have neither followed a common methodology nor presented conclusions or recommendations in the same manner. No common approach presented functionally-focused economic analyses, with some cases presenting only traditional cost/benefit analysis. When Activity Based Costing (ABC) was referenced, the past cost data were unavailable, because accounting systems do not collect AS-IS data supporting activities. No risk adjustments were made to the projected savings, and in only some cases were life-cycle savings estimated with a discount for inflation. No consistent estimate time frames, e.g., three years, five years, etc., were used in projecting future savings.

Implementation of an IWSDB capability dictates that investments made to establish this capability follow a valid business case basis. Weapon system management must have uniform business case parameters in order to plan and program resources to achieve an IWSDB capability. Because there was not a demonstrated, consistent approach, we must develop a model business case for the IWSDB, including strategy, structure, and cost drivers. This model must be based on DoD economic policy (Program, Analysis, and Evaluation (PA&E)), cost structure (Major Automated Information System Review Council (MAISRC)), and FEA and lessons learned from prior, related economic analyses.

We can make IWSDB business case methods and tools available more quickly if we build upon previously implemented and accepted work sponsored by DoD:

- **Functional Economic Analysis Methodology**

Because an FEA is itself a business case, most concepts and actions prescribed in FEA guidance appear consistent with the needs of managing business processes and justifying IWSDB investments within a particular weapon system. Guidance, function and data models, and software were developed to support the FEA process. This material provides a rich basis for adoption and extension within an IWSDB business case methodology.

- **IWSDB Architectural Approach**

The development and integration within and among IWSDBs promise to be a difficult and involved undertaking in which a balanced view of business processes, technology solutions, and management control is required to ensure a meaningful result. The American National Standards Institute's Standards Planning and Requirements Committee (ANSI/SPARC) Three Schema Architecture Framework is recommended as a means of evaluating the issues associated with each of the three areas. This approach is used extensively in the CALS Architecture Study¹ to describe transitions from current to future ways of doing business.

¹ "CALS Architecture Study," *Version 1.0, Volume 1*. Washington, D.C., Joint CALS Management Office, June 1991.

3.0 DEFINING AN IWSDB BUSINESS CASE

The Integrated Weapons System Data Base, or IWSDB, is the weapons system technical data delivered, maintained, and distributed in electronic form, using CALS concepts and standards to achieve the improved operating efficiency of creating data once and using it many times throughout the life-cycle of the weapon system.

The business case for IWSDB implementation is an organized set of economic metrics that provides program management with a means of identifying the cost of managing weapons system technical data in order to budget for the most cost effective solution. Because the business case examines the cost of acquiring, maintaining, distributing, and disposing of technical data over the weapon system life-cycle, it provides program management with guidelines for deciding the best uses of available funds. It provides for comparative analysis between the cost of current activities and alternatives that utilize the CALS concepts and standards for management of electronic data. To achieve lower cumulative operating costs, the business case could justify additional funding for a weapon system program during one phase of acquisition.

The IWSDB Business Case is a structured proposal that provides insight for decisions made by weapon system management. It includes:

- An analysis of functional process needs or problems.
- Proposed solutions, assumptions and constraints.
- Alternatives.
- Life-cycle costs and benefits.
- Investment risk analysis.

The business case uses some of the tools and ideas of FEA, identifying opportunities for process improvements in the management of technical data. IWSDB business case analysis uses ABC methodology to determine costs relating to weapons system data storage, transmission, and manipulation capabilities as performed today and depicted in AS-IS function models. These costs, both investment costs and operating expenses, are projected through the weapon system's planning horizon, modeled as an intended, or TO-BE state.

It is important to recognize that the business case, unlike an economic analysis, is used to determine the lowest cost course of action to achieve a common set of achievable goals and objectives. These goals and objectives should include minimum acceptable levels or ranges of performance for elements such as readiness, cycle time, training/operational efficiency, quality, logistics tail, et el. Alternatives that fail to achieve these goals and objectives are not considered. If all alternatives fail to meet the goals and objectives, then additional initiatives must be identified and incorporated or the goals and objectives are not achievable and must be revised.

A template of common, TO-BE IWSDB capabilities serves as a jumping-off point for developing investment alternatives. Alternatives, each with its own action plan, are groups of initiatives that offer different ways of migrating from the AS-IS state to the TO-BE state. Initiatives are one-time actions or projects that put into place improvements that simplify, integrate, or automate functional processes or activities. Alternatives focus on cost savings, not cost avoidance or other intangible benefits. Risk is attached to each alternative through its collective initiatives. Each

alternative is stated in constant dollars, and optionally in current dollars. Affordability of any alternative is determined outside the business case discussion.

The analysis within the IWSDB business case process helps to define where and how to exploit IWSDB capabilities to achieve the greatest savings among alternative ways of doing particular functional processes (see Figure 3.0-1). The analysis also ties to the weapon system's life-cycle phase, aiding cost and benefits determination. An IWSDB business case must focus on measurable performance improvement in process outputs and program outcomes, rather than on the reconstitution of program inputs.

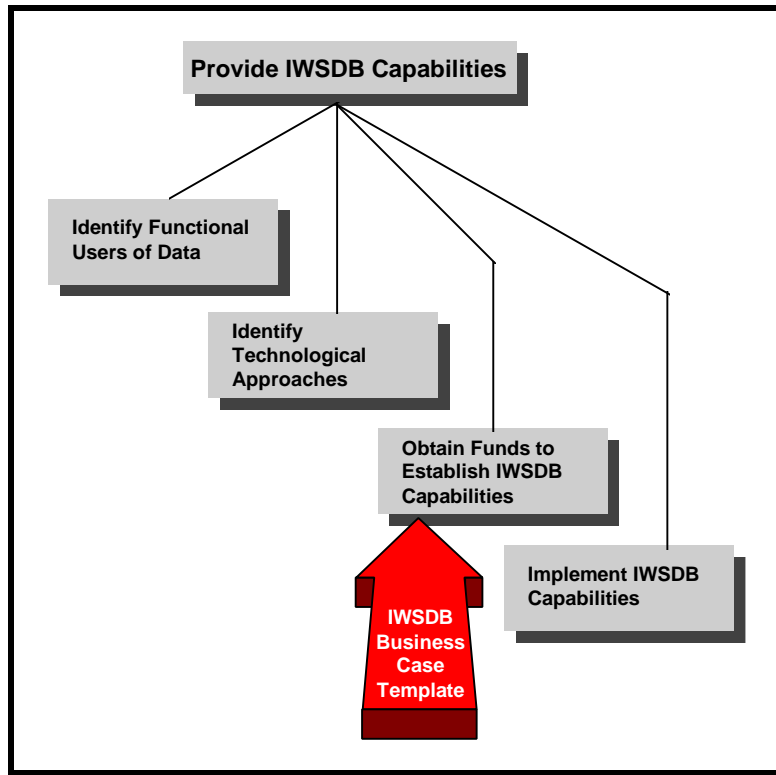


Figure 3.0-1 IWSDB Business Case Template Supports Weapon System Investment Activities

The business case methodology identifies "cost-drivers," the factors in business processes that cause cost to occur. Each weapon system will have individual and unique cost drivers that affect the implementation of the IWSDB. There are desirable costs, such as the cost to deliver maintenance instructions to a mechanic, and undesirable costs, such as the cost of searching through reams of paper documents or aperture cards for the correct maintenance instructions. The business case helps program management identify cost-drivers associated with the IWSDB and make decisions to implement improvements to eliminate the undesirable costs.

Successful functional process improvements include attributes or "characteristics" that are critical factors in their success. The IWSDB business case gives program managers help in planning the realization of characteristics their programs need to be successful.

"Barriers" to success have been identified from previous process improvement initiatives. The business case provides guidelines for program management to identify these barriers in specific programs and to formulate plans to overcome them.

The IWSDB business case is not a cure-all for the day-to-day systemic problems encountered by program management. For example, the business case will not isolate the PM from the across-the-board budget reductions, nor is it intended to do so. The IWSDB business case will, however, provide him with a tool to assist in the effective utilization of allocated resources and to manage changes in processes to obtain the greatest performance from available funds.

In summation, program management of any weapon system is currently funding the management of technical data, whether the data is in paper or electronic form. Program management will use the IWSDB business case to plan and implement the most cost effective solutions to manage technical data for that specific weapon system. Improved processes will be required to meet program missions in an environment of DoD downsizing. Program management will use the IWSDB business case methodology to manage necessary changes.

4.0 BUILDING THE IWSDB BUSINESS CASE FOUNDATION

This section offers technical direction and the format for specific weapon system functional direction. Technical direction applies to the overall vision for an IWSDB. Program-specific functional direction recaps policy, workloads, time-frames, mission, outcomes, etc., given to the PM by higher authorities.

4.1 IWSDB Concept, Architecture, and Capabilities

The IWSDB concept embodies the principle of data access as opposed to data delivery. Under this principle, data is created in a shared environment where authorized users of data are provided access rather than given copies of the data. This approach reduces the complexity of configuration management, reduces storage costs, and reduces data version related errors.

The generic IWSDB architecture in Figure 4.1-1 puts forth a client-server approach, with the entire IWSDB distributed into multiple regional Repositories. One or more servers are running at each region, and an arbitrary number of clients are running on geographically distributed local sites. Each regional repository contains physical data as well as associated meta-data (data about data). The repositories are supported by a set of tools that provides capabilities² including:

- **Database Management** that supports the internal schema of the database as to how and where the data objects are stored in the database.
- **Security** that insures that the data stored in the database cannot be accessed, modified, or deleted by unauthorized users.
- **Directory Management** that provides name to address conversion allowing user requests to be routed in a network without the user having to specify the location of the data.
- **Data Dictionary Management** that supports a repository of IWSDB information to provide for definition, structuring, access, and usage of data within the repository.
- **Version Control** that ensures consistency among data objects stored throughout the IWSDB. This will entail the automatic update of revised data objects as they enter the system.

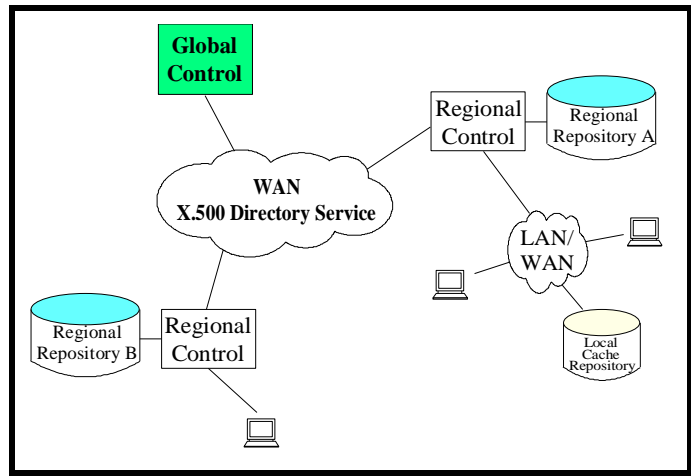


Figure 4.1-1 IWSDB Architecture

²ManTech International Corporation, "Preliminary Integrated Weapon System Database (IWSDB) Implementation Strategy Paper," *Non-CDRL Document For The OSD CALS IWSDB PROJECT*. (Fairmont, WV: ManTech International Corporation, 1994).

- **Project Control** that supports systems development and maintenance activities through access to and manipulation of repository data objects.
- **Data Modeling** that is used to build and maintain the conceptual schema for the IWSDB, a neutral view of data that can be shared among all users.
- **Maintenance** that provides system operation, system monitoring, backup, and reporting functions for the IWSDB.

The Scope of Technical Data Operations

Program managers spend current funds on technical data supply operations. They provide "products" (weapons system technical data) in many formats and media (including paper) to "customers." The customers' use of products does not affect management's operation. The "products" are obtained from "suppliers" (contractors, functional areas, etc.). The business case lets program managers analyze the technical data supply operation using the customer/supplier analogy to set the boundaries of the analysis, so that management can focus on improving operations, independent of customer and supplier internal activities (see Figure 4.1-2).

Demand

Customers create "demand" for product that determines the load or volume of transactions and the types of technical data. The weapon system life-cycle will determine which types of technical data (design, maintenance, etc.) are in the product "mix." Managers will need to forecast demand, using program plans and past performance metrics to budget for future years' data requirements and capacity. This workload can be assumed to be independent of the delivery channel implementation. This establishes the baseline for technical data operations. The business case is used to analyze alternative methods for delivery of data to customers and to seek out opportunities

for improving service or lowering the cost of managing data. In addition, customer requirements become performance requirements for the operation. The business case will help program management decide what levels of performance, for example response time, can be implemented with available funds. The business case scenarios can compare alternatives that provide different levels of service for an equal workload using different delivery channel implementations.

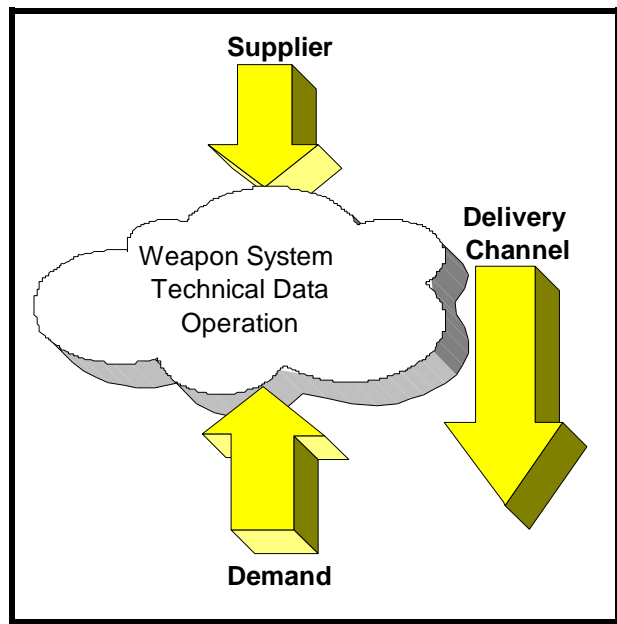


Figure 4.1-2 IWSDB Weapon System Technical Data Operation

The Delivery Channel

Program management decides "how-to" meet the customer demand. For example, management may determine that a supplier will operate a technical data service for certain products (as in a Contractor Integrated Technical Information Service (CITIS)), so that products are delivered directly from their creation point to the user. Not all of the data reside on a single, large computer system. The delivery channel can be Government owned and operated, contractor owned and operated, Government owned and contractor operated, or a mix depending on the program.

Supplier

Any source of technical data is a supplier. Major corporations, such as prime contractors, will have capabilities to supply the data in formats desired by customers, but smaller contractors may not possess the capabilities. Program management will need to arrange for conversion of paper or non-standard format data, either through third party services or through an internal conversion resource. Managing supplier relationships will be a primary activity of technical data operations. Program management will decide how to buy access to data.

Products

Technical data will be in paper and electronic form. Many types of data elements will be in the IWSDB, such as engineering design data, logistics records, manufacturing drawings, technical manuals, etc. Users will expect Help services. Training will need to be provided as an ongoing activity.

4.2 IWSDB Cost Drivers

Cost drivers are factors in a business process that cause costs to occur, particularly those costs incurred by factors that cause delay in production, excessive consumption of resources, or variation in the quality of a product in an activity. Many times, events or instances that trigger, bind, or constrain activities yield such factors.

The identification of cost drivers is imperative to activity-based costing and business process improvement. Drivers that produce unwanted cost should be identified and minimized for successful process improvement and cost effective processes. Many times a downstream activity must pay the price in performance for an upstream activity's cause, e.g., rework due to engineering changes. Providing the capability to convert technical information products within one class from a standard format to another format within that same class (e.g., Electronic Technical Manual/Interactive Electronic Technical Manual (ETM/IETM) conversion) typifies a condition where an identifiable and quantifiable cost driver (e.g., Format Conversion) impacts weapon system technical data operations. It is important to recognize that not all costs drivers cause unwanted cost. For example, placing an order for a product is a cost driver that does not cause non-value added cost. In this example, the customer order is a trigger for many activities that will involve the manufacture and distribution of a product. Analysis of cost drivers can help determine the priority of necessary changes, as many drivers affect multiple activities. High impact cost drivers lend themselves to examination using techniques such as Ishikawa (fishbone) or Pareto analysis.

It should also be noted that cost drivers may affect fixed or variable costs. That is, as performance of a given activity increases or decreases, the costs imposed by each cost driver may remain constant or may increase/decrease in some proportion to the volume of output. Relationships between cost drivers and respective activities can be used to augment current procedures used to calculate and estimate resource requirements and activity costs. Cost drivers have a closer correlation to variations in activity costs than the more uniformly distributed factors of square footage of floor space or total contract cost.

For the purpose of the IWSDB business case, cost drivers affecting the weapon system technical data operation (Figure 4.1-2) need to be identified during the development of the AS-IS models for the business case. Figure 4.1-2 depicts the environment surrounding the weapons system technical data operation including the suppliers of data, the demand for data, and the delivery channel for data. While out of the scope of the IWSDB business case, the areas of demand, supplier, and delivery channel may affect costs inside the weapon system technical data operation. This is due to an indirect relationship between the activities and cost drivers of these areas and the activities and cost drivers of the weapon system technical data operation. Again, these relationships are outside the scope of the business case but are important to recognize, because they can affect the internal cost drivers of the weapon system technical data operation. For example, if a factor changes the consumer's need for data, then the demand placed on the weapon system technical data operation will change, thus affecting the cost of doing business inside the scope of the weapon system technical data operation. Also, if an activity inside the weapon system technical data operation increases the supplier's cost of doing business, then the supplier may well raise the prices on the products purchased by the weapon system technical data operation. This price increase obviously raises the cost of doing business inside the weapon system technical data operation. Therefore, it is important to recognize not only internal cost drivers, but also factors that affect the processes outside the weapon system technical data operation that may affect internal costs.

Example Candidate Cost Drivers for IWSDB Implementation

Ad hoc Test Data Loads

Unplanned re-loading of the test databases. This causes extra man-hours to be spent in testing the prototype and delays in the implementation schedule.

Regulatory Changes

New or revised regulations governing the IWSDB that occur during or after implementation. These changes will cause additional resources to be expended to conform to the new regulations.

Data Ownership Issues

Conflicts between organizations over which organization should have authority to add, change, or remove data from the IWSDB. Time spent in negotiating the solution adds cost to the project. The manner of resolution can affect the complexity and cost of application software. Not resolving them endangers the integrity of the database.

Use of Obsolete Versions of Data

Utilization of data that is out of date thus causing unnecessary rework.

Changes in Standards

New or revised standards that pertain to the operation or implementation of an IWSDB. To comply to standards, system managers must spend time revising or replacing software and/or hardware.

Data Security Restrictions

Elaborate restrictions placed on access to data. This will result in additional staffing for data security administration.

Data Replication

The use of multiple copies of data in an IWSDB. Multiple copies of data will result in the need for a version control system.

Use of Non Standard Product Generation Tools

The utilization of tools that are not compliant with CALS standards. The output of these tools will be converted to a CALS-compliant format if the data are to be placed in the IWSDB.

Translation of Legacy Data

The amount of time and resources that need to be used to change legacy data into a format that is compliant to CALS standards.

Errors in Data Conversion or Translation

The number of instances of incorrect data conversion. These errors will require extra time and resources to correct them.

Data Consistency When Using Data Replication

Fidelity of replicated data. Unless changes are immediately propagated to all existing copies, data that has been replicated may not be the most current version.

Overlapping Standards

Two or more standards that exist for an activity. This causes extra man-hours to be spent in determining which standard has precedence and in re-working deliverables to conform to the selected standard.

Number of Data Replications

The degree to which copies of data are allowed to exist. In the IWSDB, if data are duplicated, then a configuration management system must be employed to maintain accurate and current versions of data. The more data that are replicated, the greater the resources needed for configuration management.

4.3 Weapon System Technical Operations Activity Cost Analysis

The business case cost analysis is based on Activity Based Cost (ABC) Accounting. ABC is a technique that allows an enterprise to determine the actual costs associated with each product and service (an outcome or output) produced by that enterprise without regard to the organizational structure of the enterprise. The resulting calculations, within a context called cost schedules, will depict the weapon system's activity levels through the planning horizon. Lowered costs are the effect of reducing baseline activity levels.

Activities are the building blocks of business processes, and understanding activities is essential to all techniques used to improve business process. ABC reorganizes traditional financial information into a form that makes sense to the casual functional users; in addition to the usual information that tells them how they spend money, they now have information that shows them what they do with the money. This ability to place costs on activities and their outputs provides a clear metric for improvement, whether for determining improvement priorities in the long-term or for measuring near-term success.

ABC also provides analytical information to analysts and designers involved in re-engineering or redeveloping business systems. Using ABC, the PM can determine the non-value added content within the business and can wring-out the waste before automating (or re-automating) activities. As a result, the PM can reduce the total cost of business modernization.

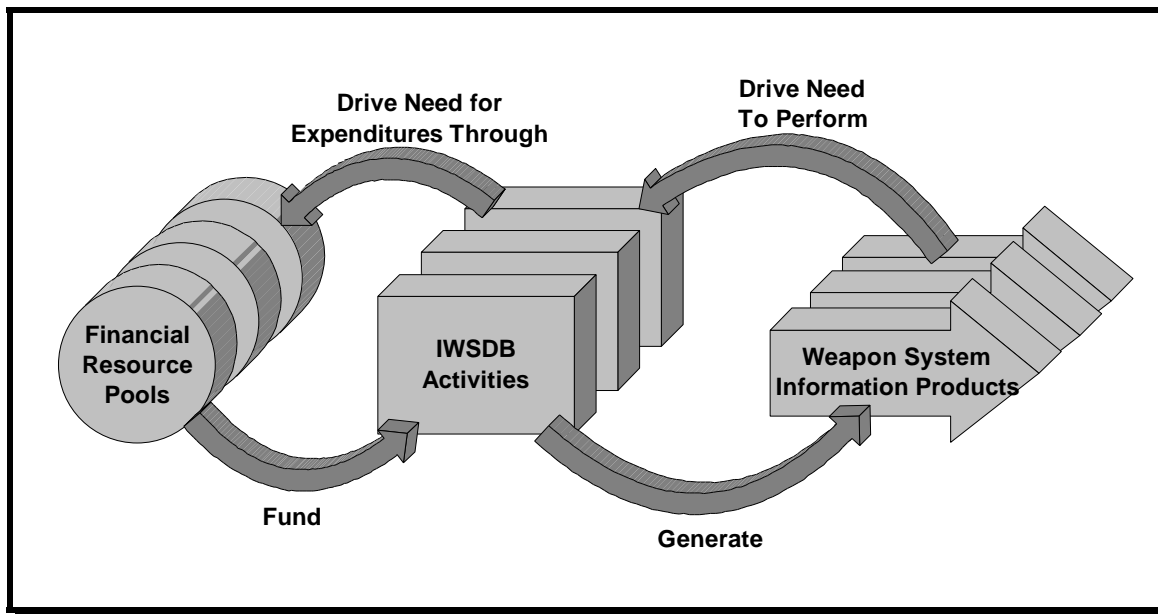


Figure 4.3-1 Activity Cost Relationships

Figure 4.3-1 depicts basic ABC relationships. The first step in ABC is identifying and analyzing activities, followed by the gathering of costs and placing these costs into pools. The behavior of costs is traced to the consuming activities, and cost drivers are used to allocate the pools to the

traced activities. Performance measures are assigned to each activity, enabling the final step of analyzing the value each activity contributes to the outcomes of the enterprise.

