THE CHALLENGE OF MPT INTEGRATION*

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ABSTRACT

Integration of manpower, personnel, and training (MPT) planning systems is needed at both the specific weapon system and aggregate levels in order to avoid disconnects and unexpected consequences for functional area managers. Some recent reports on the need for MPT integration are reviewed, and a number of MPT integration needs are identified. New systems that are already under development in order to meet these needs are described. The new MPT planning systems can be organized into three categories: (1) the consolidation of MPT guidelines; (2) the use of computer-assisted techniques for MPT tradeoffs, multi-source input aggregation, and aggregate systems management; and (3) the use of incentives for timely and accurate MPT planning by contractors and aggregate systems managers.

INTRODUCTION

Manpower, Personnel, and Training (MPT) plans do not occur as an afterthought when new weapon systems are designed. Statements of Operational Need and Program Management Directives--which are carefully reviewed by higher echelons--provide direction, guidance, and responsibilities for the design, development, and implementation of new and modified systems. They are the "starting blocks" for the acquisition process.

In subsequent stages, however, the complexity of military MPT management requires some degree of specialization, and this specialization has taken the form that exists today. The manpower portion of the MPT system deals with force structure, modeling, analysis, and the anticipation of requirements and strength figures. The personnel portion of the system deals with the categorization and identification of skills, job classification criteria, grade/rank structure, and selection requirements to fill the force structure. The training portion of the system traditionally takes the people who result from the manpower and personnel processes and provides them with the basic fundamentals and prerequisite skills needed to operate and maintain new and modified weapon systems.

The importance of MPT issues is becoming more and more evident to those involved with systems acquisition and aggregate systems management. These three functions share common purposes, but also have a history of operating independently of each other. The need for integration of M, P, and T becomes critical as we look for responsive and effective planning for future years. Examples of "disconnects" in the process make some of the dangers clear: (a) manpower requirements could be set that cannot be met by personnel resources projected to be available; (b) training planners could develop costly training programs that don't match the skills or needs of trainees; (c) the personnel system might design career progression plans based on previous systems that proved to be entirely unworkable without major force realignment or costly retraining. The complexity of these issues is great, but the problems won't simply go away--they must be addressed.

SPECIFIC WEAPON SYSTEMS VS. AGGREGATE SYSTEMS

The nature of the challenge posed by MPT integration varies depending upon whether one is talking about specific weapon systems or aggregate systems.

In specific weapon systems, the major issues and concerns are ways of influencing the design of a specific weapon system and facilitating cost effective performance by the personnel assigned to it. Qualitative and quantitative MPT requirements, key design characteristics for manning, job aiding, systems maintenance, supporting job structures, and training--all of these must be evaluated with respect to optimum MPT performance for a specific weapon system.

Aggregate MPT systems combine information from several different weapon systems and examine MPT policy issues from an organizational unit, Major Command, and/or Air Force wide perspective. In aggregate systems, the major issues are the availability and affordability of manpower, personnel, and training options in the context of the total force structure and all the other demands that are made upon it. The important objectives are to avoid disconnects and unexpected consequences for M, P, and T subsystems in future years.

* The opinions expressed in the paper are the authors' own and do not necessarily reflect an official position of the Department of Defense or the U.S. Air Force.

NEED FOR MPT INTEGRATION FOR SPECIFIC WEAPON SYSTEMS

The need to consider MPT factors at an early point in the weapons systems acquisition process has been pointed out by a number of advisory groups, including the General Accounting Office [1] and the Defense Science Board [2]. One reason for the concern, as illustrated by Figure 1, is the difficulty in making changes and the subsequent expense if one or the other of these factors is overestimated or underestimated during the early stages of weapon systems development. In response to these pressures the various military services have made a number of efforts to change their procedures, but the results have not always been fully satisfactory [3] [4]. Many of the changes are still in process.

Integrated manpower, personnel, and training plans in systems design are essential, since many different ways of meeting requirements need to be considered. It is sometimes possible to compensate for inadequate manning by providing more job aids, more training, more personnel with higher skill levels, equipment that requires fewer personnel to operate or maintain it, etc. Figure 2, which is based upon on early version of a Navy model developed by Blanchard [5], illustrates the tradeoff options that exist. Ideally these tradeoff decisions are considered at very early stages in the development of a new weapon system--but some tradeoff options will still exist after a weapon system has become operational.

