# Manpower, Personnel, and Training Analysis in Aerospace System Development

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## ABSTRACT

The Manpower, Personnel, and Training (MPT) in Acquisition Decision Support System (DSS) is an Air Force program providing the first integrated tool for addressing MPT requirements during system acquisition and design. New weapon system development and major modifications have historically neglected how our most important and costly resource – people – will maintain and support the fielded system. Inadequate planning for training and deploying the human element has often delayed system operational dates. This DSS will assist acquisition managers and analysts to effectively integrate people issues (numbers, characteristics, proficiency) with equipment (aircraft) early in the acquisition cycle. Acquisition specialists can use the structured analysis approach provided by the MPT DSS to ensure that system people costs are affordable, jobs are properly structured, and people are trained prior to the system becoming operational. The MPT DSS is being designed to support the Human System Integration requirements, now directed under DOD Instruction 5000.2.

## ABOUT THE AUTHORS

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## INTRODUCTION

New defense systems acquisition or major modifications have historically focused on system costs, schedule, performance, and in recent years – logistics support. Unfortunately, the human element has always been left for last. Human factors experts have made strides to enhance performance and logistics maintenance work, but how we employ our people (recruiting, job descriptions, personnel abilities, training, organizational responsibilities) and their associated costs are often neglected. The opportunities to optimize the human centered elements are enormous. By considering the human capabilities and limitations, beginning with weapon system conceptualization, the human can be eliminated as the factor which currently restricts combat capability; systems can be maintained faster, smarter, and cheaper; people can be trained better, in less time, with higher efficiency; systems can be made safer for the operator, the maintainer, and the non-combat environment. All of this can be achieved by influencing the design of the weapon system to enhance the combat capability through economies of our human resources.[1]

## Need for Human Systems Integration in Aerospace Systems

In this era of decreasing defense budgets, each system is coming under increasing scrutiny concerning mission need, system requirements, logistics support, and life-cycle costs (LCCs) by both Congress and the Department of Defense (DoD)[2]. This scrutiny drives our need to economize the way we employ our human resources to achieve the best people-to-system tradeoff we can obtain. Every system requires people to operate, maintain, and support it. An Air Force cost study showed that up to 60 percent of an aircraft's yearly operations and support costs can be directly attributed to manpower, personnel, and training cost elements[3]. As the Air Force's manpower authorizations continue to shrink, and personnel compensation increases, this trend is likely to increase unless new system designs are influenced and adjusted to make the systems easier to operate, maintain, and support with fewer people at existing skill levels. Early identification of manpower, personnel, training, and safety (MPTS) high (cost) drivers, goals, constraints, and issues can provide positive design influences for new weapon systems if properly integrated into the acquisition and engineering process.

Aerospace system developers are constantly striving to exploit new technologies to achieve better, faster, and more powerful defense systems. As a result, the pace of introducing new technologies is threatening to overwhelm the Air Force at a rate never before experienced. Technology is advancing on a broad front and the MPT process of the '90's cannot adequately support the Air Force of the next decade and beyond. Instead of considering the larger issue of "total system performance," acquisition objectives have historically focused on a few variables, maximizing the probability of completing the system's primary mission while minimizing acquisition related costs.

Total system performance is a key new concept in the acquisition directives. DoDI 5000.2 defines the total system to include not only the prime mission equipment, but also the soldier, sailor, airman, or marine who will use or maintain the system, the logistics support structure for the system, and the other elements of the operational support infrastructure within which the system must operate.

Many acquisition professionals have recognized that the cost of acquiring a new system *is dwarfed by the cost of the "total* system." These same people also recognized that if we could quantify the operations, support, and training costs of existing systems, we could identify components of systems that historically have presented technological problems since their introduction. Assessing MPT impacts provides one of the best methods of identifying existing costs of operations. By exploiting this knowledge, aircraft designers can use tomorrow's technology to help solve today's problems rather than simply creating more future challenges.

In the past, the solution to technology problems was to employ smarter or more manpower to address the problem until we overcame the technological hurdle. This was application of contemporary organizational theory focused on adapting organizations to their environment. The military then lived with the results until a major pre-planned product improvement occurred or the service retired the weapon system. Congress took note of the ever-increasing use of manpower to support "low-cost" systems and the associated long term life-cycle costs associated with this solution. As a result, it passed a public law (Title 10, United States Code, Section 2434) mandating that the Department of Defense report all costs of new systems during major milestone reviews, specifically addressing manpower costs, before Congress would approve funds for that system. As a result of defense acquisition management reviews and the public law, when the acquisition directives were revised they included requirements for Human Systems Integration (HSI)[4]. The acquisition directives now dictate that "human considerations shall be effectively integrated into the design effort for defense systems to improve total system performance and reduce costs of ownership by focusing attention on the capabilities and