Financial Resource Pools

A financial resource pool is an apportionment of funds that relates how funds are spent in regard to outcomes. A financial resource pool's source of funding is an authorization to apply financial resources to accomplish specified purposes either from Congress in an appropriation or from a customer through a revolving fund. Financial resource pools behave the same as cost pools found in conventional ABC.

Each financial resource pool is further broken down into up to seven costs elements that characterize a natural category of expense. These cost elements are defined in Appendix C.

Activities

An activity is a function, process, task, action, etc., that requires some amount of time to produce one or more discernible results. The IWSDB business case uses activities as the device to align resources with outcomes and outputs. The business case differs from other types of economic analyses, because it focuses on the impact of activities and their related performance measures.

The current snapshot of activities is called the AS-IS state. Some future, desired set of activities is called the TO-BE state. AS-IS activities form the starting point for a business case baseline. Various models of activities used to establish baseline costs and the cost of each alternative are available to the PM. The DoD Enterprise Model³ (specifically, activity A21, "Manage Acquisition") and lower-level, decomposed activities depict functions performed in a typical weapon system program office. This model further contains other activities supported by the weapon system technical data operation that should be included under the top-level node, or "A0," in an IWSDB business case activity node tree, specifically:

- IWSDB Activity A1 equates to DoD Enterprise Model Activity A21.
- IWSDB Activity A2 equates to DoD Enterprise Model Activity A22.
- IWSDB Activity A3 equates to DoD Enterprise Model Activity A23.
- IWSDB Activity A4 equates to DoD Enterprise Model Activity A33.

Another activity model source is described in Section 5.0. This puts forth a generic Weapon System Program Management activity node tree, developed and partially validated during the development of the B2 CITIS Business Case.⁴ The level depicted provides a common generic activity model for the conduct of the business case analysis. In order to complete a business case for a specific weapon system further decomposition may be required and lower levels of the activity tree become weapon system program unique.

³OSD, ASD(C³I). "The DoD Enterprise Model." *Volumes I and II*. Washington, D.C. January 1994.

⁴Northrop B-2 Division. "Contractor Integrated Technical Information Service (CITIS) "Business Case," *Feasibility Study*. California: Northrop, August 1992.

Figure 4.3-2 illustrates a three-dimensional spreadsheet that is the result of tracing and then allocating cost pools to activities for each fiscal year within the IWSDB business case planning horizon. As each pool is allocated (by cost element), it adds to the costs brought in from other pools to form a total for each activity. Activity costs are then assigned to outputs based on a primary performance measure.

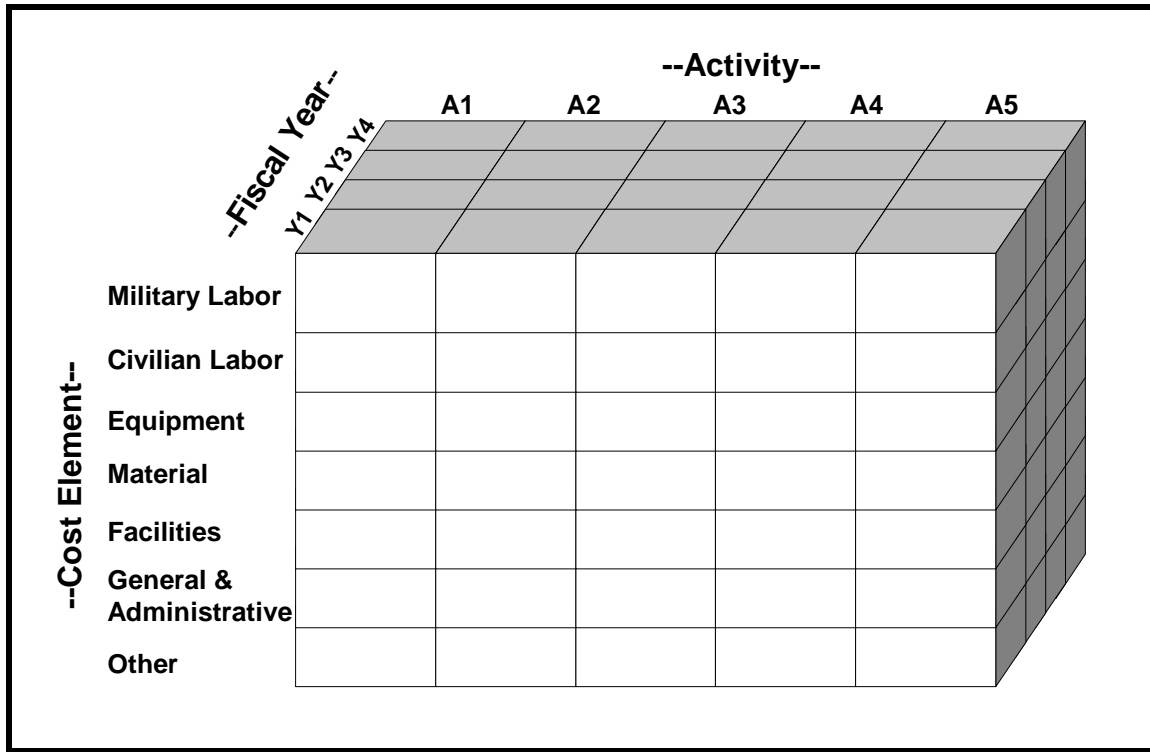


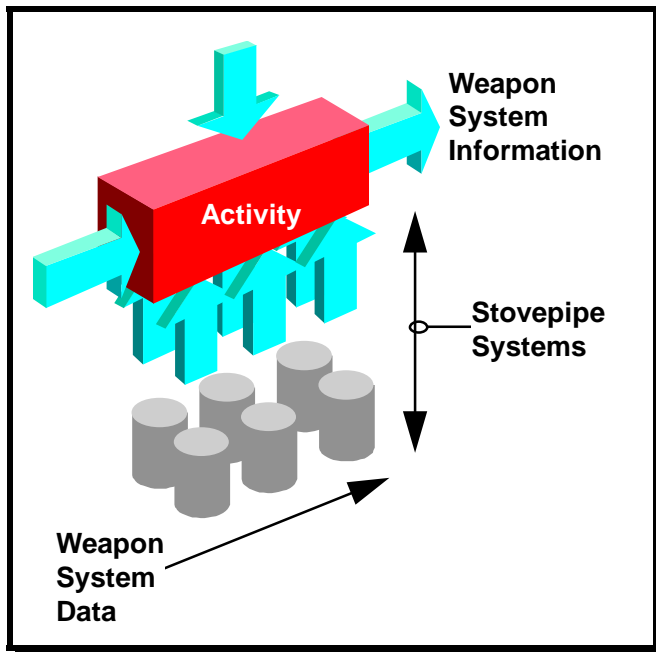
Figure 4.3-2 Activity Cost Matrix

Weapon System Information Products

Weapon System Information Products are the results of performing activities. These results are either specific activity outputs (e.g., processing a data request) or some combination of outputs and specific transformed inputs (e.g., producing a particular Technical Data Package). Weapon System Information Products have the same characteristics as cost objects found in conventional ABC.

What is the Cost of Information in an IWSDB Business Case?

The IWSDB business case includes the costs of recurring activities involved in data storage, transmission, manipulation, and presentation. Capital costs for related automated systems, equipment, and facilities also fall within the business case boundaries. But what of the cost of intellectual property, the data asset cost? Like any other asset cost, sunk costs are not considered in a business case, so any previously acquired data that is the undisputed property of the Government must be considered as a sunk cost. However, anecdotal evidence indicates that a great deal of product and process data developed by prime contractors and their subcontractors is considered as proprietary. Must a business case consider the cost of data ownership? Can we separate the cost of the data property from the costs of data-related activities?



We illustrate the current state of data-related activities in Figure 4.3-3. Weapon system activities produce information as a primary output (e.g., a detailed part design) or byproduct (e.g., measurements from a test procedure). Stand-alone, stovepipe systems act as data mechanisms supporting these activities and fencing off data from other systems and activities, regardless of who owns the data property.

Figure 4.3-3 Weapon System Activities Supported by Traditional Data Mechanisms

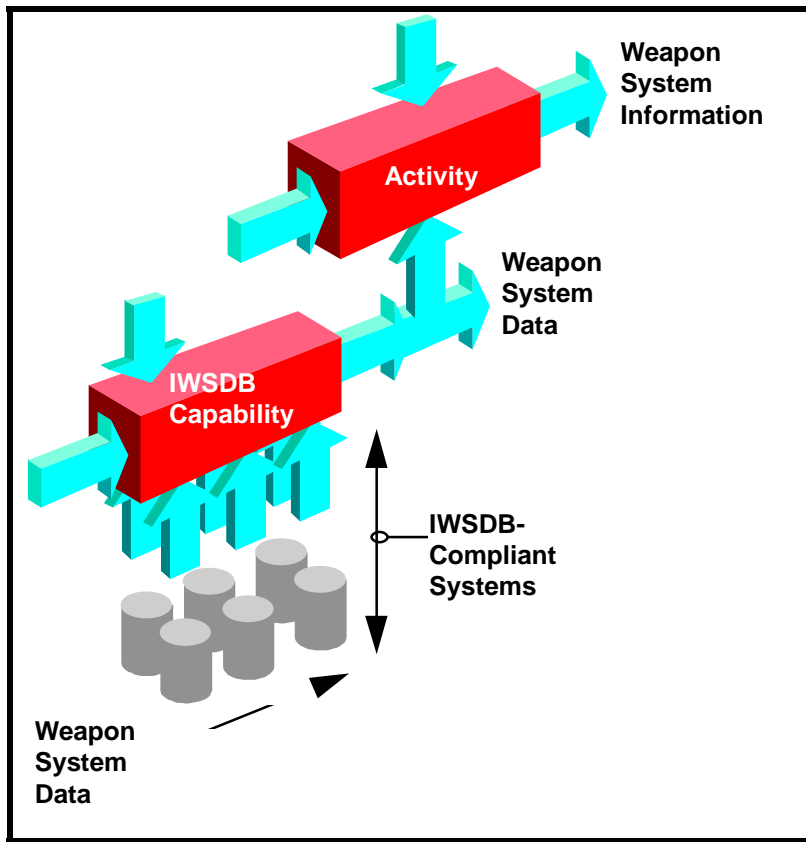


Figure 4.3-4 Weapon System Activities Supported by IWSDB Data Mechanisms

We depict the future IWSDB state in Figure 4.3-4. Weapon system activities still produce information as an output or byproduct. However, a logical set of IWSDB capabilities now acts as the data mechanism supporting these activities, providing weapon system data through IWSDB-compliant systems, again regardless of who owns the data property.

In both cases, weapon system data logically stand apart from functional activities. Presumably, data assets are reusable, despite the delivery system.

Data ownership becomes crucial when an IWSDB investment upgrades access to contractor-supplied data, e.g., technical data needed for

spare part production requiring transmission and translation through a series of older-generation systems and networks. Can we now determine the contractor's handling charge versus the incremental charge for using the intellectual property, i.e., something akin to a royalty?

It could be argued that data are the object, i.e., what is acted on, of IWSDB capabilities and that their costs should not be part of an investment decision. This is analogous to not including the purchased cost of material moved in a material-handling process investment decision. On the other hand, including data acquisition costs in the IWSDB business case could indicate that the baseline remains the least cost alternative, particularly if the current data charge is skewed heavily towards the incremental charge for using the intellectual property rather than the handling charge. Omitting data acquisition costs is the recommended approach because determining incremental intellectual use costs may be impractical.

4.4 Action Plan Issues

Action Plans array (in month, quarter, or year “time buckets”) initial estimates of required resources over the lead-time needed to change the current way of doing business. The IWSDB business case must consider any prior decisions made regarding the selection of particular systems for continued use during the weapon system’s life. This may include prior decisions to invest in major modifications to modernize a legacy system. This could also include programs to implement cultural changes within organizations performing the weapon system’s business processes. In effect, the IWSDB business case should include a recap and analysis of prior management decisions or current strategic planning that must be considered in any of this weapon system’s IWSDB operational improvement alternatives.

4.5 Risk

The business case must describe the schedule risk and impacts for the implementation of each alternative. The analysis will show a range of estimated costs for the alternative, based on schedule variance from best to worst case. Because the business case does not present affordability, the risk of funding short-falls can be ignored. A Monte Carlo simulation approach provides the most effective conceptual and operational model for risk involving activities with constraints like the precedence and resource limitation encountered in a PERT framework.⁵

The most useful basic definition of risk is "an undesirable implication of uncertainty." Sometimes risk is a convenient short form for "source of risk" or "the probability of realizing a source of risk."⁶

Planned schedules are based on the experience of planners, on historical performance, and on intuition. Managers having experience with similar activities will make better estimates than inexperienced managers. However, accurately estimating program schedules is difficult for another reason. Experience shows that during the process of estimating schedules, estimators are always asked how the schedule can be accelerated.

The question "What does it take to make this program take longer?" is never asked. Pressure is exerted on the estimators to provide more optimistic estimates, without an equalizing force to balance the estimator's work. We know that rules-of-thumb are applied as well as generalizations, such as "I take every programmer's estimate and add 50%" or "If I schedule slack time, the work will expand to fill the time."

As part of the process of improving the management of weapons system programs, management must do a better of job of estimating schedules and understanding risks. Management will need to value accurate estimates more than pleasing estimates. Managers will encourage accelerated schedules through improvements in work methods, reduction of redundancy, and elimination of

⁵Cooper, Dale and Chapman Chris. "Risk Analysis for Large Projects." Norwich Great Britain: John Wiley and Sons Ltd., 1987.

⁶Cooper, Dale and Chapman Chris. "Risk Analysis for Large Projects." Norwich Great Britain: John Wiley and Sons Ltd., 1987.

non-value added activities. Estimates will be based on the successful implementation of improvements, using input from lower level managers and honest analysis of risk.

The resulting *best* schedule is usually the one that accomplishes the objective in the least time with the fewest resources. The business case needs to present the schedule that meets the mission requirements with the lowest *life-cycle cost*.

The business case is about managing the change from the AS-IS way of doing things to the TO-BE improved way of doing things. Lack of historical performance of the TO-BE processes increases the expected error in estimating.

5.0 BUILDING THE BUSINESS CASE

This section describes the contents of the business case and addresses the contents of each of the six major sections: Defining the Current (AS-IS) Environment, Defining the Future (TO-BE) Environment, Weapon System Information Performance Metrics, IWSDB Initiatives and Alternatives, Analysis of Alternatives, and Comparative Analysis.

5.1 Defining the Current Environment

This section documents the existing environment including those planned changes that have already been approved.

5.1.1 Government Concept of Operations

The Government Concept of Operations (GCO) in this section documents the general flow of Weapon System Activities as currently practiced. It describes existing technological capabilities, data delivery media and method, data storage media and method, data maintenance requirements and controls, data dissemination media and method, and the relationships to the various functional areas of the program.

5.1.2 Weapon System Information Baseline

This section is developed within the context of a generic Weapon System Program Management Activity Node Tree. The source of this initial generic model was developed and partially validated during the development of the "B2 CITIS Business Case."⁷

One leg of the "B2 CITIS Business Case" Activity Node Tree correlates with the activities supported by an IWSDB. The "Satisfy Weapon System Capability Requirements" activity, chosen as the top-level, or A0 node, provides the *context* for an IWSDB business case. Although all of these areas are likely to benefit from the IWSDB, the business case will address only those activities directly related to the acquisition, storage, maintenance, and dissemination of technical data (shaded areas in Figure 5.1.2-1), as the *object* of the IWSDB business is the set of activities within weapon system technical data operations. These activities are located under A1 and A4 and are specifically addressed by nodes A.1.5.5.3, "Manage Contractor Supplied Technical Data," and A.4.2, "Reprocure, Stock and Disseminate Spares." Further decomposition of these activities as indicated in Figures 5.1.2-2 through 5.1.2-4 provides boundaries for the information baseline. Complete definitions of the identified activities (including activities supported by weapon system technical data operations) are included in Appendix B.

The Node Tree presented in Figures 5.1.2-1 through 5.1.2-4 provides an abstraction of activities common to all weapon systems. This Node Tree can be further decomposed, or detailed, for each weapon system, and also can serve as a starting point for developing weapon system specific TO-BE models.

⁷Northrop B-2 Division. "Contractor Integrated Technical Information Service (CITIS) Business Case" *Feasibility Study*. California: Northrop, August 1992.