Figure 3 which is taken from the Army's HARDMAN Comparability Analysis Guide [6], contains the basic ingredients of the current Department of Defense approach to estimates of MPT requirements. The Army's system is based upon the Navy HARDMAN approach [7] [8], which was originally based upon some early Air Force work in this area [9] [10] [11]. This Air Force Acquisition of Supportable Systems Evaluation Technology (ASSET) approach did not provide the complete system for supportability analysis and conceptual plans design impact that was originally envisioned, but it did demonstrate the feasibility of conducting various kinds of MPT analyses with implications for reliability, maintainability, life cycle costs etc. [12]. The Army has adopted similar techniques based upon an early version of the Navy system [13], and is currently expanding this approach to include even more areas of responsibility as part of a program called MANPRINT (for Manpower and Personnel Integration) [14].

Actually, few weapon systems program offices follow all of the formalized procedures for considering MPT factors in the way that the regulations prescribe. In one collection of four case studies describing some Army projects, it was concluded that each weapon system bypassed at least one development phase, and with it, several MPT events. The procedural manuals were considered to be complex, cumbersome, and not well understood by either participants or product users; and there was not much confidence in the data that were available:

> "Logistics Support Analysis (LSA) and Manpower Authorization Criteria (MACRIT) currently are the primary sources of data elements used to calculate quantitative manpower (especially maintenance) requirements for a major new material system. However, manpower planners generally have little

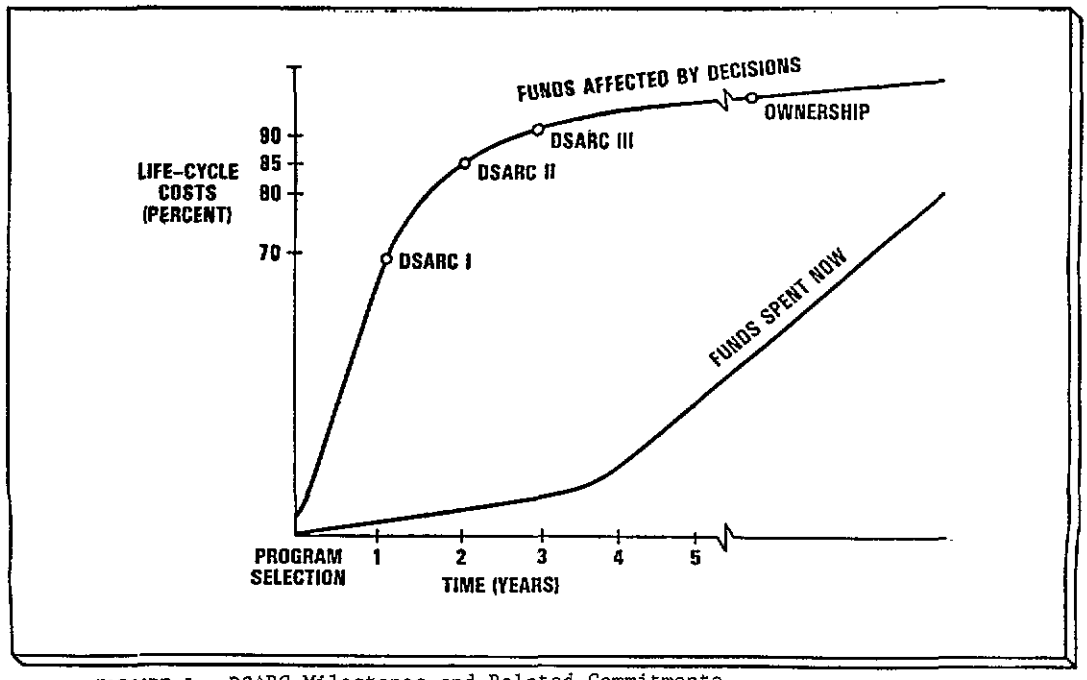

FIGURE 1. DSARC Milestones and Related Commitments. (Source: Defense Systems Management College).