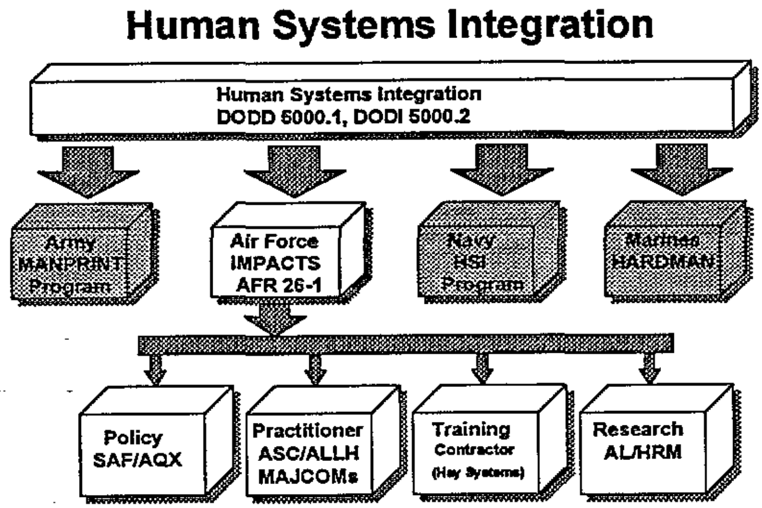


Figure 1

limitations of the soldier, sailor, airman, or marine; and objectives for the human element of the system shall be ... traceable to readiness, force structure, affordability, and wartime operational objectives ...."[5] This level of focus was very problematic for the services because there existed no mechanisms to quantify the costs required or provide the traceability requested. As a result, each military service structured an implementation program (Figure 1) to factor the human into weapon system design — for both new developments or modifications of existing inventory.

The US Air Force's implementation of these procedures is embodied in the Integrated Manpower, Personnel, and Comprehensive Training, and Safety (IMPACTS) Program (AFR 26-1). Just as the Army's Manpower and Personnel Integration (MANPRINT) program, the Navy's Human System Integration (HSI) and Marines' Hardware versus Manpower (HARDMAN) integration program look at integrating soldiers, sailors, and marines into defense systems that are peculiar to those services, the IMPACTS program emphasizes integrating airman into air, space, and ground support defense systems within the Air Force organization.

The IMPACTS program consists of a policy arm, trainers, practitioners, and continuing research (Figure 1) to improve IMPACTS processes and methods. This paper addresses the research arm of the IMPACTS program and describes an integrated analysis system now being developed. IMPACTS analysts and acquisition *managers will use this analysis system to ensure* weapon system MPT costs are affordable, jobs are properly structured, and people are trained for their jobs prior to a new system becoming operational.

To achieve the objectives of improved "total system performance" and "reduced costs of ownership" each service needs to consider how the human element interacts with, supports, and is trained to operate and support new technologies and systems. The cost of ownership for today's systems is high; the need for effective MPT analysis in developing new aerospace systems is just as great.

## High MPT Operations and Support Costs for Existing Systems

One data source, Air Force Regulation 173-13 — US Air Force Cost and Planning Factors, summarizes operating and support costs for Air Force aircraft. These cost summaries, in conjunction with variable-cost models (e.g., Cost Oriented Resource Estimating (CORE) and the Systematic Approach to Better Long-Range Estimating (SABLE)) are maintained and updated by the Air Force Cost Center, Operating & Support Division (AFCSTC/OS).

Using the CORE model, studies have been done to quantify the MPT portions of yearly operations and support costs. Figures 2 and 3 show the astounding results of one such cost study completed using this AFR 173-13 data[6]. Figure 2 illustrates that up to 62% of the total annual operations and support cost for just one F-16C squadron with 24 primary aircraft authorized is directly attributable to MPT cost elements. The bulk of these MPT costs is due to aircraft maintenance. Figure 3 illustrates the same high MPT costs in the airlift category of aircraft. In this example, 66% of one squadron's annual operations and support costs was directly attributable to MPT cost factors. Summing such costs across all squadrons shows that MPT expenses represent the bulk of the Air Force's operating budget. As seen in the figures, there is a great opportunity to reduce ownership costs by driving new system solutions to include human-centered costs.