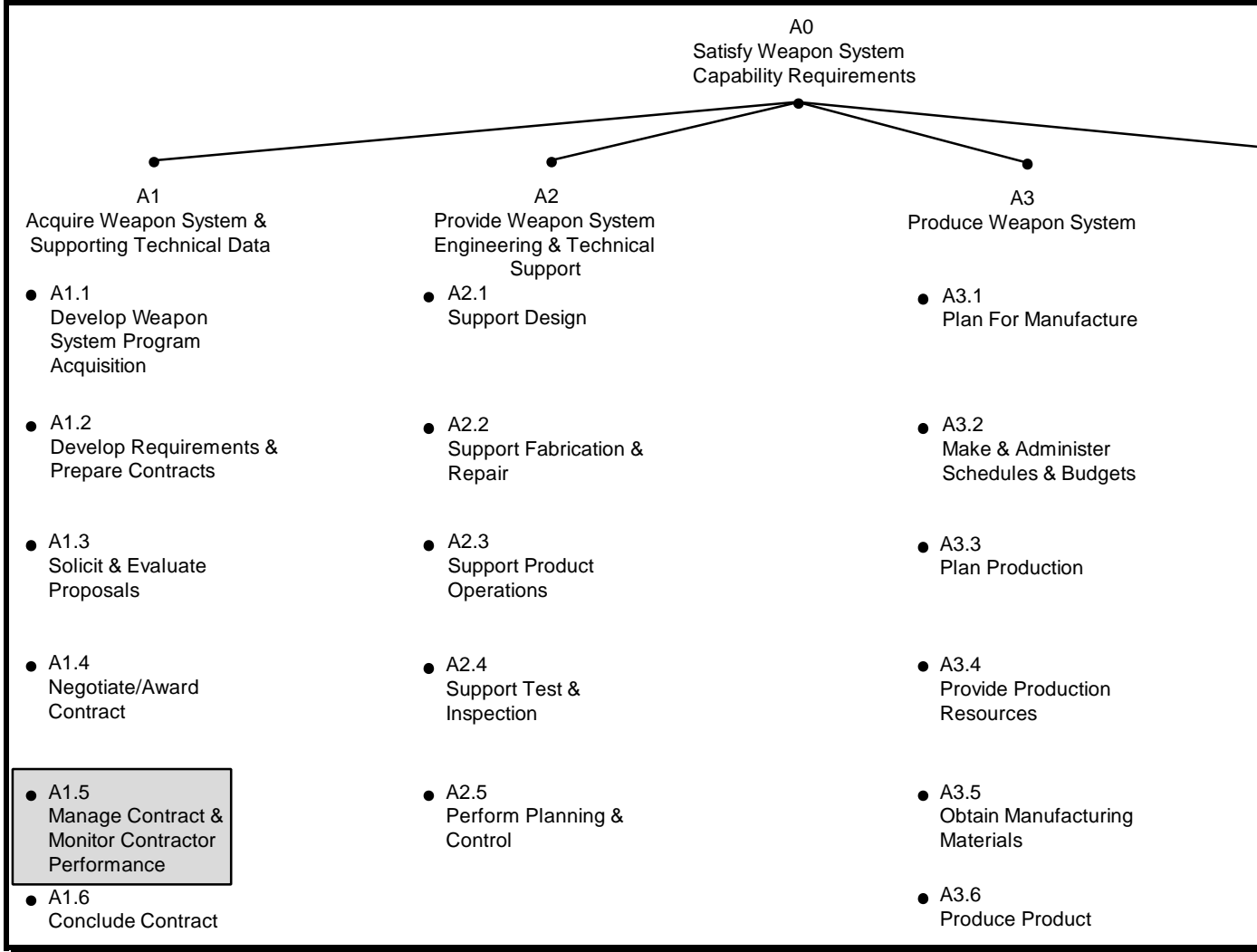


Figure 5.1.2-1 Node A0 Satisfy Weapon System Capability Requirements Node T

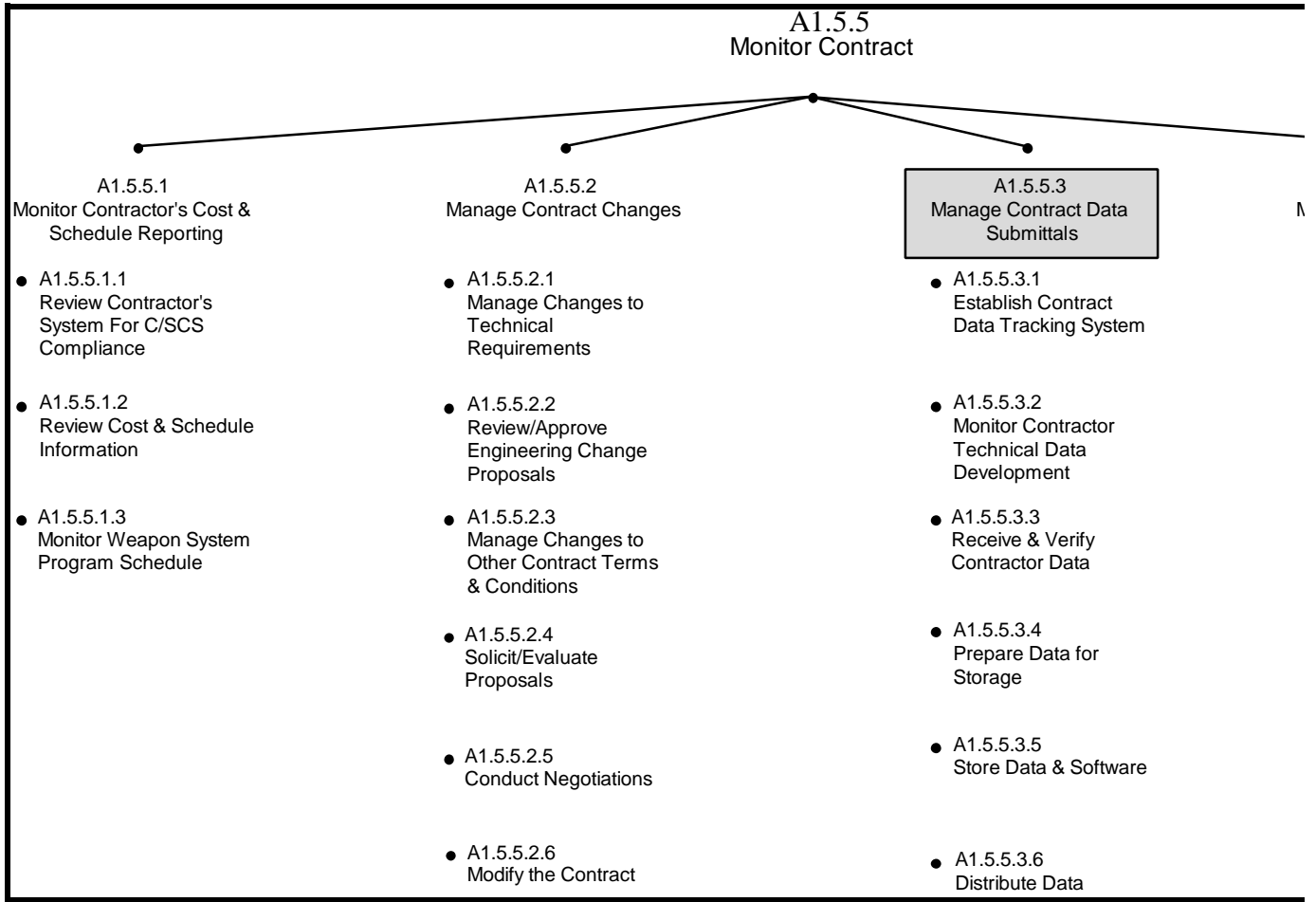


Figure 5.1.2-2 Node A1.5.5 Monitor Contract

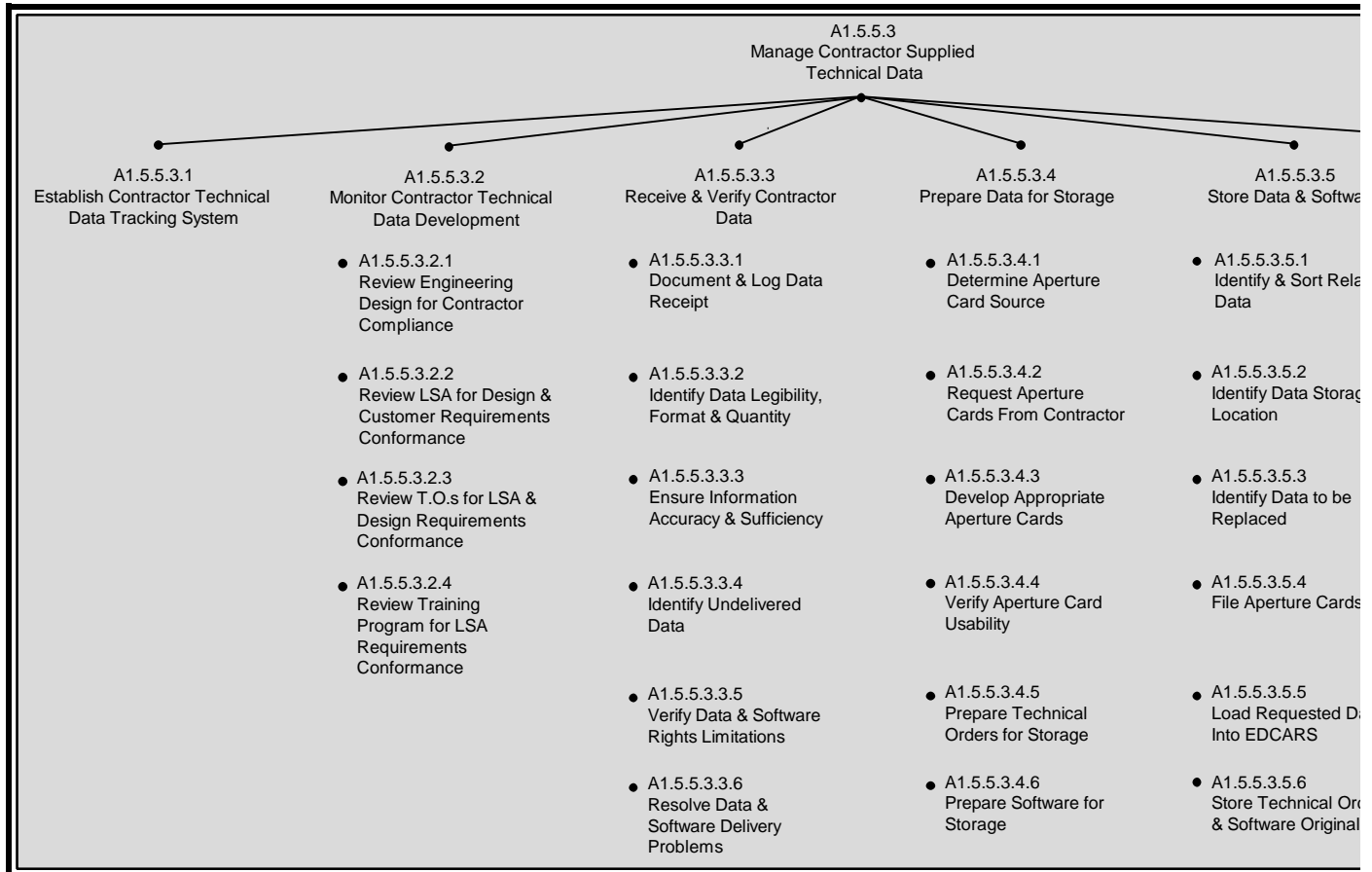


Figure 5.1.2-3 Node A1.5.5.3 Manage Contractor Supplied Technical Data

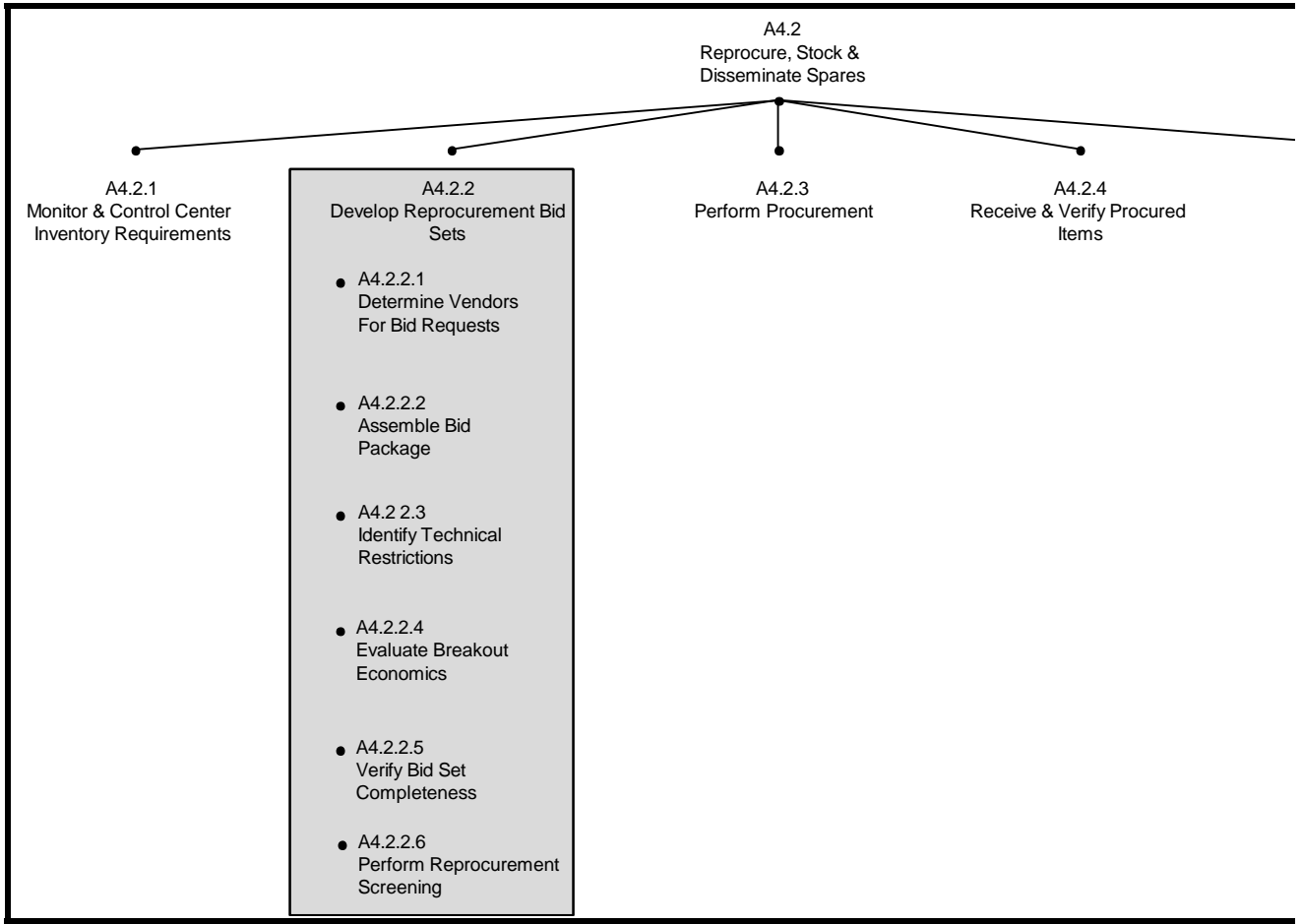


Figure 5.1.2-4 Node A4.2 Reprocure, Stock and Disseminate Spares Node Tree

To further define the baseline environment, project managers must establish activity levels and resources for the planning horizon. This process describes the resources needed, using current processes and reflecting pending changes, to satisfy current and future workloads. It recognizes the AS-IS manner of doing business, considers previously approved investments and projects, and arrays the volume of work over time. The extension of workload times the effort expended (the current process) is also called the activity level. The activity level is measured in dollars. A planning horizon represents, at a minimum, the amount of time (critical path) determined necessary to react to a major change in mission, put into place capacity to meet an order-of-magnitude change in workload, or reconstitute resources. Typically, the planning horizon should, at least, span the Fiscal Year Defense Plan period of six years (see Figure 5.1.2-5).

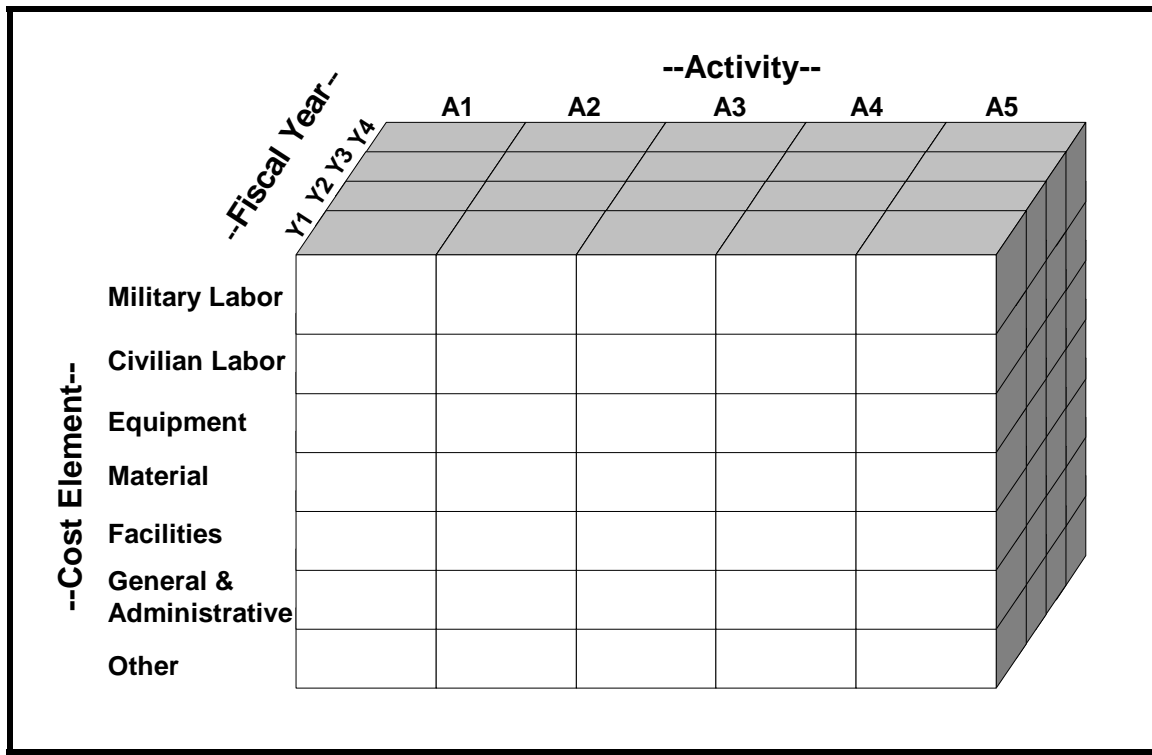


Figure 5.1.2-5 Activity Cost Matrix

An inventory of hardware and software capabilities located in specific facilities and managed by an organization is called a geo-technical baseline. If a geo-technical baseline exists, it must be documented here.

5.2 Defining the Future Environment

This section presents alternative potential views of the future environment in a consistent format to facilitate comparative analysis.

5.2.1 Government Concept of Operations

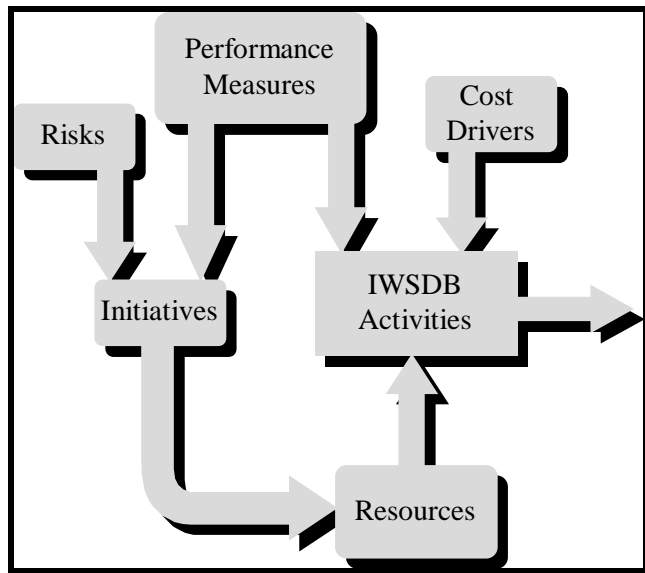
The GCO in this section documents the general flow of Weapon System Activities in the envisioned (TO-BE) environment. It describes required technological capabilities, data delivery media and method, data storage media and method, data maintenance requirements and controls, data dissemination media and method, and the relationships to the various functional areas of the program.

5.2.2 IWSDB Initiatives and Alternatives

This section presents individual "initiatives" as well as collections of these initiatives bundled into "alternatives."

5.2.2.1 Improvement Initiatives

This section introduces specific initiatives meant to put improvement opportunities into place. Initiatives can be as large in scope as a major project such as Joint Continuous Acquisition and Life-Cycle Support (JCALS), or as limited as requesting a change in a departmental policy. Regardless of size, initiatives have similar characteristics. That is, they measurably change activities, workloads and/or activity levels required to provide the Weapon System Capability. Any one initiative may deliver one or more improvement opportunities, and any improvement opportunity may be delivered through one or more initiatives (see Figure 5.2.2.1-1).



**Figure 5.2.2.1-1
Performance Based Alternatives**

5.2.2.2 Improvement Alternatives

Because of the number of initiatives and their possible combinations, a consolidation device is used to group initiatives contributing to a clearly different manner of doing business, consistent with TO-BE GCO and IWSDB capabilities and functional requirements. This device is called an alternative. Alternatives are presented as executive-level decision packages, and each business case will have two or more alternatives in comparison to the baseline. Like the baseline, each alternative (which may be phased over time) depicts activity levels with improved processes through the planning horizon. For alternatives that do not achieve the envisioned state within the planning horizon, an appropriately modified GCO must be provided.

5.3 Weapon System Information Measures of Performance

This section identifies and defines the metrics used to gauge the performance of functional activities and processes. These measures are the unifying factors between activities, improvement opportunities, strategies, and the initiatives developed to meet the requirements posed by the improvement opportunities. The business case should describe how these measurements will be gathered and used, including the possibility of gathering metrics through proposed automation.

Examples of Measures of Performance

(Representative of typical customer performance requirements)

Measure of Performance

- **Transaction Response Time**
- **Transaction Fidelity**
- **Transaction Accuracy**
- **Transaction Availability**

Customer's Perspective

- "How fast did I receive what I wanted?"
- "Did they receive the message I sent them?"
- "Did they send me what I asked for?"
- "Was it there when I wanted it?"

This section should also be used to identify and establish performance goals and objectives for the automation process, e.g., 50% reduction of number of copies of the engineering technical data distributed and under revision control.

5.4 Alternative Analysis

For each alternative described in paragraph 5.2.2.2, the following sections will be used to document relevant characteristics for comparative analysis.

5.4.1 Activity Analysis

This section identifies those nodes in the Weapon System Program Management Activity Node Tree that must be redefined to reflect the future environment. Nominally, the affected nodes will be A.1.5.5.3, "Manage Contractor Supplied Technical Data" (Figure 5.1.2-3) and A.4.2, "Reprocure, Stock, and Disseminate Spares" (Figure 5.1.2-4).

As in the AS-IS environment, TO-BE activity levels and resources must be established through the planning horizon, using future processes to satisfy workload requirements. This analysis recognizes the TO-BE manner of doing business for the alternative being described, considers investments and projects requirements, and arrays the volume of work over time to establish the activity level.

Again, the activity level is measured in dollars. The planning horizon must be the same as the one used in the AS-IS state. If the planning horizon must be extended to accurately depict the economics of the future state, then the planning horizon for the current state must be extended as well.

If a geo-technical baseline was provided in Section 5.1.2, then a proposed geo-technical description should be provided for the TO-BE state.

5.4.2 Performance Analysis

This section contains an assessment of the anticipated performance level achieved through the implementation of each alternative and the baseline. Performance metrics documented in Section 5.3 are used to ensure consistency (see Figure 5.4.2-1).

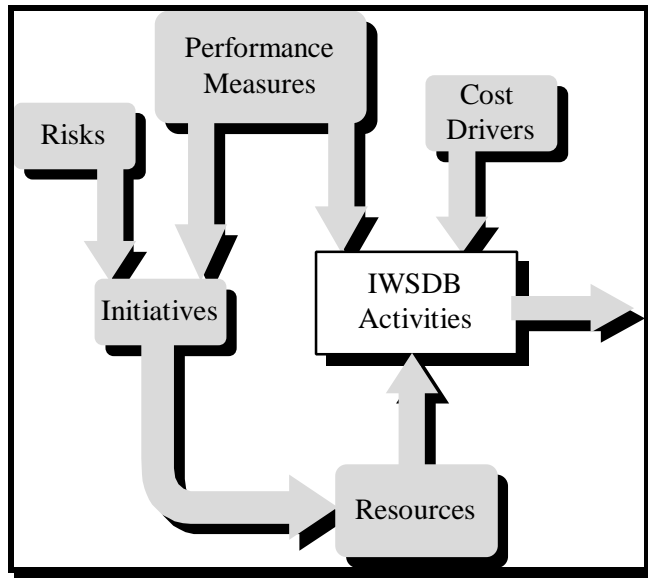


Figure 5.4.1-1 Activity Analysis

5.4.3 Cost Analysis

This section summarizes the results of Activity Based Costing for the baseline and each alternative. Cost analysis begins after establishing IWSDB activities, gathering cost information, and tracing costs to activities. Regardless of the techniques used, this analysis has these major thrusts:

- Determine the amount of activity costs impacted by cost drivers for ranking improvement potential.
- Determine the presence of non-value added activities (activities that could be eliminated or reduced without causing a deterioration of products or outcomes).

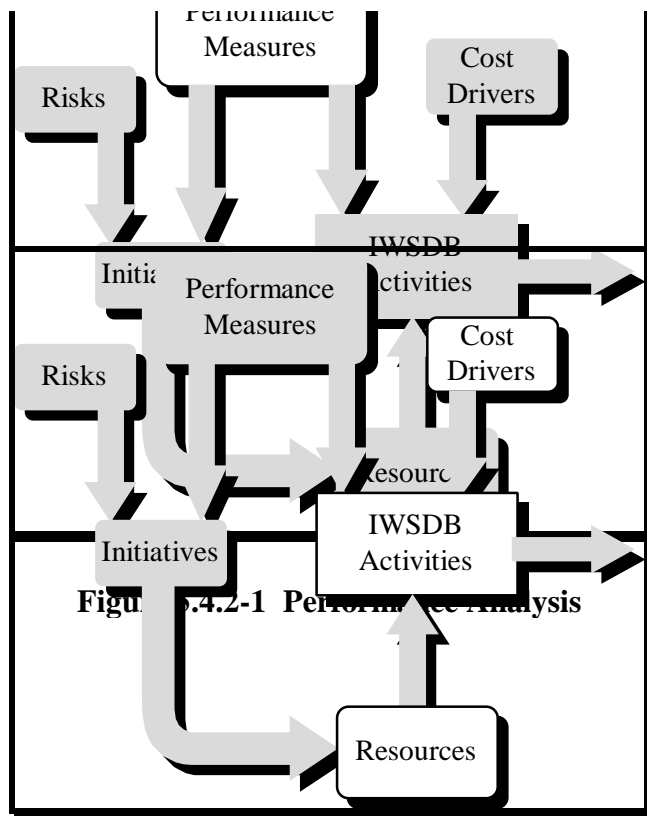


Figure 5.4.3-1 Cost Analysis

- Determine the cost of each activity's primary output (activity measure) and other cost-based performance measures.
- Determine the prorated contribution of activity costs to certain information products (products that may require a number of different outputs or that may have pass-through costs, or those direct costs not part of the cost of doing the activity). The conventional term for this determination is a *Bill of Activities*.