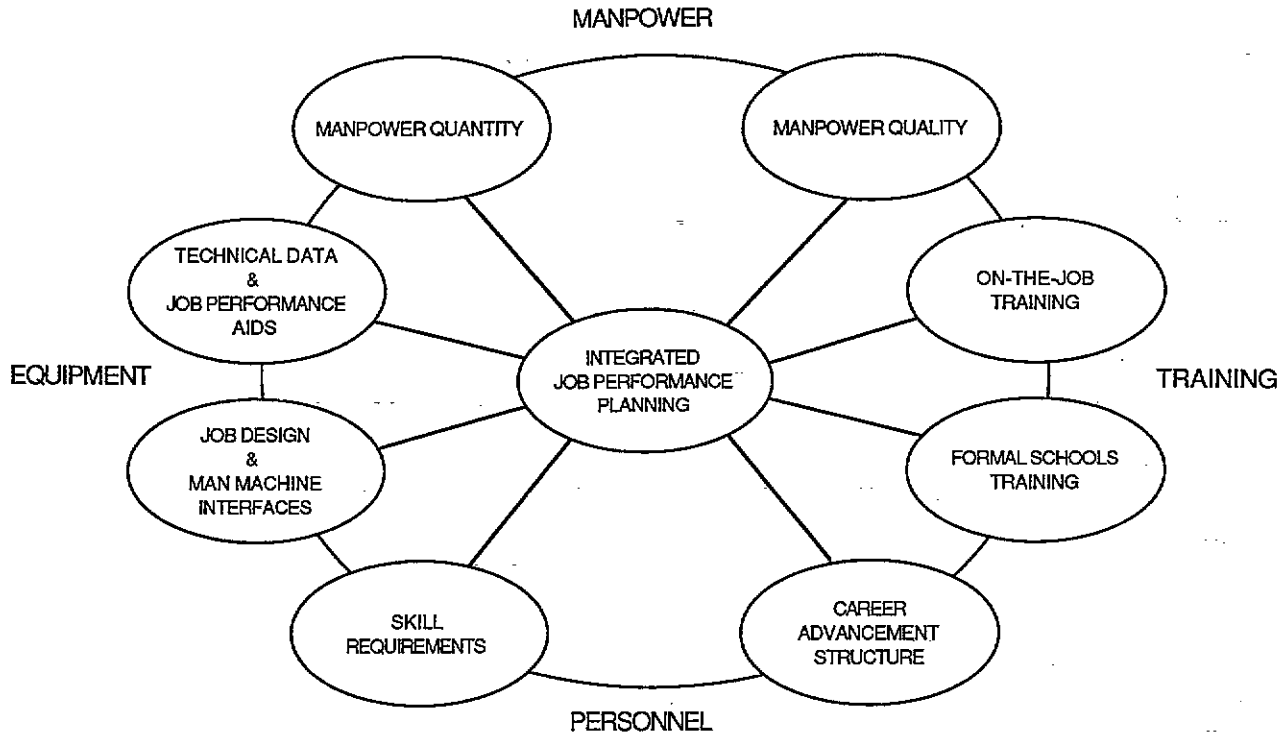

FIGURE 2. Options that need to be considered when MPT Tradeoff Decisions are made. (Adapted from Blanchard, 1979 [5]).