With such potential savings, why aren't predecessor system costs used more within the acquisition community? The answer is that costing of new systems is normally a function of the financial management community at an Air Force system program office (SPO). This is a self-contained organization that advises the Program Manager on costs using size and weight information for system

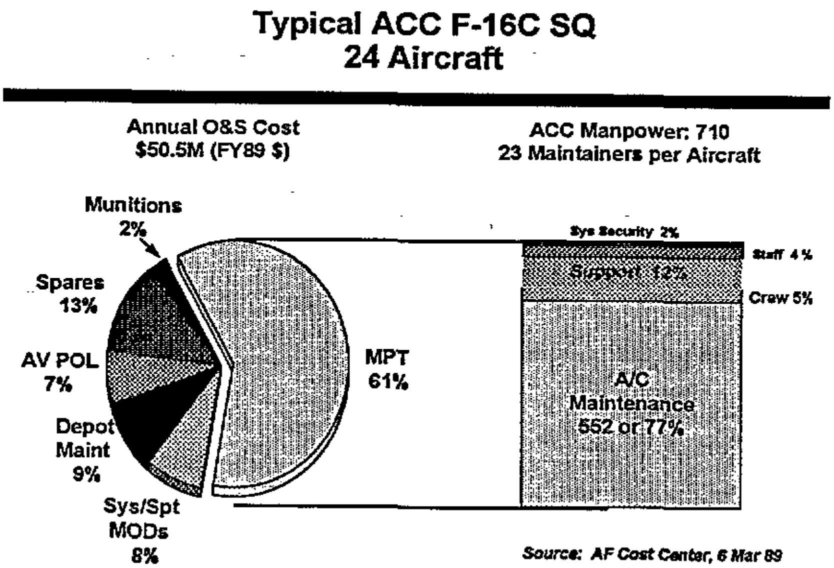


Figure 2 - F-16C Cost Summary

components from the engineering community to create a prediction of system costs. Clearly, this approach does not integrate other functional areas (systems engineering and human systems integration) that can gain significant benefit from using total system costs *as a variable in tradeoff analyses.*

Historically, the Air Force has focused on the limited picture of "how much it is going to cost to procure this system" rather than the expanded view of total life-cycle cost. This short-sighted approach was practiced because of the old Air Force command structure of having separate procuring maintenance and support commands. These commands have now been merged and the "cradle to grave" management responsibility for procuring and supporting weapon systems falls squarely on the Air Force Materiel command.

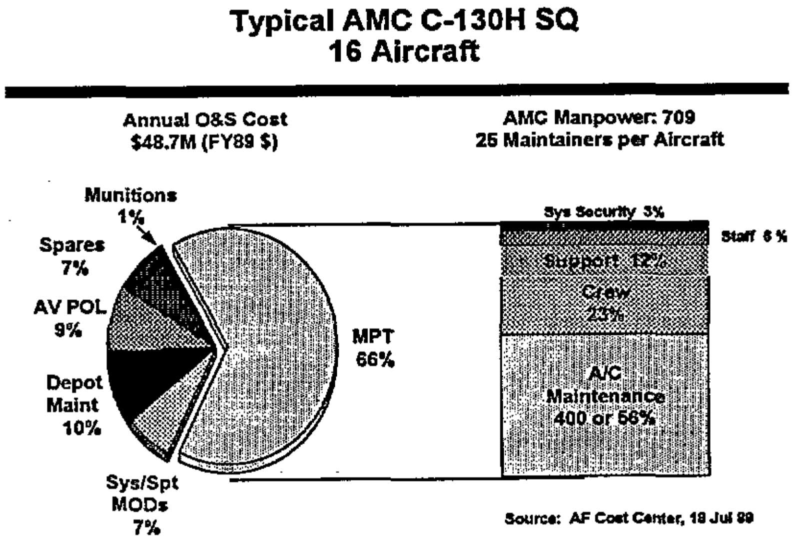

Figure 3 - C-130H Cost Summary

People costs have always been accepted as the fixed costs of doing business and were difficult for acquisition experts to quantify. This difficulty was more a problem of not knowing that such cost data were available (analysis always done within the financial management community) or not knowing how to exploit data that were available to represent these costs. From the examples given, there is clear benefit to having systems engineers and acquisition logisticians use historical cost data to help focus their development effort. SABLE is an easy-to-use cost model that is available from the Air Force Cost Center in Microsoft Excel spreadsheet file format. Some level of tradeoff analysis can be conducted through the built-in menuing and template system implemented within the model. This model provides a range of "looks" at cost data, from Air Force wide operating costs to the perspective of a single weapon system. Until more mature MPT analysis tools are institutionalized, this is one cost model that should be better integrated into the acquisition process.

## MPT Research Program

The MPT research program at the Air Force's Armstrong Laboratory represents a subset of the elements contained in the DoD human systems integration program. MPT analysis represent the most challenging and least researched components within the HSI program.

MPT analysis evaluates human-in-loop costs and capabilities with intent to minimize MPT related LCCs while maximizing system capabilities. To clarify terminology, *manpower* refers to the number of positions needed to operate, maintain, and support a system in its operational environment; *personnel* to the types of people required and their characteristics and skills; and *training* to what they need to know to do their job and what resources (trainers and training systems) will be required to achieve the desired skill proficiency. "This amounts to sizing (M), describing (P), and enabling (T) the work force so that it can accomplish a given workload or function effectively and economically"[7].