Cost analysis within the IWSDB business case should be considered as a management accounting function, where the degree of cost precision is not as critical as that needed for financial accounting. However, participants must use consistent techniques for meaningful year-to-year cost comparisons.

Determination and Use of High Cost Drivers

As discussed in Section 4.2, the identification of cost drivers is vitally important to successful process improvement. One of the major purposes for the IWSDB business case is to identify and implement process improvements in the weapon system technical data operation. The identification and mitigation of high cost drivers is one of many improvement methods that are contained in the IWSDB business case.

Many tools and techniques can be used to determine high cost drivers for the IWSDB business case. One possible method to determine high cost drivers is as follows:

First, identify the cost drivers that affect the activities in the AS-IS environment. Then, determine which activities are driven by each cost driver. Next, determine the total of activity costs for each cost driver by adding the costs of activities driven by a specific cost driver. (Note: Each cost driver may impact one or more activities and vice-versa.) After the total activity costs are determined for each cost driver, each driver is then stack ranked by the total of activity costs, i.e., high to low. The grand total of all of the activity costs for all of the drivers is then calculated and accumulated by rank. Next, determine which cost drivers (by rank) equate to the first 80% of the grand total of activity costs for all cost drivers. These drivers are the high cost drivers for the reviewed activities. According to Pareto's law, 20% of the total number of cost drivers will usually make up 80% of the grand total of activity costs.

Now that high cost drivers are identified in the AS-IS environment, plans to mitigate the effect of the cost drivers in the TO-BE environment should be developed. This is done by examining the activities affected by the high cost drivers to identify improvements that can be made to the activities for the TO-BE model. Then determine the performance indicator for an activity that best relates to its cost driver(s). These indicators need to be measurable in the TO-BE environment. Therefore, performance metrics need to be determined for the activities. The metrics should then be incorporated into the TO-BE model to evaluate the performance in the future environment.

5.4.4 Action Plan

As stated previously, an action plan arrays (in month, quarter, or year “time buckets”) initial estimates of required resources over the lead-time needed to change the current way of doing business. An action plan is focused on change, and it bridges the operational strategic plans and negotiated implementation plans. This section contains an action plan for the implementation of each alternative. Action plans describe the major actions required to implement the alternative, and include macro-level resources and schedules. Action plans may have a unilateral viewpoint, and typically do not include implementation strategies; impact statements; and negotiated schedule, delivery, and performance commitments.

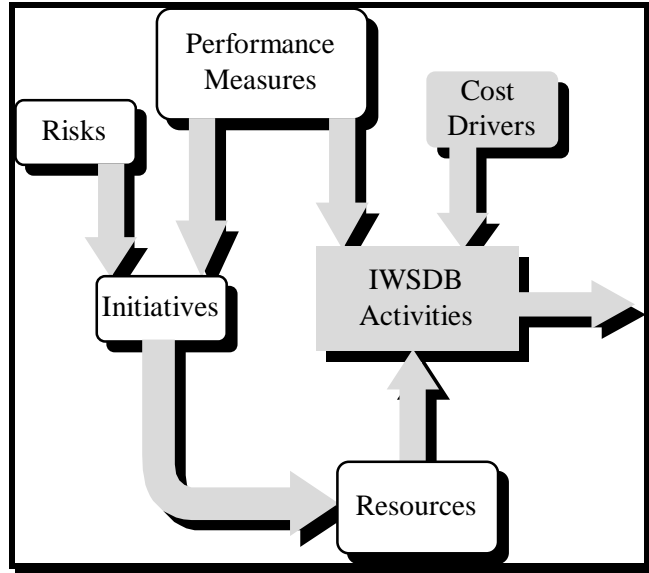


Figure 5.4.4-1 Action Plan

5.4.5 Risk Analysis

This section presents a determination of risks inherent in each alternative. This risk is usually related to the performance or delivery of an initiative or its deliverables (see Figure 5.4.5-1), rather than risks recognized during the transition from development to production. Because an initiative may be packaged in more than one alternative, the determination of risk, tied to initiatives, may be done once and passed on to each alternative employing the initiative. In the absence of demonstrated performance statistics similar to actuarial tables, calculating risk is subjective. Risk categories and a scale of values for each category are best presented to business case preparers as a template.

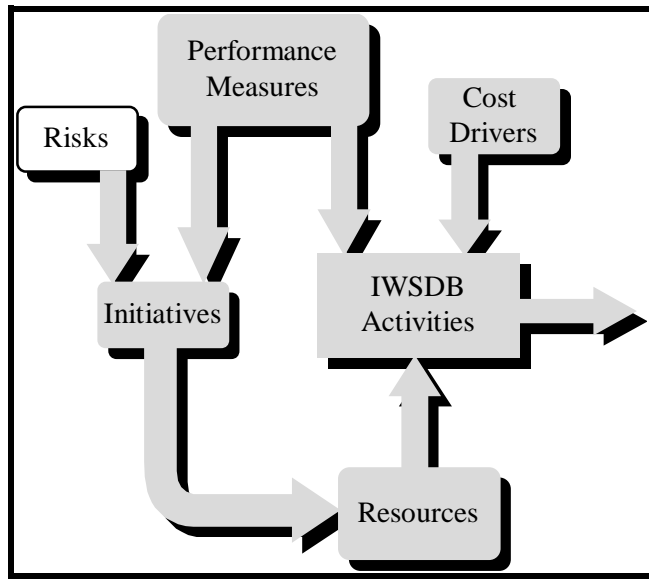


Figure 5.4.5-1 Risk Analysis

5.5 Comparative Analysis

This section is used to present a comparative summary of the salient characteristics for each alternative and the baseline as document in preceding sections. Comparison of each alternative with the baseline provides a common basis for comparison of the alternative, even though the end state of the alternative may differ. In addition, this section will document the extent to which the alternative meets performance goals established in Section 3.3. Business case preparers must develop all alternatives with the expectation that they produce results (relating to the transitions among design, test, production, support, and management processes) that fall within acceptable boundaries and are implicit acceptable risks. Any impact caused by an alternative on such risks should be presented in the comparative analysis.

The intent is to provide the decision maker with a clear, concise comparison of the alternatives that will support an informed decision. Recommending one alternative over the other alternatives is unnecessary and counter productive. Avoiding the use of factors, multipliers, or algorithms used to arrive at one quantitative value for each alternative. Instead, the IWSDB business case should present, per alternative, how each alternative satisfies important performance measures. One presentation method would place each alternative's expected result (per performance measure) in red, yellow, or green regions. The approach of not determining "the" recommendation gives the choice to the decision-maker.

6.0 TRANSITIONING TO IMPLEMENTATION

This section presents major considerations in achieving the TO-BE environment put forth in the IWSDB business case analysis. This section is not part of the business case but is to be used as information that must be considered when developing action plans to migrate to the TO-BE environment. From this section, the reader will learn the characteristics and barriers of successful implementation for advanced technologies.

6.1 IWSDB Implementation Strategies

There are several key strategies for implementation of an IWSDB. The most important is the commitment of management to the CALS critical success factors, including:

- Effective Outreach to DoD Contractors and Suppliers.
- DoD Adoption of Commercial Standards and Practices.
- Streamlining and Integration of DoD and Industry Data Requirements and Architectures.
- Modernization of DoD Information Infrastructure.
- Revised Policy and Laws to Support Real Process Improvements.

Data management tools that provide the required capabilities must be adopted and utilized. The technical approach should utilize Open Systems Architecture and Client-Server applications, along with secure communications networks and CALS standards. Program managers can choose a phased "migration" implementation to achieve full CALS operability by the year 2010.

Effective Management Commitment

The Secretary of Defense embraces the CALS Strategic Plan, and the commitment to re-engineer DoD business practices is strongly supported throughout the organization. This commitment enables the cultural changes required to put new policies and procedures into action, and empowers program managers to change procurement practices to support real process improvements.

Data Management Tool Set

The IWSDB is supported by a Data Management Tool (DMT) set including Database Management, Security, Directory Management, Data Dictionary Management, Version Control, Project Control, Data Modeling, and Maintenance. DMTs are intended to support concurrent engineering by allowing multi-functional, geographically distributed teams to share common data. Database distribution and global configuration management control also support business process re-engineering, automated technical manuals, logistics, and the rest of weapon system life-cycle activities.

Open Systems Architecture

The Open Systems Architecture (OSA) is utilized to overcome the differences in computer hardware, operating systems, application products, vendors, and data formats, among the local, regional, and global control entities. Different types of computer systems can be integrated and can communicate through the use of common standards and protocols, such as the Government

Open System Interconnection Profile (GOSIP) and Portable Operating Systems Interface (POSIX). This allows existing systems to be connected and accessible to the various users.

Client-Server

A client-server architecture is utilized to integrate heterogeneous platforms. Using Structured Query Language (SQL) to form queries or commands, the client can access any server that presents a SQL interface. Therefore, the application can be implemented in any language or environment.

Communications

The communications network infrastructure will interconnect systems and sites, using Local Area Networks (LANs) for intra-site communications and Wide Area Networks (WANs) to connect local sites and regional repositories.

The database management systems, operating systems, and add-on products used must be capable of providing a B1 level of trust. Communications must provide end-to-end security using a method of encryption to prevent intrusions such as altering, inserting, or re-transmitting messages. User authentication by secure identification, using unique user-id and password, will be used to determine the validity of user access to data.

CALS Standards

Data objects stored in repositories will conform to the CALS-Standard defined in the MIL-STD-28000 series, including Initial Graphics Exchange Specification (IGES), Standard Generalized Markup Language (SGML), Consultative Committee of International Telephone and Telegraph (CCITT) Group 4 Raster, and Computer Graphics Metafile (CGM). To eliminate the distortion from conversion tools, all end users will use CALS-compliant product-generation tools so that very limited or no conversion facilities are required. This is the full-restriction approach targeted as a goal for the year 2010 (see Figure 6.1-1).

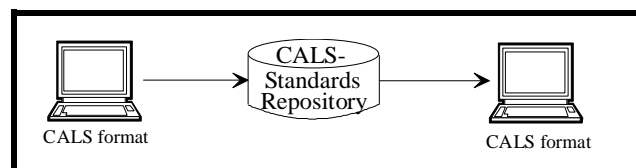


Figure 6.1-1 Full Restriction

Migration to the CALS-Standard Repository

Before the target vision will be accomplished, a phased approach will be taken based on user acceptance, AS-IS environment, and functionality. The stages in the phased approach are categorized by the restriction level imposed on product (data) generation tools.

Non-CALS-Standard Repository

Users can place data objects into repositories regardless of the original formats. This provides users with the flexibility of using any product-generation tools. The success of this approach relies on the quality of facilities required to convert the data into the format needed by the end user (see Figure 6.1-2).

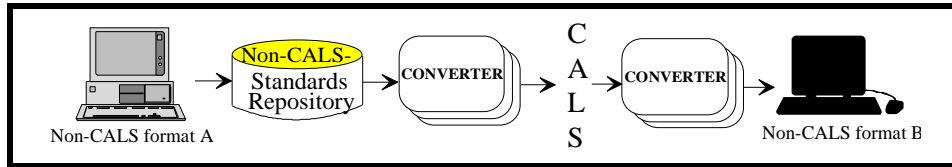


Figure 6.1-2 Non-CALS-Standard

No Restriction

In this case, users can create data using any product generation tool(s) without restriction. The data is then converted into the desired CALS-Standard format before being stored in the repository. Another conversion could be required if the end user cannot use the data in CALS-Standard format (see Figure 6.1-3).

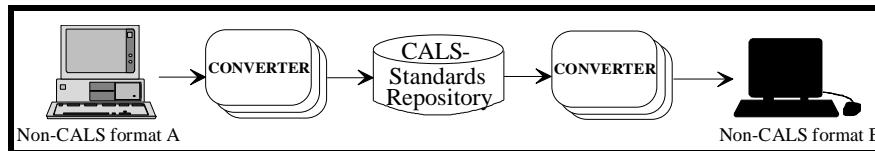


Figure 6.1-3 No Restriction

Limited Restriction

In this case, users select CALS compliant product generation tools and a limited number of non-CALS compliant tools that are recommended, based on certain established criteria. This will provide users with a certain degree of freedom while reducing the number of conversions required (see Figure 6.1-4).

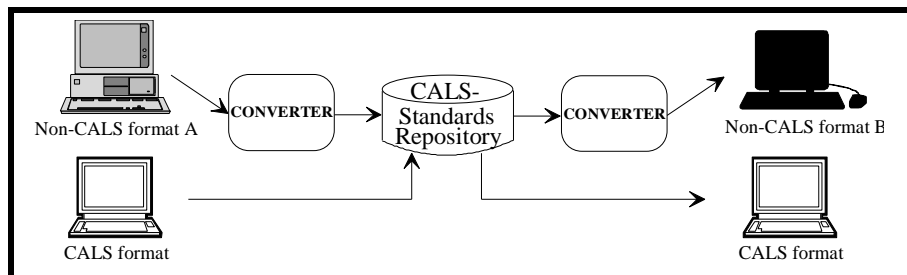


Figure 6.1-4 Limited Restriction

NOTE: In general, conversion tools are inefficient. Conversion tools are expensive, introduce errors or distortions in data, and increase the complexity of the environment. The more that conversion tools can be eliminated and the shorter the period of time they are required, the greater the benefits and performance improvements.

6.2 Barriers to Successful Implementation

“Barriers to successful implementation” refers to those situations in the development environment that tend to be outside the span of control of the developers and that have prevented the desired outcomes of previous attempts to adopt new technologies. It is believed that similar technology implementation efforts must find ways to overcome or bypass these barriers in order to achieve closure. By cross-referencing the barriers identified in the lessons learned with a matrix of implementation strategies, the IWSDB business case will present an excellent starter set of strategies and supporting references for consideration by the PM planning an IWSDB implementation. Table 6.2-1 correlates the list of implementation strategies with the following specific barriers to successful implementation:

1. Traditional procurement practices.
2. High investment costs.
3. Resistance to change.
4. Lack of common approach.
5. Knowledge burden.

Table 6.2-1 Strategies Vs Barriers

<i>BARRIERS</i>	1	2	3	4	5
<i>STRATEGIES</i>					
Effective Management Commitment	x	x	x	x	x
Data Management Tool Set		x		x	x
Open Systems Architecture		x		x	
Client-Server		x	x		
Communications			x		x
Security				x	
CALS Standards	x			x	
Full migration to CALS compliance in a phased approach		x	x		

6.3 Characteristics of Successful Implementations

“Characteristics of successful implementations” refers to those actions and decisions (or direct results of those actions and decisions) that tend to fall within the span of control of the implementers and that positively influenced the outcome of previous attempts to adopt new technologies. It is believed that similar technology implementation efforts can achieve enhanced results by emulating the characteristics of previous successful attempts. By cross-referencing the characteristics identified in the lessons learned with a matrix of implementation strategies, the IWSDB business case will present an excellent starter set of strategies and supporting references

for consideration by the PM planning an IWSDDB implementation. Table 6.3-1 correlates the list of implementation strategies with the following specific characteristics:

1. Lower life-cycle costs.
2. Improved procurement practices.
3. Use of standards.
4. Cross-functional involvement.
5. Training.
6. Addressing cultural issues.
7. Concurrent engineering practices.
8. Definition of scope.
9. Formation of virtual companies.
10. Three schema architecture.
11. Use of metrics.
12. Use of activity-based costing.

Table 6.3-1 Strategies Vs Characteristics

<i>CHARACTERISTICS</i>	1	2	3	4	5	6	7	8	9	10	11	12
<i>STRATEGIES</i>												
Effective Management Commitment	x	x	x	x	x	x	x	x	x	x	x	x
Data Management Tool Set			x				x	x		x		
Open Systems Architecture	x		x						x	x		
Client-Server	x		x	x						x		
Communications			x	x			x					
Security			x									
CALS Standards	x	x	x				x					
Full migration to CALS compliance in a phased approach	x	x	x			x		x	x		x	x

Initiatives need to concentrate on *characteristics* and *barriers*. Studies show that an economic justification for investment in automation based on AS-IS and TO-BE activity analysis does not, by itself, result in successful implementation.⁸ This is because barriers to success are not actively removed by the initiatives. The business case cannot assume that achievement of the desired characteristics, along with the adoption of CALS standards, will be possible without action to remove these barriers.

The downsizing of DoD will result in fewer producers of military weapons. DoD procurement will be a smaller percentage of each producer's income. Therefore, DoD will not be able to use

⁸ManTech International Corporation. "CALS EC/EDI Report For The OSD CALS IWSDDB PROJECT" (Fairmont, WV: ManTech International Corporation, 1994).

competitive pressure on contractors to reduce cost. Other cost-reduction methods need to be emphasized in the procurement process. One cost-reduction method is reduced *time to market*, using concurrent engineering practices. Thus, the weapon system life-cycle model of development will have to be streamlined or replaced with a new management approach.

DoD can achieve process improvement only with the commitment of management, especially mid-level management. Studies show that top management support is necessary, but not sufficient to implement change. Strong participation by middle managers is a requirement for success.⁹ This view is supported by the fact that companies that successfully re-engineer their processes are often battling for survival, creating an environment where radical changes are accepted.¹⁰ DoD management needs to recognize its own critical need for change.

Introduction of new technology is not enough. Existing policies, procedures, and processes were developed to fill a perceived need. If the users of new technology have the same needs, they will find ways to adopt the new technology to the old process and procedures. DoD must re-engineer its process and change policies and procedures that do not support the TO-BE environment. Fundamental policy changes are required in order to promote change. Although incentives to re-engineer exist, they are driven by cost reduction, which does not generate enthusiasm or commitment.

The complexity of the weapons system life-cycle is increasing. This increased complexity comes from the *knowledge burden* of increasingly complex weapons and the logistics systems to support them.¹¹ The business case must present a concept of operations that clearly describes how the IWSDB will support the knowledge of the weapons system. This knowledge will exist across the enterprise and throughout the contractor and supplier base. By incorporating the knowledge of the weapon system into a shared database, we can achieve economies of knowledge, replacing economies of scale once achieved by high volumes.

The business case must focus on a reduction of management activity in the TO-BE environment. Effective implementation of information technology will reduce the number of weapon systems management processes, not just low level activities. Organizations without a strong motivation to change will use automation to reduce low level activity such as clerical work, but over-achievers will obtain better value from technology through increased management productivity.¹²

⁹United States of America. General Accounting Office. "Defense Management: Stronger Support Needed for Corporate Information Management Initiative To Succeed." GAO/AIMD/NSIAD-94-101. (Washington DC: General Accounting Office, April 1994).

¹⁰Michael Hammer and James Champy. "Re-engineering the Corporation," (New York, NY: Harper Collins Publishers 1993).

¹¹Chris C. Demchak. "Complexity, Rogue Outcomes, and Weapon Systems." Public Administration Review. Volume 52, Issue 4 (July/August 1992): pages 347-355.

¹²Paul A. Strassmann. "The Business Value of Computers." (New Canaan, Connecticut: The Information Economics Press, 1990).

APPENDIX A GLOSSARY

ABC (Activity Based Costing) - An accounting technique for assigning cost to outputs of an activity that includes the cost of performing the activity, and the cost of providing the controls and resources for performing the activity.

Action Plan - High level management plan describing the major actions required to implement an alternative.

Activity - A named process, function, or task that occurs over time and has recognizable results. Activities use up assigned resources to provide products and services.

Activity Model - Graphic representation of the processes that make up the functional activity showing inputs, outputs, controls, and mechanisms through which the processes of the functional activity are (or will be) conducted.

AFMC - Air Force Materiel Command.

ALC - Air Logistic Center.

Alternatives - Different combinations of initiatives that, when completed, achieve the desired TO-BE state.

ANSI - American National Standards Institute.

Architecture - An organized framework consisting of principles, rules, conventions, and standards that serve to guide development and construction activities such that all components of the intended structure will work together to satisfy the ultimate objective of the structure.

AS-IS Model - An activity model that portrays how a business process is currently structured. It is used to establish a baseline for subsequent business process improvement actions or programs.

ATOS - Automated Technical Order System.

Baseline - An approved plan describing the resources needed, using current processes and reflecting pending changes, to satisfy current and future workloads.

Business Case - An organized set of economic metrics that provides program management with a means of identifying the cost of managing weapons system technical data in order to budget for the most cost effective solution.

CALS (Continuous Acquisition and Life-cycle Support) - An integrated data environment created by applying the best technologies, processes, and standards for the development, management, exchange, and use of business and technical information among Government and industrial enterprises.

CCITT - Consultative Committee of International Telephone and Telegraph.

CDRL - Contract Data Requirements List.

CGM - Computer Graphics Metafile.

CIM (Corporate Information Management) - The major strategic initiative of the Secretary of Defense to offset reductions in DoD resources by improving the efficiency of DoD business practices.

CITIS (Contractor Integrated Technical Information Service) - A computer-based information service that draws upon integrated information from a contractor's enterprise, contracting team, and suppliers to implement Electronic Data Delivery (EDD) using a "Delivery in Place" methodology.

Cost Drivers - Factors in a business process that cause excess, delay, or variance in the product of a business activity.

CSF (Critical Success Factors) - Those characteristics of previous, similar projects that contributed to successful achievement of project goals and those barriers to successful achievement of project goals that needed to be overcome.

Data Base - A collection of interrelated data, often with controlled redundancy, organized according to a schema to serve one or more applications; the data are stored so that they can be used by different programs without concern for the data structure or organization.

DBOF - Defense Business Operations Fund.

DID - Data Item Description.

DMO - Data Management Officer.

DMT (Data Management Tools) - A set of tools that provide IWSDB capabilities for database management, security, directory management, data dictionary management, version control, project control, data modeling, and maintenance.

DoD - Department of Defense.