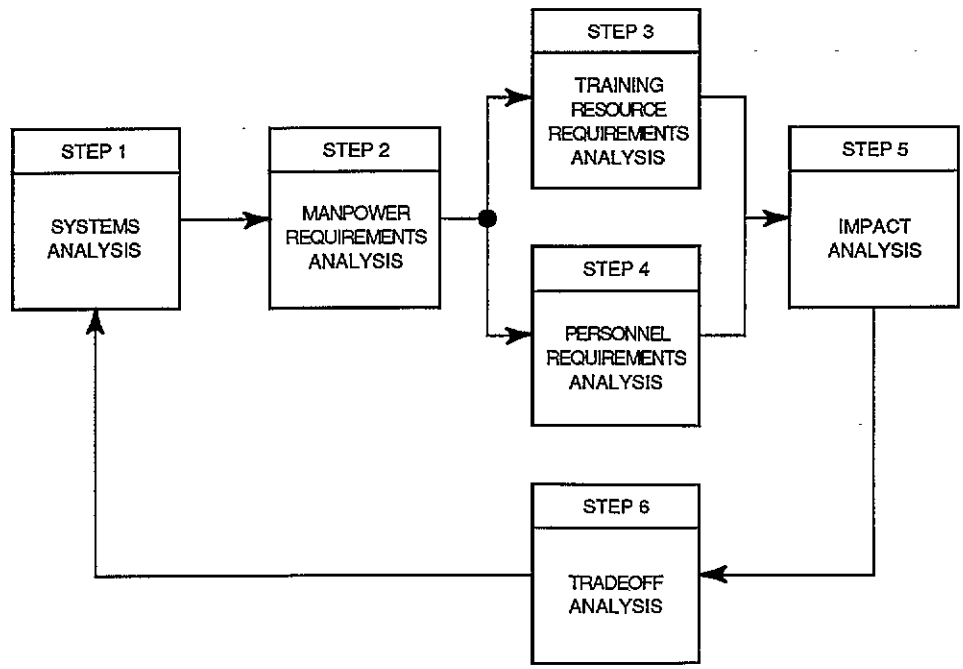

FIGURE 3 Steps in the HARDMAN methodology. (from U.S. Army Research Inst, 1985 [6]).

confidence in the validity of either LSA data or MACRIT factors. This skepticism is compounded by a lack of definitive procedures for applying the data with either consistency or discipline" ([3] pv).

Some specific consequences of inadequate MPT planning in the Army were documented by the General Accounting Office [4] as follows:

"--Maintenance personnel needs for the Black Hawk helicopter system were underestimated. As a result, the Army had to undertake new recruitment initiatives to meet these needs after the system was fielded.

"--Maintenance training programs for the M-1 tank were not developed before the tank was fielded. As a result, the Army will implement programs without formal evaluation of their effectiveness.

"--Flight simulator development for a new helicopter was poorly managed. As a result, with one-third of the helicopters already produced, only one flight simulator was available, adversely impacting training" ([4], p 2).

Similar findings have been reported by Akman Associates [15] for three Air Force weapon systems.

F-16: "No manpower estimates were made until the F-16 approached DSARC II. At this point, the opportunity for meaningful participation in design tradeoff decisions has been largely lost" ([15], p H-2).

A-10: "Though the A-10 followed a standard procurement pattern, like the F-16 it suffered from a lack of early MPT participation, with the initial estimates not being made until almost 11 months after DSARC II. Also like the F-16, the first five A-10 manpower studies failed to include estimates for the Munitions Maintenance Squadron" ([15], p H-3).

E-3A: "Planning for training support for the E-3A proved to be particularly lacking. Funding for maintenance procedure simulators was deferred during acquisition, forcing some basic technical training to be conducted using operational aircraft" ([15], p H-4).

Although the Navy has moved out smartly in developing HARDMAN, the procedures were not always used as consistently or as successfully as one might hope during the pilot implementation program [16]. The aggregate projection models are still very limited, and the Navy does not have quick methods for assessing the MPT impact of alternative fleet sizes and configurations on long range support manpower requirements.

"Because the planning, programming, and budgeting system (PPBS) is so long, involves so many commands, and is so data-intensive, minor changes, such as procuring 10 guided missile destroyers instead of 10 guided missile frigates over the next 5 years, require a long and detailed revision to estimate resource requirements" [17].

THE NEED FOR MPT INTEGRATION AT THE AGGREGATE SYSTEMS LEVEL

Figure 4, which is taken from some Rand Corporation reports in this area [18] [19], is a simplified picture of Air Force MPT decisions at the aggregate systems level during a single review cycle. Figure 5 illustrates how complicated the situation can get if one considers the many iterations through which MPT decisions must go.

Well organized and well structured as Figure 4 may seem, a lot of disconnects can occur. One problem is that changes made in one subsystem may not be incorporated as quickly as they should be into the models and procedures used by another subsystem. For example, a change in the plans for grade allocation by the personnel subsystem may not be incorporated quickly into the grade structure for authorizations by the manpower experts. As a result, manpower offices could be assuming the availability of additional personnel at higher grade levels when they will not, in fact, be available. Disconnects also occur as a result of changes in one part of the system that increase or decrease the requirements in another. For example, a change in reenlistment policies by the personnel side of the house has clearcut implications for the training side of the house. If the number of reenlistments goes up, the training requirements go down; if the number of reenlistments goes down, the training requirements go up. Failure to communicate this kind of information or respond to it quickly can result in overfills or underfills. The training management subsystem can also complicate life for the manpower and personnel people. If the training managers increase the length of a resident course from 3 months to 6 months, they create a need for more people to man the slots that must be filled as well as a need to change the career progression plans.