To provide the best new, or modified, weapon system at the least LCC, decision makers need up-to-date data and analysis tools. The first Air Force-wide MPT conference[8] held in May 1987 identified that a major problem within the acquisition community was (and continues to be) the lack of an integrated database and analysis methodologies to effectively analyze interrelated MPT issues. The Air Force Human Resources Laboratory (AFHRL — now Armstrong Laboratory, Human Resources Directorate) launched a comprehensive research program to meet the needs of System Program Office (SPO) decision makers in the acquisition process[9]. This program was designed to investigate data and data sources that could be used to support MPT analyses and began developing methods and tools in each of the functional domains to exploit the data. The objective was to develop a collection of methods and prototype tools that could eventually be integrated into a single integrated decision support system. The integrated system would enable acquisition and operational analysts to demonstrate the MPT related costs associated with various proposed weapon system designs, thus allowing design tradeoffs to reduce life-cycle costs.

The research culminated in the MPT Integration Branch awarding a four year, multimillion dollar advanced research and development (R&D) contract to provide acquisition decision makers with just such a DSS[10]. The contract to develop a Prototype Manpower, Personnel, and Training (MPT) in Acquisition Decision Support System (DSS) was awarded (Feb 92) to Dynamics Research Corporation and their subcontractors; Micro Analysis and Design, Rishi Technologies, and Organizational Research and Development. These companies have researchers who are intimately familiar with both the acquisition process and MPT issues and possess the needed knowledge and skilled staff capability to successfully develop an integrated system.

## MPT in Acquisition DSS

This Advanced Technology Transition Development program will provide the first *integrated* tool for addressing MPT requirements during system acquisition and design. The MPT DSS is a micro-level (job task level) tool that will help analysts build a credible baseline of measurable MPT goals and constraints, provide MPT inputs needed for system tradeoff studies, allow analysts to study design alternative implications, and verify whether the completed system development achieved the MPT goals and constraints. The system will automate the extraction of historical MPT data from Air Force data bases and new system data from the Logistics Support Analysis Record (LSAR). This historical data will be used to create a baseline comparison system. As new system information is received, a notional or proposed system configuration will emerge. Finally, a suite of MPT analysis methodologies and tradeoff tools applied to a baseline comparison system (BCS) and proposed system will produce key MPT products needed to support the acquisition and design process. The purpose of the MPT DSS is to reduce defense system's life-cycle costs while improving combat readiness and supportability by identifying and resolving MPT issues *early* in the acquisition of these systems.

The MPT DSS is graphically depicted in Figure 4. This illustrates the micro-level data bases and types of analysis techniques needed to provide a comprehensive, integrated tool. The MPT DSS will support all phases of the acquisition process, from requirements analysis and determination at the Air Force major commands (MAJCOMs) to design evaluation in the SPOs. Primary analysis goals are to validate that emerging weapon system designs meet MPT constraints imposed on that system and to provide personnel and training planners with information and decision processes to establish efficient training and personnel pipelines before weapon system delivery.

The MPT DSS is based on the results of a Manpower, Personnel, Training, and Safety (MPTS) factors in the system acquisition process study completed for the Human Systems Division (HSD)[11], a front end analysis of an MPT modeling architecture[12], and an evaluation of the Army's Hardware versus Manpower methodology (HARDMAN III) suite of MPT tools[13]. Continuing close coordination with Army HARDMAN experts is ensuring compatibility between the tools and avoiding duplication of effort.

The unique capability distinguishing the MPT DSS from Army and Navy HARDMAN research is that it is a cross-domain integrated system. The manpower, personnel, and training domains are interrelated. If an analyst makes changes in any one domain, these changes will most likely effect the other two domains. For example, if you reduce the number of people you plan to use to perform maintenance on a new fighter, you then have to expand the job definitions of the remaining people to cover those tasks that would have been performed by the manpower spaces that were eliminated. Once you have expanded the job descriptions for the remaining people, your training program becomes longer and more complex for both initial and recurring training. Unfortunately, the domains are managed separately, and the reality is that when changes are proposed within any one domain (e.g., the manpower community), those changes may be coordinated with the other domains (personnel and training) but there has been no mechanism available to study the long term impacts of these changes. The MPT DSS will include functional relationships within the integrated system tradeoff analysis methods to automatically reflect the horizontal cross-domain effects of making changes in one functional domain. This cross-domain capability will greatly enhance the ability to demonstrate the cost impacts associated with different policy decisions in any one single domain.