DoD Enterprise Model - A representation of the activities and data of the entire Department needed to accomplish the defense mission, from war fighting to acquisition and logistics support.

EC/EDI (Electronic Commerce/Electronic Data Interchange) - The integration of Electronic Data Interchange, electronic mail, bulletin board, electronic funds transfer, and internal automated processing into a comprehensive system supporting all business functions (e.g., procurement, administration, payment, supply management, transportation, etc.). Electronic Data Interchange, one of the components of Electronic Commerce, refers to the exchange of routine business information that is processed in computer formats, using accepted standards.

EDCARS - Engineering Data Computer Assisted Retrieval System.

EDD - Electronic Data Delivery.

ETM - Electronic Technical Manual.

FEA (Functional Economic Analysis) - The methodology used in Functional Process Improvement to evaluate and rank alternative ways to achieve functional objectives.

Function - A functional area under the direction of an OSD Principal Staff Assistant or the area's subordinate activities, each under the direction of a functional manager.

FYDP (Fiscal Year Defense Plan) - Current year budget plus five additional years.

G&A - General and Administrative.

GCO (Government Concept of Operations) - A description of technical capabilities, data management methods for delivery, storage, and dissemination, and the relationships to various functional areas of the program.

Geo-technical Baseline - An inventory of hardware and software capabilities located in specific facilities and managed by an organization.

GFE - Government Furnished Equipment.

GFI - Government Furnished Information.

GOSIP - Government Open System Interconnection Profile.

IDS (Integrated Data Strategy) - An Air Force Materiel Command (AFMC) CALS initiative to capture and manage digital technical information across the life of a weapon system. The program is defining, validating, and refining user requirements for technical data and system requirements for an integrated, information management capability with the Air Force Air Logistic Center (ALC) environments.

IETM - Interactive Electronic Technical Manual.

IGES - Initial Graphics Exchange Specification.

IM - Item Manager.

Initiatives - Strategies for improving the performance of a program or function through changes in, or elimination of, the activities performed within the program.

IPB - Indentured Part Breakouts.

IWSDB (Integrated Weapon System Database) - The concept of shared weapons system technical data delivered, maintained, and distributed in electronic form throughout the life cycle of the weapons system.

JCALs - Joint Continuous Acquisition and Life-Cycle Support.

JCS - Joint Chiefs of Staff.

LAN - Local Area Network.

LSA - Logistic Support Analysis.

LSAR - Logistics Support Analysis Records.

MAISRC - Major Automated Information System Review Council.

MIC - Material Inventory Control.

Model - An abstraction or representation of a complex, real-world phenomenon that allows us to answer questions about the phenomenon.

NMCS - Not Mission Capable due to Supply.

Node Tree - Representation of an activity hierarchy. It is analogous to a Work Breakdown Structure (WBS) or an indentured list.

OC-ALC - Oklahoma City Air Logistics Center.

OSA - Open Systems Architecture.

OSD - Office of the Secretary of Defense.

Open Systems Environment - An environment in which computers are capable of communicating through the use of agreed upon standards and protocols. Open systems are intended to allow more accurate, timely, efficient, and economic exchange of data without relying on a single vendor's product.

PA&E - Program Analysis and Evaluation.

PCA - Physical Configuration Audit.

PDES/STEP - Product Data Exchange using STEP/Standards for the Exchange of Product.

Performance Metrics - The measures used to gauge the performance of functional activities and processes.

PERT - Performance Evaluation and Review Technique.

POSIX - Portable Operating Systems Interface.

PPL - Provisioning Parts List.

PWB - Printed Wiring Board.

SGML - Standard Generalized Markup Language.

SPARC - Standards Planning and Requirements Committee.

SPO - System Program Office.

SPM - System Program Manager.

Standard - A document that establishes engineering and technical limitations and applications of items, materials, processes, methods, designs, and engineering practices. It includes any related criteria deemed essential to achieve the highest practical degree of uniformity in materials or products or interchange ability of parts used in those products. Standards will be used in specifications, invitations for bids, requests for proposals, and contracts. It is an exact value, a physical entity, or an abstract concept established and defined by authority, custom, or common consent to serve as a reference, model, or rule in measuring quantities or qualities, establishing practices or procedures or evaluating results. A fixed quantity or quality.

Three Schema Architecture - An architecture developed in 1975 by the Standards Planning and Requirements Committee (SPARC) of the American National Standards Institute (ANSI). The architecture describes three views, called "schemas," of the information asset. The External Schema describes the way that data is used as information. The Internal Schema describes how data is represented in computer systems. The Conceptual Schema describes the meanings and rules for data of an enterprise independent of how they are used or stored in the computer.

TO - Technical Order.

TO-BE Model - An activity model that results from a business process redesign action or program. The TO-BE model shows how the business process will function after the improvement action is implemented.

TP - Test Procedures.

WAN - Wide Area Network.

WBS - Work Breakdown Structure.

Weapons System Life Cycle - The time frame spanning the period from Research and Development, through production, until the weapon system is retired from active service.

APPENDIX B BUSINESS CASE STUDY NODE TREE GLOSSARY

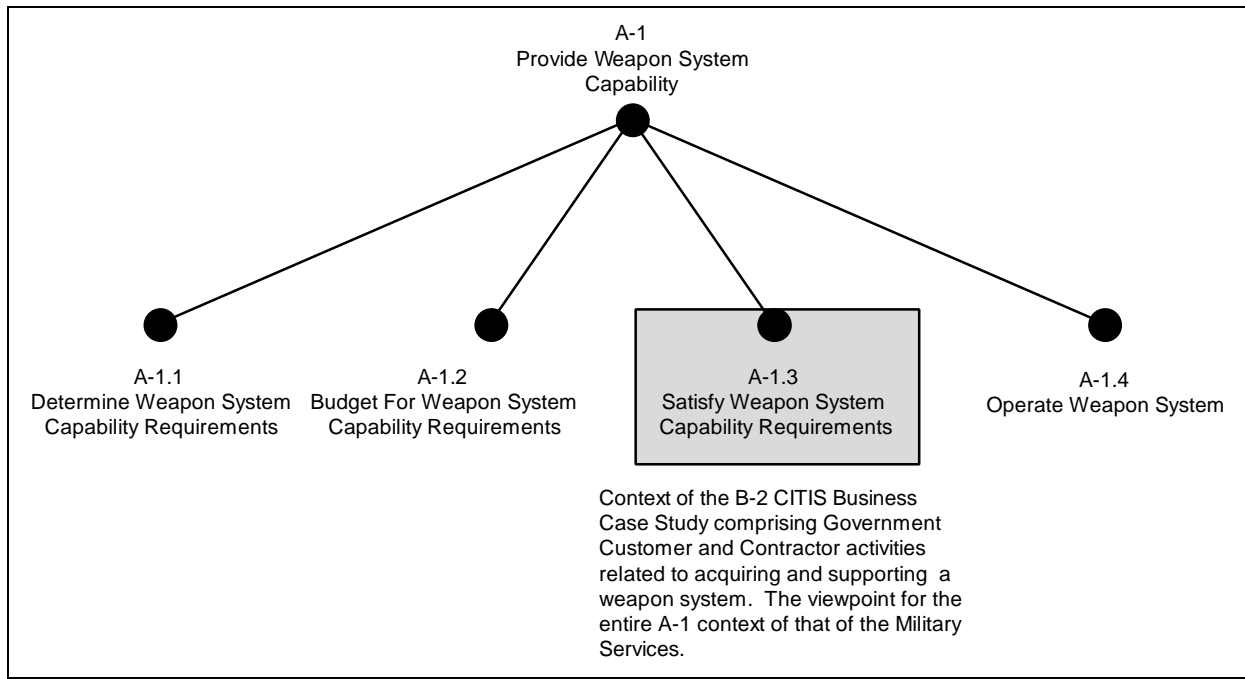
Introduction

The activity node analysis, conducted under the CITIS Business Case Study, was not a requirements definition exercise, but instead a merging of several reference models to approximate a context for CITIS. The resulting node tree presents a composite of viewpoints from the Government (e.g., System Program Office (SPO), ALC) and Contractor. The node tree analysis begins by representing the requirements definition and constraint logic for the weapon system capability. The focus of the node tree analysis then shifts to the weapon system and its satisfaction of the defined capability requirements. The GCO and Government Furnished Information (GFI) are outside the scope of this node tree analysis for CITIS Services. This scope constraint limits the emphasis placed on weapon system requirements definition and operations activities relative to CITIS services.

A-1 PROVIDE WEAPON SYSTEM CAPABILITY

A-1 Provide Weapon System Capability

Under the context of providing for national defense are weapon system capability requirements in both wartime and peacetime. The military services must assess national defense plans and directives to determine the capability objectives to be achieved. Capability objectives are in turn transformed into capability requirements and requisite levels of military and industrial base performance capacities to achieve the capability objectives. The capability requirements are then transformed into resource requirements that are reviewed against existing resource levels and states of readiness. Plans and budgets for alleviating resource shortfalls are prepared and submitted to the DoD and the Congress for approval. Approved plans, budgets, and actual appropriations establish the military command, intelligence, operations, and logistics infrastructures needed to satisfy the capability requirements.



A-1 Provide Weapon System Capability Node Tree

A-1.1 Determine Weapon System Capability Requirements

The military services transform national defense plans into capability requirements defined as force structure, modernization, readiness, and sustainability (Joint Chiefs of Staff (JCS) Pub 1-02). Mission requirements, logistics requirements, and industrial base requirements are representative outputs of this transformation. The requirements are reviewed against existing military and industrial base infrastructure, capacity, and technology to assess the shortfall in same for meeting capability objectives. The shortfall is provided to planners for strategic, tactical, and operational planning and budgeting necessary to acquire resources to meet the capability objectives.

A-1.2 Budget For Weapon System Capability Requirements

The resource shortfalls for desired weapon system capability are provided to planners for the development of plans and budgets to alleviate same. The plans and budgets are submitted to the DoD and Congress for approval and funding. The plans and budgets consider all aspects of resource acquisition including research and development in specific technologies. Also included is the development of specific performance capacities within the military and industrial base to develop, produce, and maintain the needed resources. The approved plans, budgets, and appropriations authorize and control the Military Services in their acquisition, use, and support of products and services to meet the weapon system capability objectives.

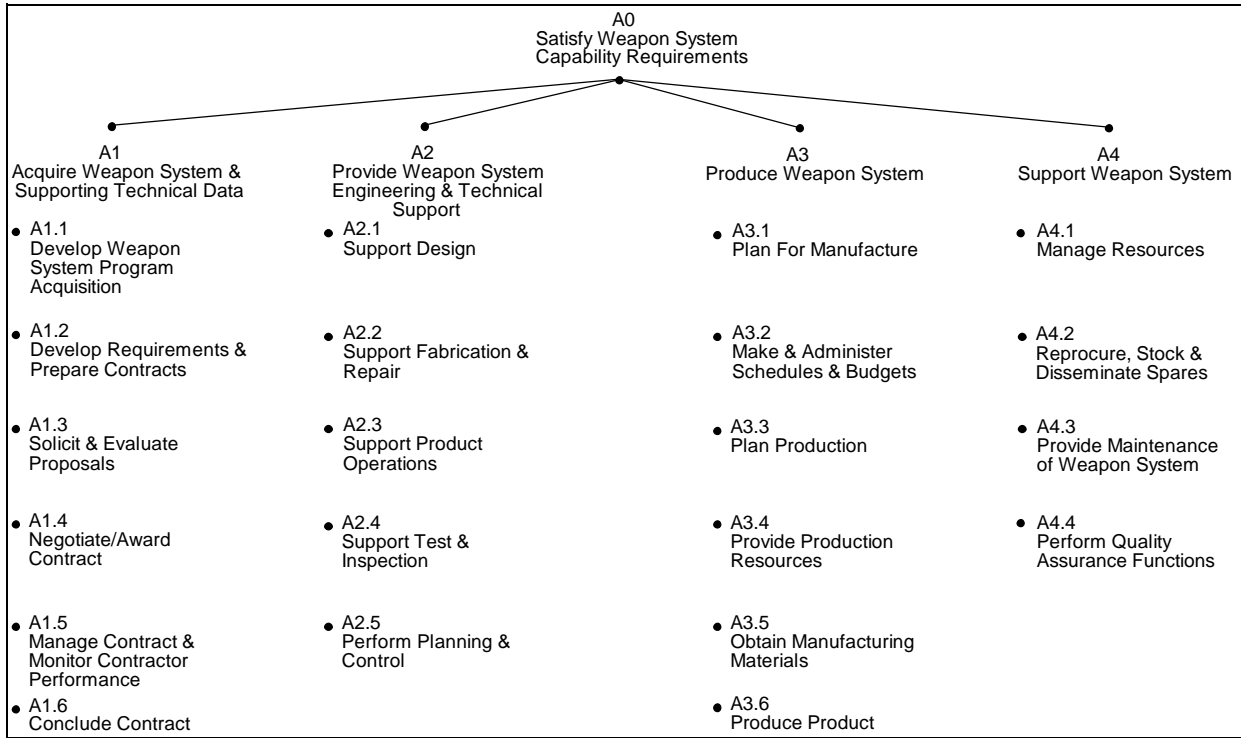
A-1.3 A0 Satisfy Weapon System Capability Requirements

Military services use the capability requirements, plans, budgets, and appropriations information to develop resource acquisition and support strategies. These acquisition and support strategies must satisfy the operational mandate within the resource constraints. The final output of this activity is the fielding of the "mission-required" resource for conducting the military operation. Unsatisfactory weapon system operations result in a highly iterative process of planning, budgeting, appropriating, and resource acquisition and development to meet the capability objectives.

A0 SATISFY WEAPON SYSTEM CAPABILITY REQUIREMENTS

A0 Satisfy Weapon System Capability Requirements

Military services use the capability requirements, plans, budgets, and appropriations information to develop resource acquisition and support strategies. These acquisition and support strategies must satisfy the operational mandate within the resource constraints. The final output of this activity is the fielding of the "mission-required" resource for conducting the military operation. Unsatisfactory weapon system operations result in a highly iterative process of planning, budgeting, appropriating and resource acquisition and development to meet the capability objectives.



A0 Satisfy Weapon System Capability Requirements Node Tree

A1 Acquire Weapon System and Supporting Technical Data

After receiving an approved Mission Element Needs Statement, the military service begins the acquisition process. The System Program Office plays a primary role in managing the acquisition of the weapon system.

A1.2 Develop Requirements and Prepare Contracts

The Air Force SPO solicits requirements input from a number of sources that will participate in the support of that weapon system during operational deployment. These solicitations are made when the SPO plans new procurements either for new equipment or for major modifications and enhancements to existing equipment. Coordination for this input from the ALCs is usually performed by the System Program Manager (SPM) at the ALC designated with the responsibility for the weapon system program.

The ALC must determine its support requirements from a number of considerations, including what resources and expertise it will require, what data is needed from the product contractors, and what spare parts and materials are needed. Data requirements to support ALC operations are solicited through a "data call" issued by the SPM. This collection of requirements provides for all technical data that is expected to be needed to service the product during its intended deployment life. This technical data includes the original engineering data (drawings, specifications, parts lists, and software), the tech orders containing the maintenance and repair instructions, and provisioning support data. This latter category includes the Logistics Support Analysis Records (LSARs), Indentured Part Breakouts (IPBs), and Provisioning Parts Lists (PPLs).

Provisioning requirements determine the quantity and frequency of specific spare parts and assemblies that the contractor will deliver to the appropriate ALCs for use in repairing and maintaining the contractor supplied products. These requirements are determined from experience, from analysis and prediction of hardware reliability, and from negotiation between the Air Force and the contractors. One or more Provisioning Conferences will be conducted to support these determinations.

In addition to requiring data to perform repair and maintenance operations, a number of other considerations must be met. Included in these are development or acquisition of new technologies, such as composite part manufacture and repair, additional facility, equipment, and tooling needs staff training, and new or modified operating procedures and controls. Many of these requirements become drivers for the center resource management function.

A1.2.2 Develop Technical Data and CDRL Requirements

Technical Data is data acquired from the contractor in response to Contract Data Requirements List (CDRL) requirements. This data is used for the logistics support of weapon systems and other end items. Technical data includes engineering drawings, specifications, parts lists, software, technical orders, indentured part breakouts, provisioning data, and logistics support analysis records. The first step in this process is to ensure that the required data is acquired from the contractor. In acquiring contractor data, specific requirements for data delivery must be determined. In general, the contractor is required to provide full design disclosure. This means

that the contractor provides all aspects of the design required to remake the products, including all applicable specifications, tolerances, dimensions, and manufacturing methods.

Many organizations have an opportunity to make their needs known through the mechanism of a data call. The SPO established the initial parameters for data calls at the ALC. The data call is initiated within the ALC by the Data Management Officer (DMO). The intent is to gather requirements from all organizations that use technical data. There are different functions for the DMOs within the ALC. These include Engineering Data, Technical Manuals, Provisioning, and Packaging for spares. The DMO consolidates and filters inputs from other organizations to develop specific requirements to report to the SPO. Another result of the data call is the development of Data Item Descriptions (DIDs) that describe each element to be delivered by the contractor. In addition, the CDRL and technical requirements are re-negotiated as the design elements and specifications become more clearly understood. The end result of this process is the documentation of all data required from the contractor to support the ALC's operations.

A1.2.3 Develop Provisioning Requirements

Provisioning requirements are developed as part of this function. The contractor must provide any data necessary to make the provisioning requirements determination. Most of the information needed is extracted from the LSARs that include the contractor's recommendations for spare items, support equipment and technical orders to be procured, and the appropriate quantity of each. In some cases, supplementary provisioning technical data is required in advance of the LSAR's completion for items with long production or procurement times.

The provisioning and LSAR recommendations are reviewed by the ALC, and specific quantities for spared items are developed after provisioning conferences have taken place. The SPO collects requirements from ALCs and Air Combat Command user elements, and conducts provisioning conferences that result in the determination of the appropriate times to acquire (spares, support equipment, etc.), the levels of maintenance and repair, and Technical Orders (TOs) required to support the weapon system. The requirements for Technical Orders to support the system include support equipment as well as the data needed to maintain and repair system components. Cataloging is also a function of the provisioning process. Requirements to support these activities are provided by the DMO in response to the data call. This function is primarily carried out by the Provisioning section.

A1.2.4 Develop Maintenance, Test, and Repair Requirements

Maintenance and repair requirements are initiated by the contractor and are part of the Logistic Support Analysis (LSA) process. The SPO has primary responsibility for this function; however, the ALCs provide input during this process.

The weapon system concepts, manufacturing methods, and LSA data are reviewed to develop requirements for facilities, support equipment for test and repair, software for support equipment, training, technical data (TOs, engineering drawings, etc.), initial levels of inventory, etc. The ALCs need early visibility for the long lead items such as requirements for facilities, support equipment, and training.

Once the requirements have been determined, the ALC capabilities are reviewed and requirements for new and/or changed facilities and equipment for the ALC are determined. Procedures, processes, and staffing and training needs are also addressed.

A1.2.5 Develop Training Requirements

Training requirements are often required for new or modified maintenance and repair procedures and equipment. Some of these requirements come from the Technology Research Centers that develop procedures and methods for product items based on new technology.

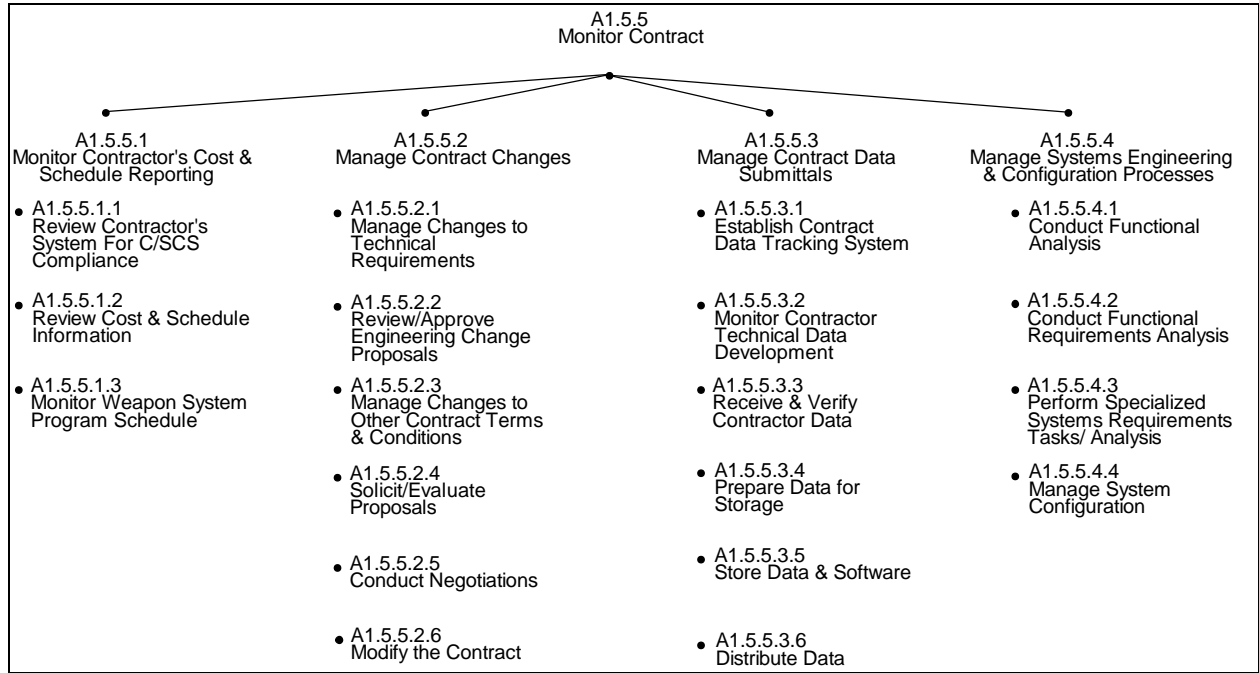
A1.5 Manage Contract and Monitor Contractor Performance

After award of the weapon system contract, the SPO will monitor the contractor's management, schedule, and financial and technical performance. During the course of the contract, changes will probably be required. These changes will be documented, reviewed, approved, and negotiated between the SPO and contractor before they are implemented.

A1.5.5 MONITOR CONTRACT

A1.5.5 Monitor Contract

The Program Manager maintains management control and understanding of the program through contract monitoring or surveillance activities. Through this activity, the SPO tracks cost and schedules, data submittals, and system configuration as well as identifies the contractor's management deficiencies.