IMPACT OF COMPUTER TECHNOLOGY

Computer technology is having a dramatic impact on MPT systems and their integration in the Air Force. This is especially true of advances in computer software, embedded systems, and microcomputers.

Advances in computer software make it possible to simulate human assistance and to portray things in graphic terms that are easily understood. It is now possible to conduct computer assisted design, as well as to provide tailor-made visual aids for use in formal courses and OJT information systems. Artificial intelligence and expert systems software permits the creation of tailor-made instruction and job guidance systems. Efficient software for large

data bases and new computer models in the manpower and personnel areas are causing revolutions in data processing capabilities for estimating the needs of new weapon systems.

Embedded computer systems are becoming quite common in new equipment systems. The capabilities of these operational computers have also increased dramatically. In some cases, sufficient surplus capacity exists to support directly embedding operator and maintenance training within on-board computers. The software providing embedded training, if written in an appropriate language, can also be operated on commercially available processors located outside the system. Such embedded training systems can provide cost effective alternatives to traditional approaches to MPT requirements. Embedded computer systems that can be used for training, job aiding, and systems checkout are now quite common. The use of computers in the workplace means that training delivery can be accomplished when and where the incumbent needs it. In many cases the effect will be less requirement for formal training and expensive simulators in future years than is the case today.

The availability of microcomputers is also having a dramatic impact on MPT decisions. Microcomputers are making it possible to deploy computer assisted instruction and computer based information systems to locations that would not previously have been thought feasible. This is very timely, since it is now necessary to redefine MPT requirements so that personnel in generalist Air Force Specialty Codes (AFSCs) that cut across several specialties can perform a wide diversity of tasks with the aid of computer-assisted job aids and complex information systems. Air Force projects such as RIVET WORKFORCE, which is specifically designed to respond to the need for skilled generalists to perform maintenance in future years, are creating a need for even more computer systems, since the generalists will need all of the computer assistance that they can get. Another way to facilitate generalist AFSCs is to restructure the workplace in ways that will decrease the requirements for specialized knowledge (e.g. modular components, standardized tools).

THE CHALLENGES TO BE MET BY MPT INTEGRATION

Table 1 lists seven specific challenges that need to be met if MPT integration is going to be successful. Table 1 also lists various ways of meeting these challenges.

A careful examination of the second and third columns of Table 1 will show that there are basicly three different approaches: consolidated MPT procedural manuals and guidelines; computer assisted systems (which have