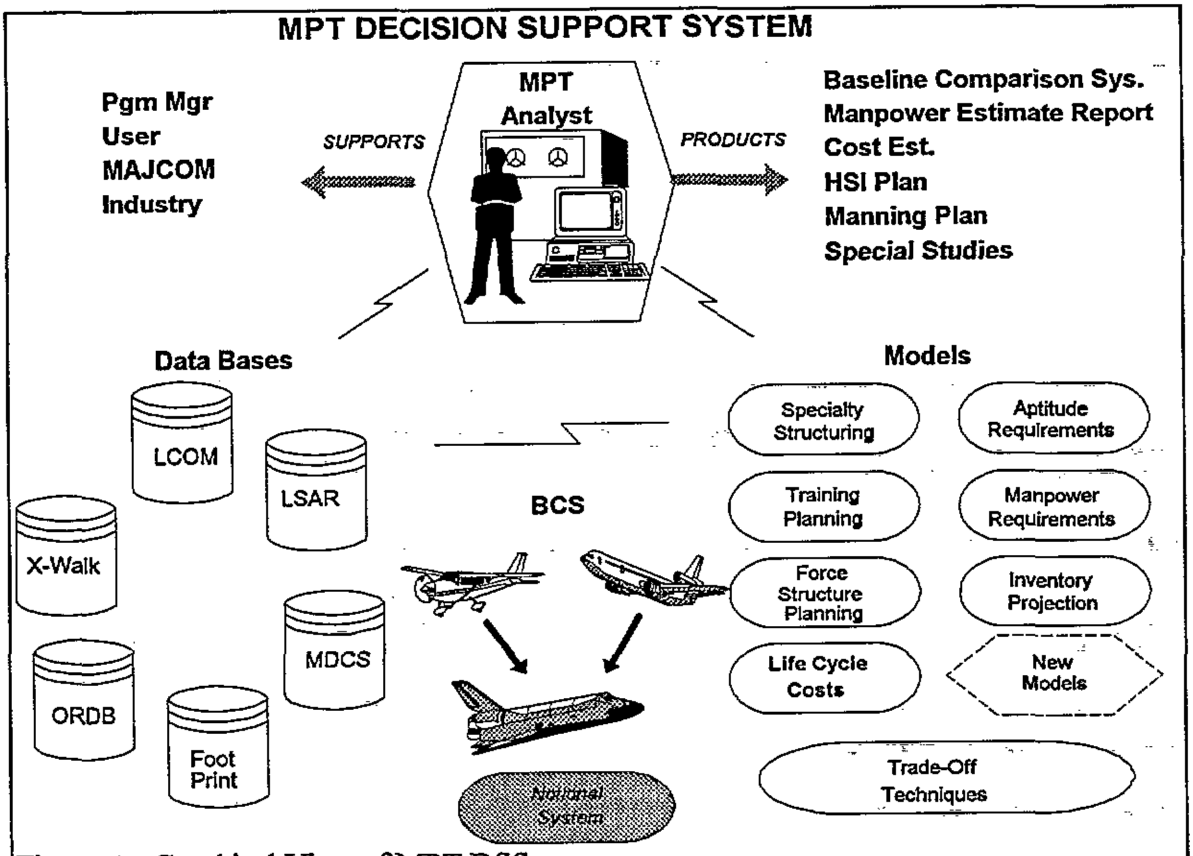

Figure 4 - Graphical View of MPT DSS

The prototype MPT DSS will focus on supporting the MPT analysis of Air Force aircraft systems but will be designed so that it can be applied to any type of system. Application to systems other than Air Force aircraft systems will require analysts to expand existing library files. The MPT DSS will concentrate on assessing MPT requirements for the maintainers and support personnel who work directly on the system in the operational units in which the weapon system will be fielded. More specifically, task-level MPT analyses will be conducted on maintainers and the support personnel whose workload is directly driven by the system. Operator crew size will be an input to the MPT DSS. Total manpower for operators, training personnel, and support personnel whose workload is not directly driven by the system will be determined by Air Force manpower standards that deal with aggregate workload, not individual tasks. The MPT DSS will contain both existing and new analytical tools.

The MPT DSS system consists of three major software components: a System Development Subsystem (SDS), a Data Base Integration Subsystem, and the Analysis Tools Subsystem. Each component is explained in the following sections.

## MPT DSS Software Components

When conducting an MPT analysis, selecting the Baseline Comparison System (BCS) is a significant first step. The SDS will assist MPT analysts in constructing the BCS, populating the BCS task-level data bases with appropriate government and contractor-furnished data, and maintaining and updating the BCS data throughout the acquisition process. The SDS methodology includes techniques to match new system functional, performance, and design characteristics to those of existing Air Force equipment, at appropriate levels of system indenture.