A1.5.5 Monitor Contract Node Tree

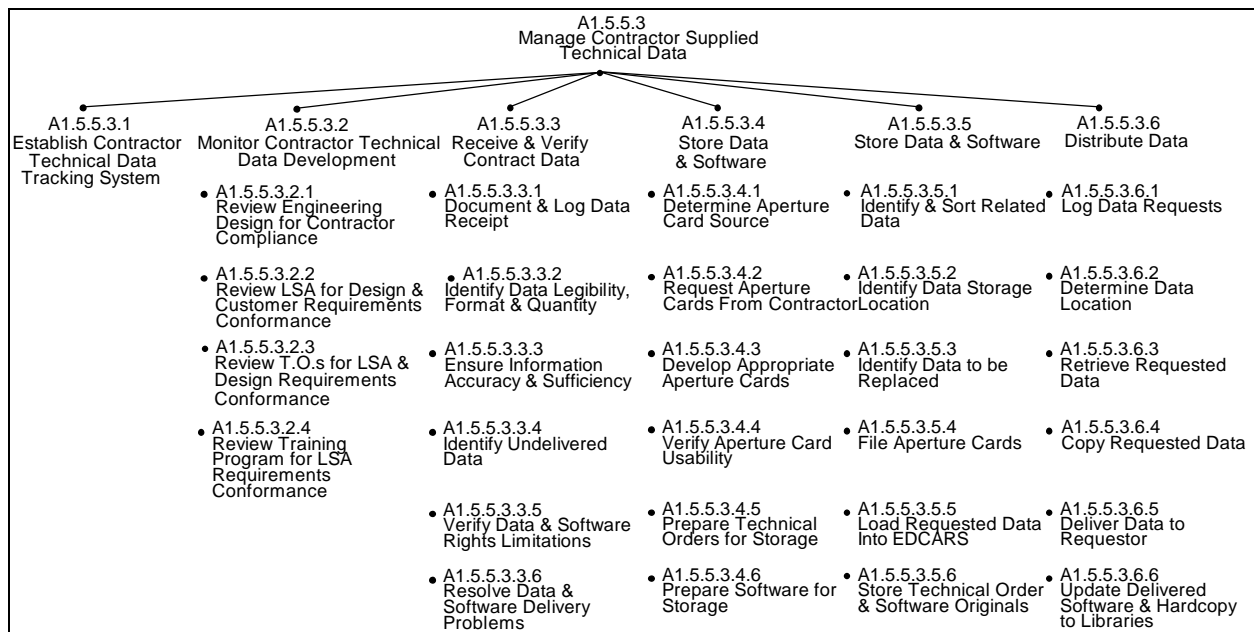
A1.5.5.3 MANAGE CONTRACTOR SUPPLIED TECHNICAL DATA

A1.5.5.3 Manage Contractor Supplied Technical Data

The contractor will normally be required to provide certain data items to the SPO in accordance with the CDRLs that were prepared as a part of the contract. Contractor-supplied data is a very important element of the Air Forces program management and support operations. Many organizations require contractor-supplied data to perform their daily functions (including organizations at other ALCs). Therefore, it is essential that this data be available to whoever needs it in a usable form, at all times. Even more importantly, this data must be accurate and complete. The purpose of this function is to acquire the data from the contractor, verify its completeness, and make the data available and accessible to the users in a timely manner.

The steps in the process of acquiring, maintaining, and distributing contractor-supplied data are:

1. Establish a contractor-supplied technical data tracking system.
2. Ensure that the contractor is meeting the CDRL requirements.
3. Verify that the data received meets the specified standards for the data requested.
4. Prepare the data for storage and dissemination.
5. Store the engineering drawings, specifications, technical orders, and software.
6. Distribute these items.



A1.5.5.3 Manage Contractor Supplied Technical Data

A1.5.5.3.1 Establish Contract Data Tracking System

To successfully track contractor data submittals, the SPO must implement a contract data tracking system to monitor the delivery of CDRL items.

A1.5.5.3.2 Monitor Contractor Technical Data Development

The first step in the process of acquiring, maintaining, and distributing contractor supplied data ensures that the contractor is meeting the CDRL requirements. This function involves the initial establishment of a Guidance Conference to make sure that the contractor and the Government have a firm and uniform understanding of the contractual requirements, including engineering data, technical orders, software, spares, and support equipment. And, to establish funding and task milestones.

As the contractor proceeds with design development, several reviews take place. In-Process Reviews allow the contractor to demonstrate specific achievements in the development of contractor deliverable items. Critical Design Reviews determine whether the detail design of each configuration item satisfies requirements, assess producibility and Configuration Item risk areas, and review preliminary product specifications.

LSARs are reviewed to establish early provisioning requirements and confirm that Technical Orders conform to the Air Force's requirements. Several reviews take place during product development to verify the validity of identified specifications and to ensure that the technical data is sufficient for production use. These periodic reviews provide the Air Force with design and development information, so they can begin and continue developing the appropriate logistics support functions within the ALCs.

Physical Configuration Audits (PCAs) are held as a final check of the technical data prior to acceptance by the Air Force. The Physical Configuration Audit is a formal examination of the "as-built" configuration of an Item against its technical documentation to establish its product configuration identification after product baseline.

A1.5.5.3.3 Receive and Verify Contractor Data

The second step in this process is to verify that the data received meets the specified standards for the data requested. This involves verifying that all data is legible, properly formatted, and complete. If this verification results in the identification of unusable or missing data, the contractor is notified of the discrepancy and must then provide the missing or replacement data.

A second verification function ensures that the text descriptions data is sufficient for use in manufacturing, maintenance, or procurement of the parts. If this is not the case, the contractor is required to provide any additional data that was not delivered, or a decision is made either to procure additional data from the contractor or to develop the necessary information within the ALC.

The contractor validates technical orders for technical accuracy by actually performing the operating and maintenance procedures on the applicable product. This same procedure would be applicable to contractor-delivered software.

Another function involves the evaluation of all data rights and limitations on engineering drawing usage. Data rights limitations restrict the ALC's use of data for procurement and are generally applicable only to processes or technologies developed by the contractor at the contractor's expense. Therefore, if data rights limits are placed on design information that is reflective of industry-wide technology or technology funded by the Government, the ALC requests changes to these limitations. Finally, a formal request is made for the contractor to provide any inadequate or undelivered data.

Support Equipment is verified to ensure its compatibility with prime equipment and planned deployments.

A1.5.5.3.4 Prepare Data for Storage

Once the hard copy engineering data has been verified, the contractor is required to deliver the data on aperture cards; however, in some instances, the ALC must develop the cards. All engineering data is maintained on aperture cards and kept in a central location. The third step in this process is the preparation of the data for storage and dissemination. This function involves making aperture cards for engineering data developed within the ALC and those aperture cards for engineering data not delivered by the contractor. In addition, this function ensures that the aperture cards delivered (or developed) are legible and adequate for usage. Because most data is initially delivered on paper, misplaced or lost cards are regenerated from the paper data. In the case of Technical Orders and Software, multiple copies are reproduced and labeled for distribution. As new versions for TOs and software are received, the old versions are removed from circulation. When TO changes are received, copies are made for distribution to all users on record of having that TO.

A1.5.5.3.5 Store Data and Software

The fourth step in this process involves storage of the engineering data. The relationships between elements are identified and sorted resulting in related data being stored together. New data is identified and the old data is replaced. As storage locations are identified, all aperture cards are stored in a central location. If data is misplaced or aperture cards are no longer usable, the previous function is notified, and new aperture cards are made from the paper data if available. Frequently used data is scanned, rasterized, and stored on optical disks in the Engineering Data Computer Assisted Retrieval System (EDCARS). This system allows users to view the data without having to use the aperture cards. The Technical Order originals are maintained in a library by the Store Data function which is performed within the ALC engineering data management organization. Technical Orders and Software are stored in separate libraries until they are requested by a using organization. Records of these using organizations are recorded so that they can receive new versions or changes to TOs and software.

A1.5.5.3.6 Distribute Data

The fifth step is distribution of the data. As data requests are made, more copies of the data are made and distributed. Distributions are made to all requesting organizations within the ALC as well as other outside commands. Engineering data is reproduced on new aperture cards or hardcopy for issuance to the requester. Updates are not regularly provided to users of engineering data unless they are frequent requesters of the data. On the other hand, accurate records are kept regarding the users of software and TOs. Software and TOs are distributed only by request, but when new versions and changes are received, they are distributed to the users without user request. TOs and Software are constantly referred to by organizations that use them. These data (software and TOs) are mostly used on a case-by-case basis.

A1.6 Conclude Contract

A contract will normally conclude in one of three ways. First, the contractor completes all required tasks and delivers all goods and services. Second, the Government prematurely terminates the contract for its convenience. Third, the Government elects to default the contractor if the contractor fails to comply with the provisions of the contract. Activities associated with any of these contract conclusions comprise the Conclude Contract activity.

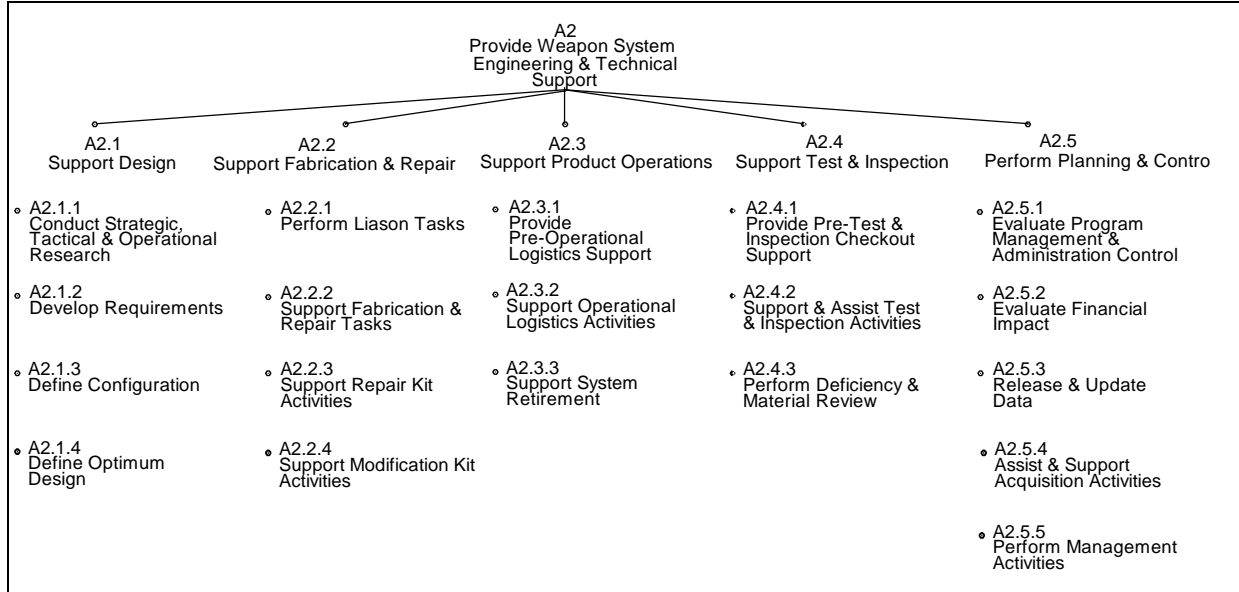
A1.6.2 Review Final Reports/Deliverables

Upon contract conclusion, a contractor will normally deliver a set of final reports and other deliverables that must be reviewed by SPO personnel. All delivered contract data items will also be reviewed in a manner that is consistent with contract requirements.

A2 PROVIDE WEAPON SYSTEM ENGINEERING AND TECHNICAL SUPPORT

A2 Provide Weapon System Engineering and Technical Support

The Provide Weapon System Engineering and Technical Support activity includes all the necessary engineering, manufacturing, logistics, and administrative support functions necessary to design a new weapon system or to design modifications or repairs to an existing weapon system.



A2 Provide Weapon System Engineering and Technical Support Node Tree

A2.1 Support Design

The Support Design activity includes all the necessary functions to support the task of designing weapon system products. These activities include research, and preliminary and final design to see if the design meets the specified requirements.

A2.1.1 Conduct Strategic, Tactical and Operational Research

The Conduct Strategic, Tactical and Operational Research activity involves conducting specified research to analyze weapon system/product requirements with respect to existing engineering capabilities and technology. The results of this research include research data, analysis information, new methods, concepts, and theoretical models. This activity involves the collection of all engineering data involved in conducting research for the design.

A2.1.2 Develop Requirements

The Develop Requirements function includes those activities needed to ascertain the customer's needs for the weapon system/product. These needs determine the technical feasibility for the implementation of concepts and identification of constraints and focus on the financial possibilities and practicalities of the purchaser's requirements. If there are possibilities for further applications of the product design, additional research would probably be required.

A2.1.2.1 Define Requirements

Within the Define Requirements function, the combination of research data and requests for redefinition are applied in defining the desired requirements subject to contracts, field inputs and change requests, market and customer needs analyses, and organizational directives and budgets. Variations to these requirements are also examined. The technical and economic feasibility impact may entail modification or redefinition of the requirements.

A2.1.2.2 Evaluate Requirements For Feasibility

The Evaluate Requirements For Feasibility function includes those activities needed to ascertain if the design requirements meet the customer needs for the weapon system/product or to determine if there are possibilities for further applications of the product design, in which case additional research would probably be required.

A2.1.2.3 Analyze and Determine Approach

The Analyze and Determine Approach activity involves the determination of the type of approach to take in performing the weapon system/product design depending upon the type of modification, feasibility, schedules, cost, and other factors.

A2.1.2.4 Review, Revise, and Detail The Approach

The Review, Revise, and Detail The Approach activity involves the review and processing of any necessary revisions to the plan for the weapon system/product.

A2.1.3 Define Configuration

The weapon system design configuration is defined based on an analysis of configuration trade-off studies and refined design requirements. Initiated with the definition of several candidate configurations that are all able to meet the program technical/manufacturing objectives, the configuration design is not started until feasible concepts have been defined to a degree that the resulting design requirements baseline constrains the scope of the subsequent engineering efforts. The activity involves applying more advanced analytical methods to the design problem in order to build confidence in the final selected design.

A2.1.4 Develop Optimum Design

Every detail part, assembly, and subassembly is defined in its entirety. This activity occurs when the configuration designs have explored representative design areas to a depth where there are no significant problems, mysteries, or voids remaining, and when the risk of design change is small and the market prospects are high, Management decides on the go ahead, and the product detail design commences. The information from prototypes, models, preliminary design, testing, and manufacturing is used to investigate, design, and document with layouts all of the task areas to the depth that there are no unknowns. The layouts are then complete enough for drafting personnel to use as a guide or pattern to produce either a detail drawing or detail data to completely describe the part to be fabricated.

A2.2 Support Fabrication and Repair

The Support Fabrication and Repair activity involves the weapon system/product process for manufacturing functions and the physical repairs of a product.

A2.2.1 Perform Liaison Tasks

The Perform Liaison Tasks activity involves providing engineering/technical assistance to production, reviewing deficiencies, determining and writing the appropriate dispositions, negotiating schedule change points, evaluating engineering/technical change request, and performing material substitution activities.

A2.2.2 Support Fabrication and Repair Tasks

The Support Fabrication and Repair Tasks activity involves the process of developing fabrication and repair source requirements, supporting fabrication/repair functions, and providing repair assistance for weapon system weapon system/product, all of which involve the coordination of work, the managing of items and tools, parts tracking, and product release. The description of step-by-step tasks (time compliance technical orders) and the equipment necessary to perform the weapon system/product fabrication/repair are also defined.

A2.2.3 Support Repair Kit Activities

The Support Repair Kit Activities involves supporting the repair kit part and material acquisition, developing the repair kit instructions, identifying the required personnel for the repair, and issuing reports.

A2.2.4 Support Modification Kit Activities

The Support Modification Kit Activities involves supporting the installation, prototyping, kit proof testing, and producing modification kits.

A2.3 Support Product Operations

The Support Product Operations activity involves force management, subcontractor assistance, and contractor and customer logistic support for weapon system modification and repair.

A2.3.1 Provide Pre-Operational Logistics Support

The Provide Pre-Operational Logistics Support activity involves providing interface support for maintenance, configuration control, reliability/maintainability analysis, acquisition services, and the design of support equipment before deployment of the weapon system.

A2.3.2 Support Operational Logistics Activities

The Support Operational Logistics Activities includes the development of field repair procedures, maintenance support, site activation support, additional equipment design, the updating of technical orders, and all interim contract support. This activity also involves supporting repair and maintenance training of field personnel and the determination of the type and quantity of spare parts to keep on hand.

A2.3.3 Support System Retirement

The Support System Retirement activity involves developing phaseout schedules for individual aircraft, determining alternative uses, and the cannibalizing of retired weapon systems for spares.

A2.4 Support Test and Inspection

The Support Test and Inspection activity involves performing test and inspection, resolution of anomalies discovered during the test and/or inspection, and the review of any material deficiencies of the weapon system.

A2.4.1 Provide Pre-Test and Inspection Checkout Support

The Provide Pre-Test and Inspection Checkout Support activity involves supporting ground, ramp, and preflight checkout tests and the resolution of all test anomalies by providing whatever technical support is needed.

A2.4.2 Support and Assist Test and Inspection Activities

The Support and Assist Test and Inspection Activities involves the preparation of Test Procedures (TP) for each weapon system. The TPs are written so as to provide design verification of the modification. Design verification includes a parametric testing of the performance limits of each tested item, including algorithm limits, monitor limits, environmental limits, and reliability limits. This activity involves developing, performing, and supporting all the weapon system tests as well as certifying instrumentation calibration and documenting test results.

A2.4.3 Perform Deficiency/Material Review

The Perform Deficiency/Material Review activity supports the process of providing feedback to manufacturing in the form of a formal disposition for any items, parts, or products with one or more characteristics that depart from requirements specified in the contract, specifications, drawings, or other approved product descriptions. This activity also supports the development of the corrective actions to be performed to eliminate the cause of recurring non conformances.

A2.4.3.1 Provide Engineering/Technical Support Of Material Deficiencies

The Provide Engineering/Technical Support Of Material Deficiencies activity supports the analysis of actual and suspected material deficiencies, including the determination of cause and corrective action, and assisting in the resolution of Not Mission Capable due to Supply (NMCS) problems.

A2.4.3.2 Review The Deficiency

The Review The Deficiency activity involves the determination of the classification of the non conformance, i.e., critical, major, or minor.

A2.4.3.3 Conduct Cause Investigations

Mishap, Accident, Special Study, and Cause and Corrective Action investigations are performed to determine what caused the damage/failure and how to prevent its recurrence, leading to the issuance of a formal report. A Cause Investigation is the process of performing investigations to determine the cause of the problem. By analyzing accident reports, and mishap and special study investigations, the depot repair personnel are able to determine how to prevent future problems of the same type.

A2.4.3.4 Determine Repair Disposition

The Determine Repair Disposition activity supports those tasks involved in taking the non conformance documentation generated during the review of the discrepant part and deciding if the part should be dispositioned by standard or nonstandard procedures.

A2.5 Perform Planning and Control

The Perform Planning and Control activity involves supporting the acquisition, planning, purchasing, funding, and scheduling of a weapon system weapon system/product.

A2.5.1 Evaluate Program Management and Administration Controls

The Evaluate Program Management and Administration Controls activity uses analysis reports, the recommended configuration, and manufacturing costs and schedules to relate program management procedures and methods to the complexities of the candidate design. This includes adoption of the decision control process and design reviews, data management and technical communication, work authorization process, cost schedule control system, and the implementation of modified procedures.

A2.5.2 Evaluate Financial Impact

The Evaluate Financial Impact activity assesses the influences of the selected configuration on the financial status. It considers the cost data base and allocations, alternate sources of funding, teaming arrangements, follow-on potential, market research, product variations, competitive capability expansion, capital improvements, return on investments, and documentation thereof.

A2.5.3 Release and Update Data

The Release and Update Data activity releases and controls the approved weapon system data and release schedules. This activity involves the formal processing of the many forms of data through the release system, which contains the checks and balances necessary to broadcast new information to the users, void existing or obsolete information, and control legitimate data.

A2.5.4 Assist and Support Acquisition Activities

The Assist and Support Acquisition Activities activity involves assisting competition advocacy activities (competitive source), assisting weapon system acquisition, assisting spares requirements and acquisition, assisting support equipment acquisition, assisting modification kit acquisition, and assisting repair kit acquisition.

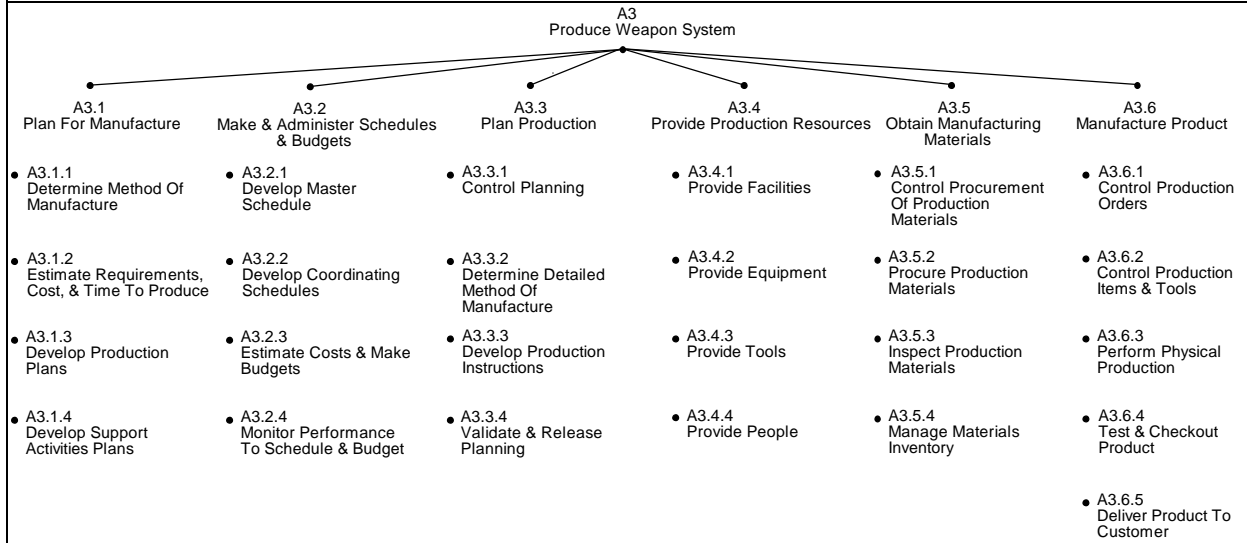
A2.5.5 Perform Management Activities

The Perform Management Activities consists of reviewing, analyzing, and commenting on technical data generated in support of a weapon system. Reviewing the job performance of both internal as well as outside source personnel to insure contract specifications are being met, and the assignment, scheduling, and monitoring completion of task assignments. The development of budgets and schedules and the action of control planning is performed. Development and implementation of engineering/technical policies and procedures are also performed.