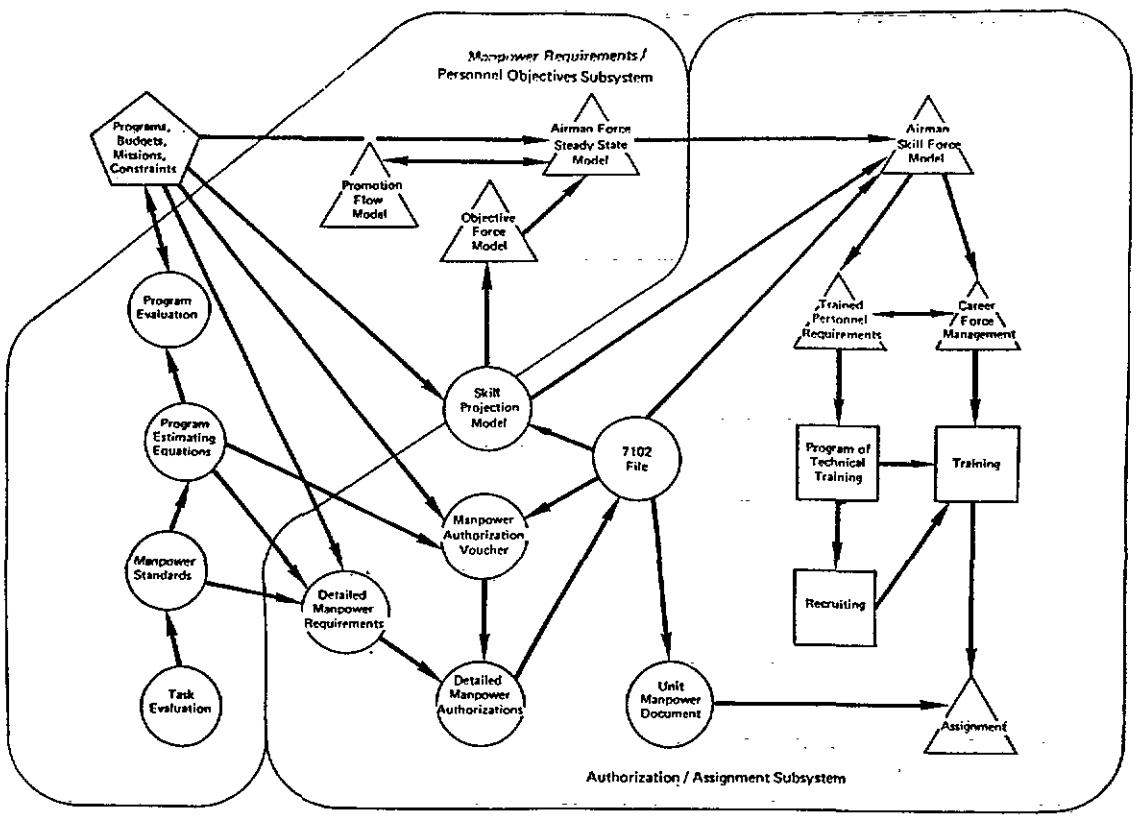

FIGURE 4. The single-cycle manpower, personnel, and training system. (From Armstrong, Chapel, and Moore, 1980 p.5 [19]).