An integrated MPT data base is needed to support the MPT DSS. The system must be capable of extracting and integrating MPT data from external Air Force data sources in a user-friendly manner. The Data Base Integration Subsystem will help Air Force MPT analysts obtain and use the input data needed for an MPT DSS application. The subsystem will request, extract, and process data from external sources; integrate input data within a comprehensive MPT DSS data architecture; and configure the data to support MPT analyses and tradeoffs.

The Analysis Tools Subsystem attempts to maximize the use of existing tools and techniques.

### System Development Subsystem (SDS)

The SDS component consolidates MPT related predecessor weapon system data into a BCS. Then as design information matures, the BCS can be updated to form a proposed system description. The predecessor system is an existing system, or systems, that have components or missions similar to the new system concept. Descriptions of predecessor equipment, maintainers that repair it, manpower standards supporting it, and training courses related to it, provide a "footprint" for a new system. As identified in Logistics Support Analysis (LSA) Task 203[14], a BCS is a representative system construct composed from existing systems/subsystems (predecessor systems), support systems, and lessons learned for performing comparability analysis. The BCS components should approximate one or more of the new system functional, performance, and design requirements. As the system matures and actual design data become available through the MIL-STD-1388-2B LSA Record (LSAR), they will replace the predecessor system data. This will permit continual improvement of system design information, and provide better predictions of Air Force MPT costs and support requirements.

Comparisons between the BCS and the Proposed System are made throughout the acquisition process as the Proposed System design evolves and design alternatives are considered. Comparison of the BCS to the Proposed System requirements in the early phases of the acquisition process help identify areas of technical risk. Comparison of contractor design alternatives to the BCS in later phases also help identify risk areas (i.e., areas for which the contractor is proposing to deliver improvements that are significantly better than what is currently being achieved) and the expected costs of reducing those risks.

Data Base Integration

This component accomplishes two tasks: it links geographically separate data sources and relates data between dissimilar databases.

One of the most difficult problems for an MPT analyst is trying to obtain all of the unrelated data from locations around the country to support the integrated analyses. This burden will be reduced by introducing a system that will automate data retrieval from geographically separate data sources. The automated system will allow the user to check a block on the user screen identifying what data are required. Then, through overnight unattended file transfer over the Defense Data Network (DDN) or by modem connection for direct attended retrievals, the data will be electronically gathered to the analyst's machine.

Another major challenge is the process of relating weapon system specific data (weapon system specific job task lists) to occupational data (e.g., which Air Force Specialties (AFSs) accomplish those tasks). In the past, this process was accomplished by gathering a group of subject matter experts (SMEs) and having them laboriously relate the data. Earlier research[15] showed that we are able to automate the process through a semantic analysis process with about an 80% text match. The SME time required is reduced by about two thirds.

This Database Integration Subsystem will provide the data needed for the BCS library and the suite of analysis tools. Maintenance, occupational, personnel, and logistic data from current systems will be used. Once predecessor systems are identified, the appropriate task-level data will be extracted. This task level data will include system costs, maintenance task data by component, occupational analysis data for job specialties working on the equipment, and training course and cost data conducted on repairing these systems and operating other support equipment. Such data bases will have their task-level data linked and extracted. If data for a specific sub-system are unavailable, then SMEs will be used. Part of this effort will require precise definitions of tasks and comparisons between the actual task statements.

Information about how to investigate the data that are available from various sources will be provided to the MPT analyst in the form of help screens. The generic content and structure of data within each source will be described. For data sources hosted at a single, or a few geographic locations, the help screens will include contact points to whom data inquiries or requests may be directed.

Analysis Tools Subsystem

This component is the core of the MPT DSS. Once the data are available, it must be analyzed and examined. The integrated set of analysis tools will be designed to support a step-wise process model for forecasting requirements based on best information available. This subsystem includes seven analysis methodologies, two tradeoff techniques, and two analysis aids, and a planning aid.

The analysis tools include a <u>Specialty Structuring Tool</u> to structure jobs from the ground up, at the task or task cluster level or restructure a specialty starting from an existing definition; a <u>Personnel Aptitude and Characteristics model</u> to ensure that the collection of job tasks does not require unreasonably high aptitude levels or physical profile characteristics that can't be supported by the current or future Air Force population; a <u>Training Resources and Requirements Tool</u> to project an estimate of resources needed to establish and maintain the training pipeline; <u>Manpower Estimates Tool</u> to determine the number of people required to operate, maintain, support, and train a single unit or squadron; a <u>Force Structuring Tool</u> to aggregate the manpower estimates into wings, groups, MAJCOMS, and force level projections using approved overhead and support ratios (sufficient to support manpower estimate reports required by DoD); an Inventory Projection/Civilian Availability Model to determine whether the civilian populace can support the level of aptitude in the numbers identified from the force projection model; finally, the last model is a LCC model that will present a bottom-line dollar figure to show the MPT related costs of the system.