A3 PRODUCE WEAPON SYSTEM NODE TREE

A3 Produce Weapon System

Once a fully engineered product design of the weapon system has been released from the design activity, the production process begins. The weapon system prime and sub-contractors play a primary role in producing the weapon system.



A3 Produce Weapon System Node Tree

A3.1 Plan For Manufacture

The first of two major planning activities involved in producing the weapon system, the Plan For Manufacture function, specifically relates to the strategy of producing the total product. This includes defining the major subdivisions of the vehicle structure, the basic method of manufacture, and the trade-offs to optimize facilities requirements, cost, and time schedules. Planning for manufacture is an iterative process of assumption, evaluation, and comparison with requirements that results in a complete set of production instructions. This activity includes the tasks of:

1. Developing the complete grand strategy for the production of the weapon system, breaking it down by major subassemblies and then successively dependent subassemblies. Manufacturing methods, sources for materials, plant capabilities (present or purchasable), costs, and delivery times are assessed;
2. Evaluating each strategy and feeding back the results of the evaluation to the planning activity;
3. Developing detailed manufacturing plans; and
4. Developing support activity plans.

A3.2 Make and Administer Schedules and Budget s

The Make and Administer Schedules and Budgets activity is primarily an administrative function. This activity produces those schedules and budgets that provide proper coordination between the separate activities A3.3, A3.4, A3.5, and A3.6. Working from the production schedule produced in activity A3.1, the work breakdown structure, and the preliminary manufacturing plans produced in activity A3.1.3, a master schedule showing the time spans of major events is produced.

This master schedule is initially expanded using the engineering parts list and finally using the manufacturing indentured parts list and tool identifications to produce coordinating schedules that provide the negotiated need dates for those items that impact the manufacturing instructions, facilities and equipment, manpower, and materials requirements.

The manufacturing plans and schedules are used to estimate costs, which are combined with the product budget requirements to produce the budgets and accounting scheme for the production project.

Throughout the Produce Weapon System activity, actual costs and times are monitored, and when necessary, the need for revisions to schedules or budgets is identified and fed back. Schedules and budgets are also revised whenever revised production requirements or revised manufacturing plans arrive.

A3.3 Plan Production

The second major planning activity involved in producing the weapon system, the Plan Production function, specifically relates to the strategy of producing the individual parts of the product. This activity has the overall task of converting engineering designs into detailed manufacturing methods that conform to manufacturing plans. This includes producing those items that will be used on the shop floor such as routing sheets, operation sheets, and the list of machine tools,

forms and cutters, fixtures, and gauges required to produce the individual components of the weapon system. This activity includes the tasks of:

1. Expanding coordinating schedules into detailed schedules that allow appropriate assignments to be made within the Control Planning activity.
2. Developing a detailed manufacturing method for each engineering item. This involves identifying the manufacturing parts to the extent that they exist temporarily in different structures or in different forms from the engineering versions, and identifying the tools to be used.
3. Producing specifications for tools and for procured items needed in the production process.
4. Validating the production plans to be sure that the items produced or acquired will conform to the engineering design.

Throughout this process, there may be feedback to the design function in the form of engineering change requests.

A3.4 Provide Production Resources

The first of two major provisioning activities involved in producing the weapon system, the Provide Production Resources function, specifically relates to the activities involved in providing those resources that will be used to produce the total product as opposed to becoming a part of the final delivered product.

Production resources come in four major categories: facilities, equipment, tools, and people. The primary controls for all of them are the resource plans that specify what they are to be and the methods for getting them, and the schedules that specify when they are required. In the case of tools, detailed tool specifications are needed in addition to the tool plans.

Interaction between the A3.4 nodes is fairly limited. Facilities place limitations on the space, power, and other support available for equipment, while the equipment imposes needs for these on the facilities. Because most tools are used in conjunction with equipment, the interface requirements of the equipment must be known in order to design or procure the tools.

Purchase requisitions from A3.4.1, A3.4.2, and A3.4.3 ultimately result in the procured items from which resources are made. Resource characteristics from A3.4.2 and A3.4.3 are provided to production planning so that the plans can conform to the available or planned resources. Tools and people are supplied to production in response to requisitions for them.

A3.5 Obtain Manufacturing Materials

The second major provisioning activity involved in producing the weapon system, the Obtain Manufacturing Materials function, specifically relates to the activities involved in providing those resources that will ultimately be included in the final delivered product. Starting with the overall material plan, the materials needs schedule and budget, detailed materials requirements planning (A3.5.1) can occur. As detailed procured item specifications are available, inventory can be allocated and requisitions generated for additional procurements.

The Procure Production Materials activity, node A3.5.2, actually obtains the items from vendors, subcontractors, or the customer (Government Furnished Equipment (GFE), etc.) reporting any problems in availability. Received material is inspected (A3.5.3) and if accepted, stored until issued in response to a material requisition. Material records are critical in knowing what is or will be available so that all material needs can be met. Information on material availability is provided to the design activity so that designers can take this into account.

A3.6 Manufacture Product

The Manufacture Product activity is where the form and character of the production materials are altered and the pieces assembled. Using a manufacturing indentured parts list and production instructions, production control (A3.6.1) can determine the proper times for performing production tasks. This results in the issue of orders to collect needed items into kits and work packages to initiate required fabrication, assembly, and test. Work packages include quantities, dates, and the instructions for the individual tasks.

All the tools and materials necessary for a task are collected into kits (A3.6.2). Requisitions are made to obtain tools from tool stores or materials from procured item stores as necessary to satisfy production requirements. In addition, the Control Production Items and Tools activity prepares spare parts and repair retrofit kits to be delivered to the Air Force.

Actual physical production is done within the Perform Product Production activity (node A3.6.3). This involves converting the kits into finished items in accordance with the work packages. In the process, difficulties encountered may result in requests for planning changes. Finished items are returned to production stores or forwarded to test. Test, checkout, and delivery (A3.6.4) result in products ready for delivery. Deliver Product To Customer (A3.6.5) delivers the tested products, kits, parts, or other items to the customer.

A4 Support Weapon System

Once the weapon system has been placed into service, it will be necessary to perform ongoing maintenance and repair activities. Ultimately, the weapon system will be retired and removed from the active fleet. The Air Logistics Center plays a primary role in supporting the weapon system.

A4.1 Manage Resources

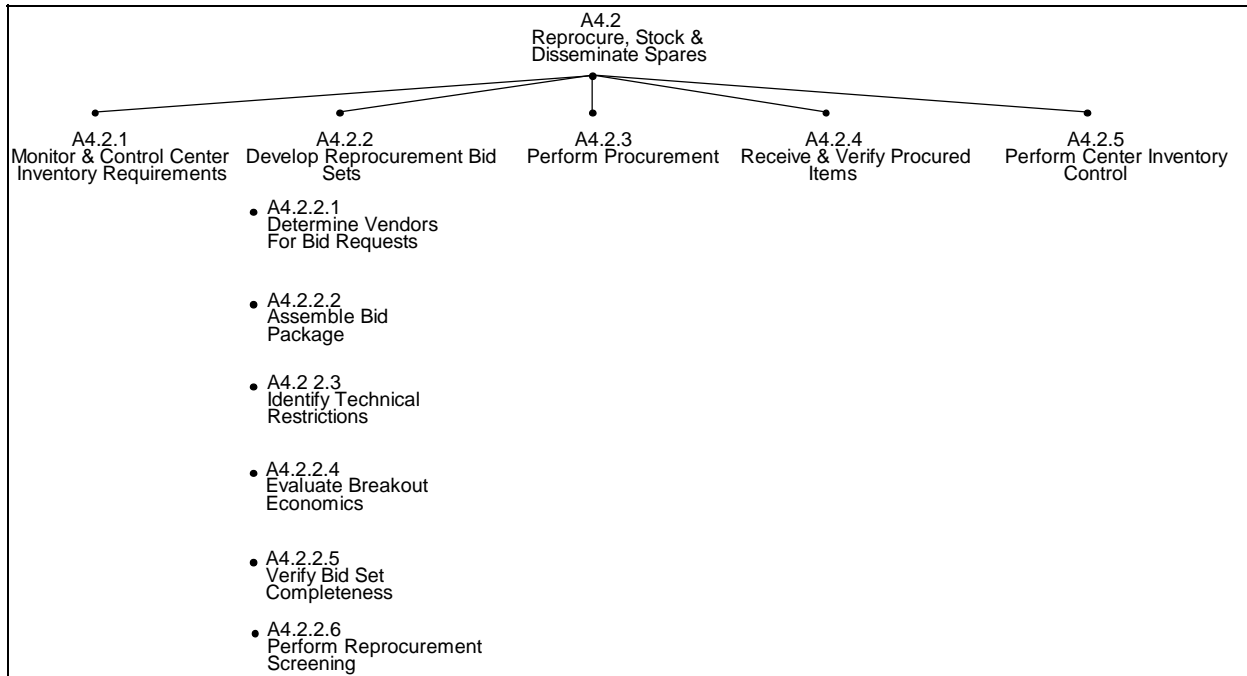
The ALC functions in much the same way as an aerospace factory, performing the same principal functions to develop and support both products and the resources used to create these products. The responsibility for managing these resources is the primary function of this activity. These resources include but are not necessarily limited to the physical plant and facilities at the center, the personnel, the center controlled policies and procedures that govern the way operations are conducted, and the center's finances, including the budgets allocated to all of its constituent organizations. Management of these assets includes providing the necessary services to maintain and control them, such as security, safety, plant maintenance and repair, health and insurance services, accounting and payroll, personnel and training, and the like.

This activity has a major interface with those in node A1.5.5.3, in which requirements for performing the center's principal functions are determined. Some of those requirements refer to the consumable materials and spares required to maintain weapon systems, others to what the contractor must supply, such as technical data, and others to what processing resources are needed at the center to perform the repair and maintenance operations. This latter category is of primary interest to this resource management node.

A4.2 REPROCURE, STOCK AND DISSEMINATE SPARES NODE TREE

A4.2 Reprocure, Stock and Disseminate Spares

This function is responsible for the maintenance of center material and spare parts requirements, and for initiating actions that result in acquisitions to satisfy these requirements after the initial provisioning contracts are placed. In this function, both the ALC inventory and product repair and maintenance history are monitored to determine real versus predicted need and to ensure adequate supply to meet that need. Once established or refined, the requirements (i.e., differences between actual and expected inventory, and predicted need levels) are fulfilled by part or material purchase, organic manufacture, or transfer of items from other ALC inventories. Decisions regarding the mode of replenishment are based on inventory analyses and evaluation of potential replenishment sources, and are participated in by the SPM, the competition advocate, and the appropriate Item Managers (IMs). Once a procurement has been made, this function is also responsible for the receipt, inspection, acceptance or rejection, storage, auditing, and shipping of the inventory items.



A4.2 Reprocure, Stock and Disseminate Spares Node Tree

A4.2.1 Monitor and Control Center Inventory Requirements

In this activity, IMs determine and provide for meeting actual center inventory requirements. This is done for both provisioned or spared items for specific weapon system use, and for general items, i.e., raw materials and industry standard component or loose parts, that are consumed during center repair, maintenance, test, and manufacturing operations. For weapon system provisioning, they do this by first monitoring deployed weapon system performance and actual repair and maintenance history, from which they compute actual reliability figures. When compared to predicted reliability values upon which initial provisioning levels and anticipated repair and maintenance schedules have been based, changes in required spare requirements can be determined. These can be both in terms of too little and too much planned inventory. When the IM determines needed adjustments, he will prepare modified provisioning plans for the affected items and will negotiate with the SPM for these changes, including the necessary budget adjustments to support changes in procurement actions.

Other IMs at the center are assigned the responsibility of providing for general inventory items, such as raw materials and industry standard components that are used on numerous weapon systems, as well as on support and test equipment at the center that is likewise used to support multiple systems. These IMs perform a similar function to those described above on specific weapon systems. Here, instead of monitoring weapon system history and performance to determine provisioning needs, the IMs monitor center inventory (raw material and loose part) usage, quality, and performance to determine and refine required inventory levels in these commodities as well. To do this, the appropriate IMs will review actual inventory usage from requisition records, and compare this to current center reprourement practices. Items that should be covered and which are not, those that are but which are no longer needed, and those whose levels are significantly out of whack with actual needs will be singled out for corrective action. As in the case of weapon system provisioning, changes here will have to be analyzed and negotiated, with appropriate changes in budget being provided for as well.

In addition to determining actual inventory level requirements and usage, and hence the needed supporting budgets and order policies, the IMs must also ensure that the appropriate actions are initiated to fill these requirements. This is done through periodic determination of the center's current, real time inventory requirement, and then initiating the purchase requisitions or their equivalent to place specific purchase orders for the needed items. As part of this, IMs will analyze and determine current inventory status, accounting for both inventory-on-hand and inventory-on-order. Comparing this to expected needs and order policies, the IMs will prepare or initiate procurement packages for those items to be acquired from outside sources. This package includes the revised item level computation, purchase justification, and a procurement request. Procurement requests are approved at the level appropriate for the dollar amount and are released to the Directorate of Competition Advocacy.

A4.2.2 Develop Reprourement Bid Sets

The Air Force competition advocate (formerly CR) prepares a bid package (called a Procurement Data Package) for procured items. All the engineering data, material, process specifications, etc., are gathered and screened for data completeness and source information.

Outside vendors are qualified after successfully completing a screening. A vendor list, which may include ALCs, is prepared for the item being procured based on the vendor's capability to perform the job. After receiving a request for item purchase, the Directorate of Competition Advocacy asks the Engineering Management Division to pull the item's entry folder and forward it to the screening section. The screening section requests a drawing tree and checks the data package to determine if adequate information exists for competitive purchase. If data is found to be missing, an attempt is made to buy the data from the contractor. If this proves unsuccessful, the part may be re-engineered through a reverse engineering process at the center.

A4.2.3 Perform Procurement

The competition advocate sends completed and verified bid sets to identified qualified vendors. These are evaluated by the potential suppliers, and those that seek participation will return their bids for the requested materials. When returned, these estimates are evaluated for cost effectiveness, and a source is selected. The IM is notified, and a procurement request is issued to the Directorate of Contracting and Manufacturing for contract award.

A4.2.4 Receive and Verify Procured Items

The Directorate of Distribution (DS) is responsible for parts delivered to the ALC. On such a receipt, PM will first inspect incoming orders for completeness and accuracy, and then will initiate activity to selectively verify the quality or functional compliance of the incoming items. In some cases, this may require testing, especially for electronic-type components and assemblies. When acceptance problems are encountered, PM will initiate corrective actions. The appropriate IMs are notified and may participate in resolving the problem, depending on its severity and on its impact on current center operations. Exceptions may be considered or work-around plans formulated to permit acceptance and immediate use of items for expedited jobs, such as those involving grounded aircraft. Once delivery is accepted, the requesters are notified of the availability of the material.

A4.2.5 Perform Center Inventory Control

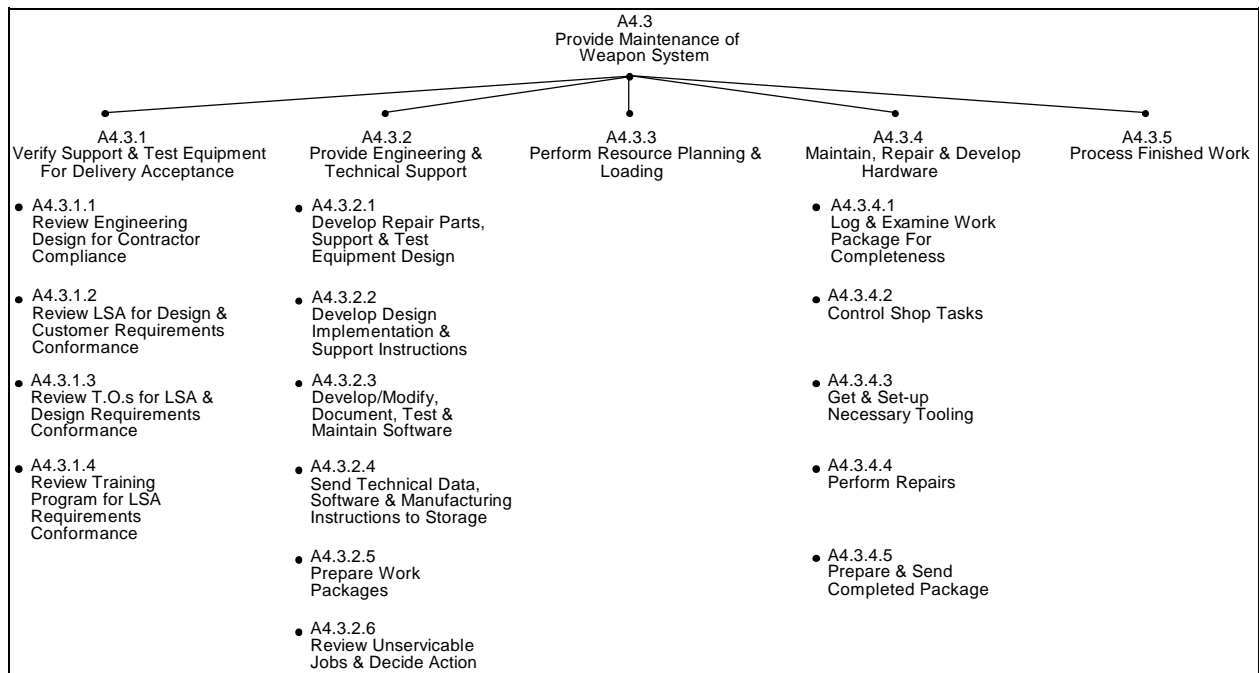
Parts are cataloged, stocked, and dispersed throughout the center and other ALCs as needed. Common and frequently used parts are treated as line stock and are inventoried on a minimum/maximum basis. Parts required at repair but not ordered are identified by the repair person. A parts list is given to the material person who checks to see if the parts are stock listed. This is done by filling out and submitting a "244 card" for each part. If the parts are not on hand at the center, other centers are tried before alternative parts are sought. If neither the part nor the alternate can be located, a procurement action is initiated. When parts arrive at the center, they are delivered to Material Inventory Control (MIC) where they are routed to the material person who made the request.

A4.3 PROVIDE MAINTENANCE OF WEAPON SYSTEM NODE TREE

A4.3 Provide Maintenance of Weapon System

The maintenance of weapon systems and parts thereof is the major responsibility of the ALC. All the other tasks that are performed there are basically done in support of this activity. Maintenance of weapon systems is meant, in this case, to include any ALC activity that directly affects the return of weapon systems and their physical parts, including both hardware and software, to an operationally ready condition. Accordingly, it includes necessary design, planning, procurement, manufacturing, verification, provisioning, and repair activities. It generally does not include weapon system operational or maintenance training, or the routine preventative maintenance activities attendant to all hardware operations. It also does not include the various management and administrative tasks needed to control the maintenance activities, including control of the resources used therein, such as personnel, facilities, equipment, inventory, and, perhaps most importantly, data. These are provided for in Nodes A1 through A4 in this architecture.

Two general classes of maintenance are performed at the ALC. The first of these is the maintenance activities performed to support the specific weapon systems for which the ALC is assigned responsibility. The second of these is for the performance of commodity class maintenance for all AF weapon systems. The Oklahoma City Air Logistics Center (OC-ALC), for example, has responsibility for propulsion systems, accessories, and software. Further, to better use its resources, the ALC can accept maintenance-type work from other branches of the U.S. Armed Services as well.



A4.3 Provide Maintenance of Weapon System Node Tree

A4.3.1 Verify Support and Test Equip for Delivery Acceptance

Capital equipment for supporting the maintenance, repair, and test of various weapon system components and assemblies is periodically acquired for use at the ALC. This equipment is comprised of both specially designed hardware for use with a particular weapon system, and of industry standard tooling and electronic testing equipment that is used in general support of the maintenance, repair, and test activities at the center. The former is frequently acquired from the weapons system prime contractor as part of the weapon system acquisition itself. The latter is acquired through the center's own directorates as part of the general facilities buildup to support all center activities.

Regardless, such equipment must be functionally verified upon receipt before delivery can be accepted and the equipment put to use. Such acceptance testing is done by the personnel who will be responsible for the program on which it is used, who will have to use it, or who requisitioned it in the first place (in the case of general purpose type of equipment).

A4.3.2 Provide Engineering and Technical Support

Engineering and technical support at the ALC are required for a variety of purposes, including but not necessarily limited to design of hardware and software, preparation of manufacturing, repair and maintenance instructions, assembly of work packages used in the manufacture, repair, and maintenance of weapon systems, and resolution of problems that are determined while performing these latter tasks. Design support ranges from the "competing" as an original equipment developer, to performing the reverse engineering process on needed replacement hardware for which neither an outside source nor the original engineering is available or acquirable within a practical time frame. Support instruction development ranges from creation of manufacturing process planning to control original equipment manufacture at the center, to enhancement of the technical orders that control bulk of repair and maintenance operations. Further, just as contractors must develop technical orders to support the equipment they design, so too must the ALC perform this responsibility for hardware and software designs developed at the center.

Engineering planners are responsible for the work packages used to supply and control shop floor operations at the center. These packages should contain all of the data, parts, and materials needed to perform the manufacturing steps. The engineering planner helps to define the job needs, to acquire them, and then to assemble and verify the completeness of the work package before it is sent to the shop. When problems occur in doing this, either during its assembly or detected by the shop floor technician, the engineering planner performs the studies, prepares recommendations for solutions, and initiates resolution activities. These problems customarily involve the lack of availability of needed components, requiring a reprourement or center reverse engineering and subsequent manufacturing effort if neither the engineering data nor a reprourement source can be located.