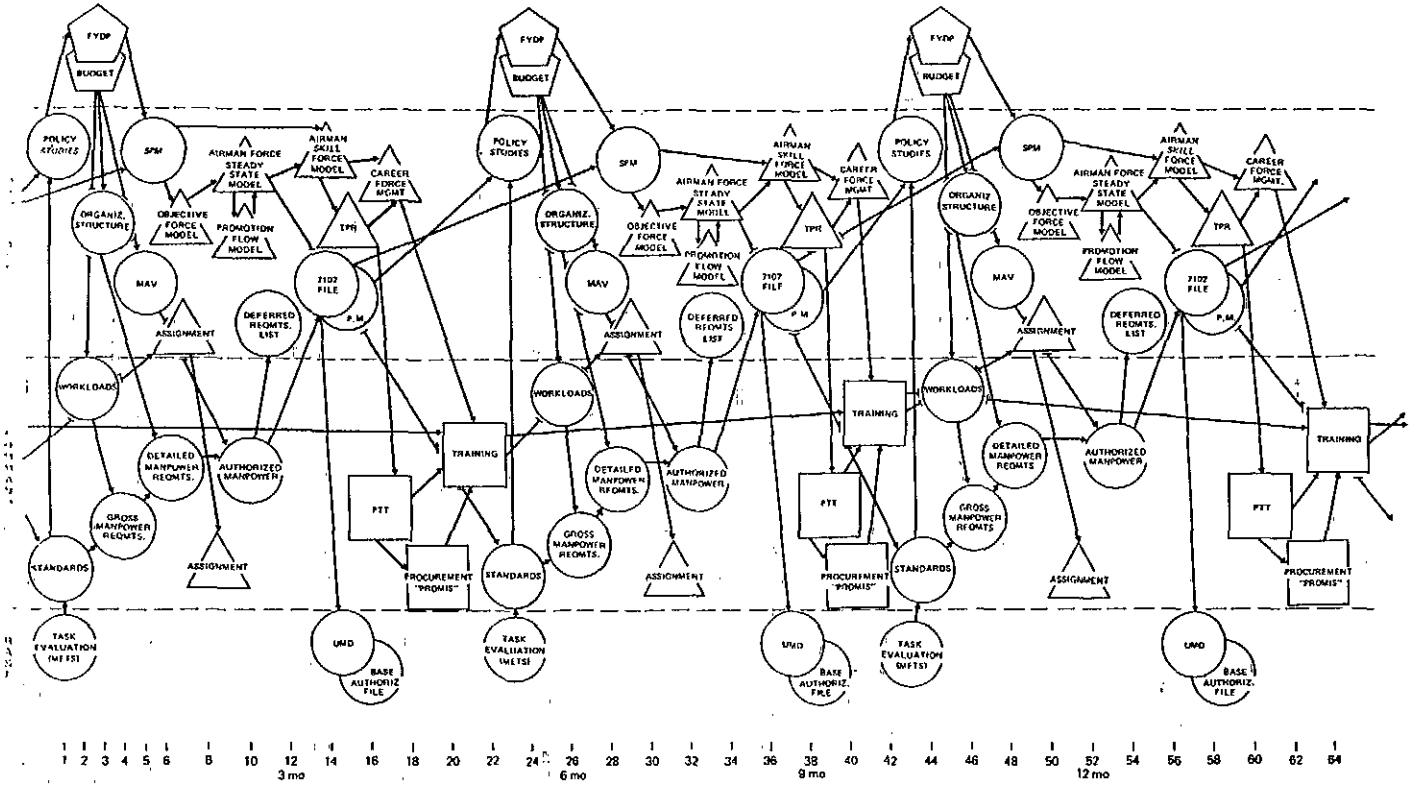

FIGURE 5. An illustration of the complexity of the manpower, personnel and training system when interactive decisions must be made by the organizations involved. (From Armstrong, Chapel, and Moore, 1980 p.4 [19]).

TABLE 1 WAYS OF MEETING THE CHALLENGES POSED BY MPT INTEGRATION

CHALLENGE	AT THE SYSTEM DESIGN LEVEL	AT THE AGGREGATE SYSTEMS LEVEL
How forecast MPT alternatives at an early stage?	Computer assisted information systems, aggregate data bases, and expert systems	Higher level systems that aggregate pre-processed inputs provided by lower level systems
How consider many different alternatives without a lot of paperwork?	Computer assisted task analysis and modeling systems	Systems that consider MPT alternatives incoporated into procedures and software lower level subsystems
How integrate MPT data bases that were designed for different purposes?	Use multi-purpose task analysis as a framework for a common MPT planning data base	Cross-walk capabilities between data bases; modular data bases; and standardized software modules
How evaluate plans when many different MPT alternatives exist?	New MPT data bases and algorithms for evaluating MPT systems	Total systems impact evaluations of MPT alternatives
How give MPT considerations more priority in a cost conscious world?	Specific MPT goals and cost effectiveness incentive contracts	Specific goals and prompt total systems feedback for the managers of those who make MPT planning decisions
How provide MPT flexibility and responsiveness in systems design and operation?	Different modes of systems operation for variable allocations of MPT resources	MPT alternative mix and scheduling plans available to pipeline and operating location managers
How avoid unexpected consequences and disconnects between MPT planning teams?	Use of standardized procedural manuals by well coordinated MPT planning teams	Policy oriented MPT tradeoff decision systems that are well coordinated and up to date

already been discussed); and incentives and goals for contractors and MPT managers.

There are, at present, a large number of different M, P, and T regulations and handbooks. Decisions are often made more or less uniliterally by one M, P, or T manager with less coordination with the other sides of the house than is really needed; or sometimes, the coordination is too late to avoid an MPT disconnect; or the managers may find that they are "locked in" to one particular approach and want everyone else to modify their own plans to accomodate the decisions that have already been made.

There is also not much incentive for people to coordinate long range plans for MPT. Plans extending beyond seven years in the future are typically given minimal support; they are considered to be "soft." It often appears that decision makers don't pay attention to long range plans because they count on the fact that new data will produce significant revisions as time passes. With this kind of attitude, incentives are needed for long range planning per-se.

Contractors also need incentives and specific goals. Contractors tend to resist placing too much emphasis on MPT factors because they are trying to convince the government that their hardware systems are less expensive than those of their competitors. In the past, a sizeable portion of MPT costs has often been a hidden expense in the contractor's proposal because contractors would be punished rather than rewarded for admitting that these costs needed to be considered.

CONSOLIDATION OF REGULATIONS AND PROCEDURES

One way to meet the challenge of MPT integration is to consolidate regulations and develop simplified procedures to enhance MPT reporting requirements. Twelve different Air Force recommendations along these lines are contained in the 1983 Akman report [15]. Some of these recommendations have been implemented, while others are still in process. The most important unmet objectives are to develop specific MPT reporting procedures to replace inadequate ones and to incorporate new and enhanced procedures into consolidated regulations. There is also a need for more progress with respect to shared data bases and information systems.