The individual methodologies briefly described above are useful, but more important are the techniques to permit interaction among the individual tools to tradeoff the manpower, personnel, and training domains. There is a great deal of interaction between each of the domains. Significant changes cannot be made to any one functional domain without affecting the other two. Therefore, functional relationships will be included which describe, in analytic terms, the relations between the various M and P and T factors. MPT measures of effectiveness (MOEs) will be used by the tradeoff process to provide objective criteria – identifiable and explicit– for evaluating MPT impacts of design, operation, and support alternatives. MPT control variables (i.e., the variables that the MPT community controls, and can change, to accommodate a new system) will be identified for each MPT MOE. In conducting tradeoffs, the control variables can be viewed as input variables and the MPT MOEs can be viewed as the outcome variables that are used to assess MPT impacts for all types of tradeoffs (design, support, operations). An MPT Analysis Tradeoff Aid will identify BCS or Proposed System high (cost) drivers from the MOEs. Using these high drivers, an analyst can begin conducting a sensitivity analysis by adjusting the control variables contributing to the MOE identified as a high driver. The MPT Analysis Aid will empower the analyst to conduct tradeoffs in an accelerated mode where only one variable has been changed and the entire analysis (including manpower simulation) will be rerun, or in detailed mode where the analyst can make multiple changes in several different tools. The second tradeoff technique is a Comparison Tool that will let an analyst display side-by-side results of different completed studies. The Comparison Tool uses summary reports and graphics to compare differences between the system, type, and versions. The *system* refers to the type of proposed system you are analyzing, *type* refers to the type of analysis you are conducting, and *version* refers to the specific analysis conducted. By varying the control parameters you create multiple versions of the analysis. The comparison tool allows you to compare these individual versions. These comparisons can demonstrate the relative value of different MPT approaches, allowing policy options or system design differences to be studied. An analyst can converge on an optimal solution before beginning the full documentation needed to complete a study in support of required acquisition documentation.

The analysis aids are tools that will improve the IMPACTS analyst's ability to use the DSS. An integral Navigation Aid assists the user in correctly using the integrated analysis methodology for different types of studies. This technique consists of both a navigation aid visually depicting the steps necessary to complete a particular type of analysis and an extensive context-sensitive help component providing detailed topic-related assistance throughout all stages of the analysis.

The planning aid, the MPT Pipeline Tool, will assist Air Force analysts in scheduling the MPT resources associated with deploying new systems. The pipeline tool will consider training, organizational, and support pipelines, to ensure plans are developed to have trained people where and when they are needed to achieve full operational capability. Outputs from this tool include a master milestone chart that will be a PERT/CPM chart illustrating the time phasing of key MPT resourcing events based on the proposed acquisition strategy. The tool will also provide system training plan information and a forecast of required PCS.

*Training Resources and Requirements (TRR) Tool* – The TRR will introduce training as an acquisition variable earlier in the process than ever before.

Through the use of comparability analysis, training courses and resources associated with specialty training or specific task training will be identified. Since the BCS is the best representation of what the new system will look like made from today's technologies, an empirical data set containing course outlines, costs, and other resources associated with the existing technologies will form a training baseline. Adjustments to the baseline in terms of tasks that are trained, instructional settings used, and task training times can then reflect the cost of these changes and allow training tradeoffs to be conducted.

The objective of the TRR is to implement the front end of the Instructional Systems Development process to the degree necessary to identify and project the training resources (people, methods, aids, etc.) and training requirements (new training) for a new system or technology. The tool will be able to exploit job analysis conducted by the Air Force's Occupational Measurement Squadron or from the MPT DSS personnel aptitude and characteristics model. Based on this job analysis, the TRR will then assist the analyst in selecting tasks to be trained, assign tasks to instructional settings, determine task training times, and determine training resource requirements. The tool is intended to be used throughout a system's life cycle and includes the ability to resource training requirements for all types of Air Force training (e.g., technical training, on-the-job training, field training, etc.). Each of the major steps in the TRR process model are explained below.

Task Selection is an optional step in the analysis but expands on the Air Force's current capability. The task selection model provides capability to select and apply existing, modified, or user-defined task selection models. The TRR includes three existing task selection models: training emphasis used with occupational survey data, training recommendations provided through Logistics Support Analysis Record data, and a 3-Factor model that consist of factors that help determine the importance of training a specific task. The 3-Factor model can be better viewed as a multi-factor model and can be modified in many ways. The three principle factors within the model are: percent members performing a task, the task difficulty, and the mean operational units (e.g., flying hours, miles) between failure occurring. Additional factors, such as hazardous maintenance procedure or task criticality, can be added to the 3-Factor model based on available data and training emphasis. The model can then be a 4, 5, ... up to a 9-Factor model. In addition, the user can define up to two additional unique factors but must manually load supporting data. Each of the factors have a value range and may be further modified with a cutoff value criteria that identifies the tolerance before the model will recommend a task for training. As an aid to model selection or development, the TRR is capable of assessing availability of task data. The custom model can then be tailored to use only those factors that have data available in the system.