A4.3.2.1 Develop Repair Parts and Support/Test Equipment Hardware Designs

Two classes of parts are "designed" at the ALC. The first class consists of parts whose design was originally purchased by the Air Force, but which cannot be reprocedured because either the documentation that was thought to have been acquired never was delivered, or the original data was lost, or misfiled and cannot be located, or the original data is no longer legible, or the component or an acceptable one-for-one substitute cannot be located in time or is no longer available from any known and available source.

In this case, the needed design documentation is achieved by essentially reversing the traditional development process, where the part geometry, tolerances, and functional characteristics are derived not from a set of design requirements, but from examination of the part and its operation. This process is called reverse engineering, where the design is derived from the manufactured article rather than vice versa.

The second class of parts designed at the ALC is that for which no prior design exists and the center resources are chosen as the best source of design expertise to perform the job. Such design work may or may not be awarded to the chosen center resource based on competitive bids. Availability of resources, projected delivery schedules, convenience, and other such factors could be determining criteria in the selection of the center to perform this work. Examples of such design, or modification of an old design, would include tools and support equipment required by the center, circuit card extenders to support fault isolation and testing, upgrades or changes in weapon system parts to meet repair and maintenance requirements, and development work won competitively by the center over other sources.

This activity includes the tasks of:

1. Determining, locating, acquiring, and verifying whatever existing prior design documentation that might reside either at the center or at a definable outside source, such as from an Air Force contractor or commercial vendor;
2. Performing the design or reverse engineering process;
3. Preparing and verifying the new or replacement engineering documentation, including functional specifications, geometry, tolerance, material usage, and parts and wire lists; and
4. Converting wiring schematics into physical printed wiring board designs, including the determination of Printed Wiring Board (PWB) etch routing and the layout of the PWB geometry.

A4.3.2.2 Develop Design Implementation and Support Instructions

Design implementation and support comprise the activities necessary to transform the design documentation and intent into functional and supportable hardware and software that make up, in this case, portions of military weapon systems. Specifically, this means that all the necessary instructions needed to manufacture and support fielded hardware must be created and verified to permit these two activities to take place. Such instructions, therefore, include data to support make/buy decisions, to create tooling to facilitate manufacturing, to perform the actual manufacturing steps, to inspect and verify both designed and manufactured articles, and to service deployed items. Accordingly, this activity includes the tasks that prepare or modify tech orders at

the ALC, that define test program requirements for center developed design, that negotiate, document, and initiate action based on make/buy decisions, that develop in-house process planning and inspection instructions, and that develop tooling requirements and design for the center operations. Further, all of these activities include the task of researching, retrieving, and verifying the engineering data needed as the basis for the manufacturing and support activities. These tasks are required whether the data is created at the center or acquired.

The tech order development process includes the draft preparation or modification of maintenance and repair instructions and supporting artwork, the verification of these, their conversion into publication-ready masters using the Automated Technical Order System (ATOS), and the delivery to an assigned authority to copy, disseminate, store, and control the originals.

The make/buy analysis process includes the determination of:

1. The component requirements.
2. The availability of these.
3. The possible sources of them.
4. The pros and cons of exercising each of the acquisition options.

Once a decision is made on how, when, and where to acquire them, it also includes the actions needed to initiate the acquisition, including negotiation of in-house services, requisitioning alternate source procurements, or preparation of "244 cards" to extract the components from current ALC inventory.

Manufacturing process planning consists of first, preparing the instructions for shop personnel to execute, and second, reviewing and modifying these to adjust to unforeseen problems that could, in turn, require a change in shop process selection or in instruction sequence to minimize disruptions from the problems. Such problems could occur from, for example, late delivery of parts and materials from the chosen sources, from processing difficulties encountered in manufacturing due to poor design producibility, design documentation error, or manufacturing planning errors, or from shop processing mistakes. Manufacturing planning also includes coordination with quality assurance, whether performed from within the shop or from a separate organization, to provide for periodic (if appropriate) and final inspection and buy-off of the manufacturing steps and articles. The design implementation function also includes providing for the tooling that manufacturing will require to make and inspect the parts and assemblies. This includes:

1. Art masters needed for manufacture of printed wiring boards.
2. N/C tapes or their equivalent to run fabrication, test, and inspection machines.
3. The design of mechanical tooling and fixtures.

A4.3.2.3 Develop/Modify, Test, Document, and Maintain Software

Software is used at the ALC to test and verify procured components and weapon systems, to exercise and upgrade the weapons system's avionics designs, and to test and isolate faults in fielded items returned to the ALC for maintenance and repair. Some of this software is procured from the suppliers (either contractors or vendors), some is modified contractor software, and some is totally developed at the center. Regardless of the source, all center software must be configuration controlled, documented, copied and distributed, and verified.

Just as hardware is periodically developed or modified at the center, so too is software that is either part of the delivered weapon system or part of test and support equipment that is used to test and trouble shoot weapon system electronics. Delivered weapon system software is centrally controlled by the Air Force (at the Oklahoma City ALC), from where it is distributed to each of the using Logistics Centers for storage until it is requested by one of the using organizations. Avionics evaluation and modification at the center is done at the Integrated Support Facility, while electronics repair (including fault analysis and isolation) involving software programmed and driven test sets is performed by ALC maintenance personnel. Existing software required to support these tasks is requested from the Integrated Support Facility, just as engineering drawings are currently requested to support hardware redesign, test, and repair operations. When existing software cannot be retrieved (because it has not been delivered, or is missing or lost), replacement software may be requested from the contractor, or it may be developed at the center if no willing, capable, available, or timely outside source can be acquired. Such software is developed, itself tested, and documented by the Integrated Support Facility.

A4.3.2.4 Store Developed Technical Data, Software, Manufacturing Instructions, and Tooling

Center-developed data, software, manufacturing instructions, and tooling are stored and controlled from various locations both within and outside the ALC. Center-developed engineering data is controlled from the EDCARS System, but center-developed tech orders are distributed only to the various individual tech order hard copy libraries at the center from an individual ALC organization; their control is maintained centrally at Oklahoma City, along with those that are developed and delivered by the weapon system contractors. Software is controlled by the same scenario as that of the tech orders, but manufacturing instructions are either controlled by the engineering planners (for unique jobs) or kept in the shop where they are used (for repeat or more-or-less continuous jobs). Soft tooling is basically kept the same way, however, with PWB art masters sometimes being sent to the Integrated Support Facility for storage.

A4.3.2.5 Prepare Work Packages

Work packages are assembled by the engineering planners in the respective divisions assigned responsibility for the work. Work packages include everything (except tools and fixtures kept locally in the shop) that the shop personnel need to perform the needed manufacturing, repair, and maintenance operations. Their tasks include examining the work piece, determining the needs (data, tooling, material, and components), locating the needed items, requisitioning the items, assembling the package, and verifying its completeness. When data, tools, materials, or components cannot be located, the engineering planner must initiate the action to get them,

including requesting same from the contractor and negotiating for their acquisition, either at the ALC or from an outside source. The engineering planners will work with the various Expert Systems (ES) and IMs to get such goods, and then will track their status to know when a complete work package can be assembled. When such a time comes, the engineering planner will notify scheduling to establish a starting date for the job, at which time the planner will forward the package to the appropriate work location.

A4.3.2.6 Review Unserviceable Jobs and Decide Action

At times, shop personnel are unable to complete the repair and maintenance of jobs assigned to them. There are a number of reasons for this. One would be the need for additional parts and materials that could not be determined by the engineering planner from a cursory examination of the piece requiring repair or maintenance. Another would be a deficiency found in the needed data that had not been determined beforehand. Regardless of the reason, when shop personnel are unable to perform their jobs from the content of the work package and when they are unable to quickly correct the deficiency from existing ALC inventory or data records, they must note the problem, set the job aside, and notify the engineering planner of the problem.

In this function, the engineering planner would review those "returned" jobs, analyze the problem, determine and evaluate the options, and initiate the actions needed to correct the deficiency. This could range from initiating an action to buy the needed part or data from an outside source, through development of same using AF resources at the local ALC or other logistic centers. Development of either parts or data at the center usually requires engineering help, because part manufacture also frequently requires the development of part definition data that is not otherwise available as well. If additional part acquisition is part of the problem, the engineering planner would initiate the activities needed to procure additional parts. If the deficiency is found in the tech order instructions, the shop floor technician will determine the modifications required, will note same, and will notify the engineering planner of a required change to the permanent TO records.

A4.3.3 Perform Resource Planning and Loading

In this function, activities are performed that control the shop floor work load in each of the repair and maintenance facilities within the ALC Maintenance Organization (formerly MA). Four primary activities are associated with this effort. The first, Develop and Maintain Process Standards, relates to the establishment and use of processing standards to help manage and control shop floor activities. Such standards include operating procedures, shop floor technology and techniques, and time standards. The latter are used to quantify the amount of work, as well as to measure actual shop floor performance and real job difficulty. Time standards are applied to each planned and scheduled job that is processed by the various shop facilities. Proper feedback, fine-tuning, and accounting of them permits schedulers to balance work loads, develop realistic schedules, and make maximum utilization of ALC repair and maintenance resources.

Standard operating procedures are an important management tool for facilitating shop floor process control and repeatability, a key to controlling operational costs and quality. They also help to greatly facilitate the manufacturing process planning effort. Their use requires fewer decisions and judgments on the part of planners, and therefore results in quicker, more accurate process instructions for shop personnel. Shop floor technology and technique development is closely related to process standardization. The development of such techniques usually results in the definition of what has to be done and how, as well as in the development of tools, fixtures, and other shop aids that themselves become part of the process standards.

The second major activity in this node is the schedule planning function. As jobs are planned and scheduled for shop floor execution, available resource capacity changes. Schedulers must keep track of such facility availability to determine, with the help of time standards applied to each job, (1) when shop resources will be available for use, (2) when additional jobs can therefore be scheduled, and (3) when, because of delivery schedule demands that cannot be met by the ALC facilities, outside sources of services should be sought or relief of delivery times must be negotiated with the customer. This function, therefore, is a combination of capacity planning and planning of shop floor loading to maximize center facility utilization.

Part of the shop floor work load comes about automatically, because repair jobs on AF weapon systems, for which the ALC has responsibility, normally flow through the center. Another portion of the work load is acquired through competitive bidding against other facilities, usually in the private sector. Based on engineering planner input regarding what has to be done, time standards are applied to determine the expected processing resource needs and costs that the ALC should bid for a job. Because such added work acquisition directly affects projected center resource capacity, it must be closely coordinated with the scheduling of work for which the center facilities are more-or-less obligated to by charter. In other words, a determination to bid or no-bid outside work must be based in part on not negatively impacting the center's ability to properly service normal work.

Finally, there is the dynamic scheduling function. Shop load capacity planning is important, but there are always many things that can and do happen that require plan changes when they have to be executed. Amongst the many surprises that can occur are unexpected surges in normal work load, inability to perform work because of delays in acquiring needed data or materials, the receipt of contracts bid on, sudden but temporary loss of resource capacity due to personnel or machine loss, and so forth. Regardless of the reason, real-time adjustments must be made in schedule plans as jobs truly become ready to be executed in the shop. Conflicting requirements for the same resources must be resolved through prioritization of jobs. In the extreme, it could result in a sudden decision to seek outside resources to perform a job once planned for execution at the center.

A4.3.4 Maintain, Repair, and Develop Hardware

This activity represents the actual "manufacturing" steps needed to perform the repair, maintenance, or production. In it, jobs are received, logged, verified for readiness, set up, executed, and checked for quality of performance. This includes original part manufacture, refurbishment, repair, fault determination and isolation, and test of product hardware, special tooling, and fixtures for test and handling. Unworkable jobs are referred back to either the engineering planners or the customer for resolution. These would include categories where either the required materials or data are not available. Besides outputting finished jobs and those that cannot be done for one reason or another, the activity also produces changes to or new technical orders to satisfy missing or inadequate input instructions to the using technicians.

A4.3.4.1 Log and Examine Work Package for Completeness

Repair and maintenance jobs are forwarded to the division shop or lab facilities by the engineering planners when they are scheduled for initiation. The shop or laboratory supervisor examines incoming packages to determine their readiness for work. His more detailed knowledge of specifically what operations will be performed to make the apparently necessary repairs may result in determination of more detailed and different data, material, component, or tooling requirements that were anticipated by the engineering planner. If this is the case, the supervisor will note such deficiencies and try to fill them if this can be done easily and in a straight forward manner. An example of this would be requesting additional engineering data from EDCARS, looking up vendor component data in a catalog, or requesting additional components or material from inventory. When such items cannot be easily acquired, the technician notifies the engineering planner of the deficiencies, to reinitiate appropriate actions on his part to fill these requirements. The work package is then set aside by the technician until the requested items are filled, and another job is requested and initiated.

A4.3.4.2 Control Shop Tasks

Once the apparent readiness of the incoming work package is determined, the supervisor dynamically schedules jobs into the shop based on the real-time availability of key resources, including facilities and personnel. Unexpected loss of such resources may force the redistribution or rescheduling of jobs into a particular queue, and jobs that cannot be immediately executed due to incomplete work packages also must be set aside. The supervisor will determine specifically who will work on what jobs and when. He will also decide whether to parallel process the job with multiple processing lines, in which case the data included in the work package will have to be duplicated. If work tasks are to be split between one-or-more technicians, job instructions, included in process plans or tech orders, will have to be likewise split to conform to the job redefinition by the supervisor. The supervisor will also assist the technician(s) with interpretation of the provided data, if this becomes necessary.

A4.3.4.3 Get and Set Up Necessary Tooling

In this activity, the shop or laboratory technician prepares the work facilities for the processing of the job. This includes retrieving all shop or laboratory maintained tools, fixtures, NC tapes, cables, circuit cards, PWB art masters, test and measurement equipment, and so forth. Once done, it is combined with any special tooling that is included with the work package to set-up the work place, be it for a manufacturing, repair, or testing step(s). Set-ups are performed according

to standard practices or specific instructions as defined in either process plans or relevant technical orders. If these should prove inadequate for any reason, the technician develops and documents any special set-up for the operation to be performed. If such is to become a standard practice at the center, this documentation is sent to the engineering planner for initiation of tech order publication and time standard determination and assignment. Needed changes in process plans should also be sent back to the engineering planner to identify possible planning practice changes for future jobs requiring similar operations.

A4.3.4.4 Perform Repairs

Each technician examines the jobs assigned him to determine, in detail, the requirements for processing. In the case of electronics, especially, this may involve testing to determine and isolate precise faults. In any case, the more detailed analysis and examination of the parts and systems to be repaired may reveal data, material, component, and tooling requirements anticipated by neither the engineering planner nor the shop supervisor. The technician will note any such remaining deficiencies and try to fill them if this can be done easily and in a straight forward manner. Examples of this are requesting additional engineering data from EDCARS, retrieving additional tech orders from the closest tech order library, looking up vendor component data in a catalog, or requesting additional components or material from inventory. When such items cannot be easily acquired, the technician notifies the engineering planner (via his supervisor) of the deficiencies, to reinitiate appropriate actions by the planner to fill these requirements. The work package is then set aside by the technician until the requested items are filled, and another job is required and initiated.

A4.3.4.5 Prepare and Send Completed Package

Work, tools, and data from completed jobs are generally returned to the responsible engineering planner for disposition. There are some exceptions to this. Tools, fixtures, and test apparatus generally stored in the laboratory or shop that has performed the work are not sent to the planner, and data that is expected to be used on continuing runs of the same repairs is also kept in the shop. If any significant break in such processing is anticipated, this material would also be returned to the engineering planner to prevent the technician from the possibility of working with obsolete information in the future. Also, any new documentation that is developed by the technician to help perform the repair, test, or production operations is sent to the planner for permanent inclusion into technical orders or process plans. Tech order manuals borrowed from local hard copy libraries are also returned.

A4.3.5 Process Finished Work

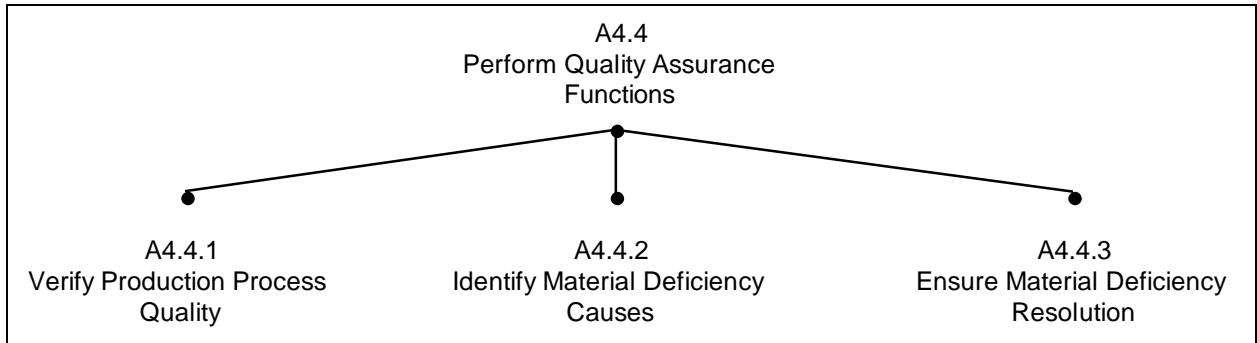
Engineering planners receive the finished work back from the various shops and laboratories that have performed the actual repair, production, and test operations. Some of this is then subjected to quality inspection review by product quality assurance personnel to ensure both quality of workmanship and continued conformance of the processes used by the various maintenance and repair shops within the ALC. When problems are determined from such inspections, the engineering planners must work with shop floor supervision and technicians to work out solutions.

The engineering planners must also decide on the actions to be taken with the data and tools (if any) that are returned with the processed jobs. In some cases, the customer owns the data and will take possession of it along with the completed parts. In others, the planner will hold on to the data he anticipates a repeat job within the following six months. Engineering data retrieved from center data storage must be returned, and revisions to existing tech orders must be verified and forwarded for publication into an official form. Process plans are either stored by the planner, if a repeat job is expected, or discarded. Some tools, such as NC programs and PWB art masters, can be retained by either the shop or the engineering planner, or sent to center data storage. Once disposition is decided and parts have passed quality inspection, the appropriate contents are packaged and sent back to the customer.

A4.4 PERFORM CENTER QUALITY ASSURANCE FUNCTIONS NODE TREE

A4.4 Perform Center Quality Assurance Functions

Quality assurance is performed at ALCs for two primary reasons: to ensure the continued conformance of laboratory and shop floor processes to acceptable procedures once those have been determined, and to ensure the quality of workmanship performed on the materials processed in accordance to those procedures as communicated via technical orders and process plans. Inspections are performed on the processes and equipment used, as well as selectively on the products that are produced or repaired. When problems are determined, their causes are determined through further inspection, analysis, and testing. Solutions are developed that could result in development of better procedures or tech orders, additional personnel training, modified equipment maintenance schedules, or combination of these.



A4.4 Perform Center Quality Assurance Functions Node Tree

APPENDIX C COST ELEMENT DEFINITIONS

A. Initiative consists of non-recurring/one time activities whose principal purpose is to change the business process to achieve improvements in cost, schedule, and performance.

- A1. Civilian Labor.
- A2. Military Labor.
- A3. Equipment.
- A4. Material.
- A5. Facilities.
- A6. General and Administrative.
- A7. Operations.

B. Operations consist of recurring or repeatable activities involved in operating and maintaining the ongoing business process.

- B1. Civilian Labor.
- B2. Military Labor.
- B3. Equipment.
- B4. Material.
- B5. Facilities.
- B6. General and Administrative.
- B7. Other.

Cost Categories represent the two major subdivisions of total cost to distinguish between activities that are designed to change the business process (initiative) and those activities that operate and maintain the business process (operations). Please note cost categories are not directly related to the funding sources for initiatives and operations. Either category can be funded by any (including the same) appropriation or Defense Business Operations Fund (DBOF) source.

Cost Elements represent the general type of resource being used to develop, change, operate, and maintain the business process. Cost elements only describe the nature of the cost and do not distinguish among the sources or suppliers of the resource, i.e., contractors, other DoD organizations, and other Government agencies. All costs regardless of source/supplier should be classified by the nature of the output, whether a product or a service.

- 1. Civilian Labor** includes costs for those civilian personnel under the operational control of the functional manager. Costs include personnel compensation (base pay, overtime, special pay, performance awards, etc.) and personnel benefits (insurance, employer payroll taxes, pensions, holidays, vacation, sick time, etc.). This element specifically excludes Government personnel assigned and under the operational personnel of other organizations and all contractor personnel.

2. **Military Labor** includes costs for those uniformed service personnel under the operational control of the functional manager. Costs include the total of all officer and enlisted pay (including all special pay) and all allowances and retirement. This element specifically excludes Government personnel assigned and under the operational personnel of other organizations.
3. **Equipment** consists of investment type assets that are normally capitalized and depreciated as determined by the OSD Comptroller. This category also includes information technology cost elements such as hardware, software, and telecommunications equipment that are classified as capital assets and depreciated. All assets in the equipment category can be purchased or leased and may even be held as inventory for resale or lease.
4. **Material** represents consumable assets (not capitalized and depreciated) that are ordinarily expensed at time of receipt as determined by the OSD Comptroller. This category also includes those information technology cost elements such as hardware, software, and telecommunications equipment that would be considered consumable and expensed upon receipt. All assets in the material category can be purchased or leased and may even be held as inventory for resale or lease
5. **Facilities** consists of all costs involved in owning, leasing, operating, and maintaining a facility to include both capital assets and expense type transactions. These costs include construction and modification if purchased, leasing costs if rented, utilities, and repairs and maintenance. Some of these costs may be included in General and Administrative and should not be double counted.
6. **General and Administrative** represents general installation support costs that benefit any organization that may reside on that installation as determined by the OSD Comptroller. Such costs typically include security, fire protection, personnel support, finance, legal, road maintenance, and grounds keeping. This category may include costs from a higher level headquarters command one level above the activity being assessed if those costs are considered relevant to the analysis; i.e., costs will vary among the baseline and the alternatives. Care should be taken to insure General and Administrative (G&A) costs are not included in any other cost element to avoid double counting.
7. **Other** consists of those costs that are not described by any of the other cost elements. Other costs can include travel and transportation of persons and things, training, and miscellaneous services. Generally, such costs should not exceed 10% of the total costs for either the initiative or operations categories. The "other" cost element may also be used to provide visibility into selected costs.