A significant advantage of selecting tasks for training early in acquisition is that a method will be available to validate logistics support analysis (LSA) recommendations of what tasks to train. When LSA training recommendations are received, they can be loaded into a notional system construct (database separate from the baseline comparison system) and differences between what was thought needed to be trained and what the contractor recommended for training can be identified. When significant differences exist, further analysis can be done. Through this type of process review, better training programs can be developed.

Another optional step in the TRR model is to assign tasks to instructional settings. This model needs to be used only if the analyst doesn't know the best instructional setting assignment and is looking for recommendations. Once this path of analysis is selected, the analysts can either make a direct instructional setting assignment or opt for the "setting selection model." The setting selection model is based on the training decision logic table in Air Training Command Regulation 52-22, Occupational Analysis

Program, and is the current method used for selecting tasks for training.

The TRR will also identify an occupation's training requirements and provide a graphical output depicting a training career path for an air force specialty. Each course depicted in the pipeline display is costed. This training pipeline is developed from the new system training plan and a review of existing associated courses. The TRR will then allow an analyst to build a course outline that is used as a course-level resource summary in subsequent analyses. These course outlines are built from existing specialty training standards and plans of instruction. As the Air Force's Base Training System and Advanced Training System programs are institutionalized, this development will try to extract this information in digital format. The outlines identify course modules (blocks, units, lessons) and the associated training resources (methods, time, instructors). The analyst will develop course outlines only as needed to determine the cost of a new course. If these costs are already determined because training is provided through contractor supplied training, then course outlines are not necessary.

Once the course outline is built, another model option is to determine task training times. This step predicts task training time for formal resident courses and on-the-job training. The model predicts time to train as a function of weapon system design-related task characteristics and personnel factors. This approach uses modified functional relationships first developed at the training systems program office (Aeronautical Systems Center) in its Training Analysis Support Computer System (TASCS) model. Task training times can be adjusted to reflect skill, knowledge, and ability similarity.

Finally, the model determines student inputs from the output of the MPT DSS manpower estimating tool, determines training man-weeks, and outputs instructor requirements to support the training program. This output is then sent on to the MPT DSS force structuring tool to be summarized in the Manpower Estimate Report.

The empirical baseline built during this training analysis is conceptually completed during milestone 0, concept exploration. The institutionalization of the process will inject training concerns into the acquisition process far earlier than ever before possible. As new personal maintenance aids are introduced and adapted as training aids, we will begin to see a new method of training that can be a driving force for developing maintenance and training aids of the future. This can only be done through effective analyses conducted *early* in the acquisition process.

## Key MPT-related Acquisition Products and Processes

Products of the MPT DSS include the Manpower Estimate Report; Comparative Analysis (LSA task 203); support for LSA tasks 303 – Evaluation of Alternatives and Tradeoff Analysis, 401 – Task Analysis, and 402 – Early Fielding Analysis. The MPT portions of a Cost and Operational Effectiveness Analysis (COEA) can be prepared or validated. Finally, analysis summaries and Human Systems Integration plans in a format needed for the IMPACTS plan and Integrated Program Summary

## Hardware and Software

The system will operate on an 80486 class (or better) microcomputer in a Microsoft Windows environment. Anticipated hardware requirements include 600 MB or more of data storage and 16 MB of RAM. The software will be object oriented and is written in the C++ programming language. There will be full documentation of the entire system, including user's manuals, design documents, technical reports, and detailed system and software specifications.

## Summary

The integrated analysis tool and decision support system will assist acquisition managers, analysts, and MAJCOM planners to effectively integrate people issues (numbers, characteristics, proficiency) with equipment (aircraft) early in the acquisition cycle. Acquisition specialists can use the structured analysis approach provided by the MPT DSS to ensure that system people costs are affordable, jobs are properly structured, and people are trained prior to the system becoming operational. The analysis methodology includes cross-domain effects (interaction between manpower, personnel, and training domains) of different weapon system designs, logistics concepts, or occupational and organizational structures. Different policy decisions can be modeled and the cost impact of those decisions identified. It will provide, in one integrated system, a means of accessing task-level data, analyzing it, and presenting it for review and study at any milestone Through use of this decision support system, the Air Force's IMPACTS program has enormous cost reduction potential in the acquisition and operational communities.

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