MPT planning teams are an important part of the consolidation process. Plans for MPT teams that could help accomplish MPT integration in the Air Force are already in process. The current plan is to use the acquisition logistics organizations in the product divisions of the Air Force Systems Command (e.g. ASD/AL, AD/AL, etc.) to integrate MPT plans for the specific weapon systems products being developed by that product division. The focal point responsibility for aggregate MPT systems at the Air Staff level

is shared by representatives of several different Air Staff organizations (e.g. HQ USAF/DPXX, HQ USAF/DPPT, HQ USAF/PRM) which are also operating as teams. Representatives of the Air Force Management Engineering Agency, the Air Training Command, and the Military Personnel Center are also working together as teams on many projects at Randolph AFB, TX.

Another example of progress in this area is the recent development of an integrated MPT systems model and a new MPT systems course by Booz-Allen & Hamilton, Inc. [20] [21]. This work was conducted at the request of the Simulator Systems Program Office (SIMSPO) in the Aeronautical Systems Division of the Air Force [22], and is scheduled to result in the establishment of a one-week Air Force MPT Systems model course at the Air Force Institute of Technology (AFIT).

COMPUTER TECHNOLOGY

Another approach to MPT integration is to use computer technology. The general plan is to collect data with computer assisted techniques, aggregate the various inputs, and then use computer assisted aggregate systems management systems to help make MPT planning decisions.

At the systems design level, computers will be used for: (a) computer assisted MPT tradeoff decisions based upon the use of expert systems; (b) retrieval of data from MPT oriented human factors data bases; (c) the design of modular MPT systems and tools that would simplify MPT requirements; (d) computer assisted MPT modeling of the workplace; and (e) retrieval of relevant information from cost effectiveness data bases and information systems.

At the aggregate systems level, computers will be used to: (a) aggregate dispersed inputs from weapon systems data bases; (b) make long range forecasts based upon projections of future weapon systems capabilities; (c) evaluate emergency MPT resource allocation plans; and (d) project future costs of MPT alternatives.

Some preliminary work on the development of computer assisted techniques has already been initiated in the Air Force. One of these efforts is the design of an Air Force Manpower, Personnel, and Training Integration System (MPTIS). Following up on their 1983 report [15], Akman Associates is developing an aggregate systems model that can be used to help manage MPT resources and requirements. The emphasis is on the delineation and evaluation of MPT support costs for Air Force weapon systems. Specific objectives are: (a) to create an advanced computer-based, decision-support capability to provide MPT tradeoff analyses and total force projections; and (b) to assist the Air Force in managing the personnel system, in determining training requirements, and in developing and fielding new weapon systems. This work is primarily oriented toward aggregate systems of interest to the Air Staff, and is monitored by an Air Staff Office (AF/DPXX) [23].

INCENTIVES AND GOALS

Another approach is to provide incentives and specific goals that can be used to reward contractors for anticipating MPT integration needs at an early point. A similar set of incentives and goals is needed to avoid disconnects and unexpected consequences within the Air Force at the aggregate systems management level. For the contractors, money is the best incentive. For the Air Force MPT managers, the best incentive is to provide prompt cost effectiveness feedback to the managers of those who make the planning decisions.

The kind of progress that could be made with incentives and goals is illustrated by the Air Force Reliability and Maintainability (R&M 2000) program that was signed into action on 1 Feb 1985 [24] [25]. Techniques used to improve the reliability and maintainability of Air Force equipment systems include: clear statements of R&M needs in official requirement documents throughout the entire weapon systems acquisition process; quantitatively stated requirements to select parts that are reliable and easy to maintain; improved source selection procedures that give weight to the past R&M record of the companies being evaluated; the documentation of "lessons learned" regarding reliability and maintainability and their dissemination to all involved contractor organizations and government agencies; contract incentives and warranties that require specific levels of reliability and maintainability; performance-based rather than calendar-based progress evaluation points; simplified systems and well known ("transparent") technologies that do not require retraining of personnel or the creation of new specialty codes; specific requirements for ready accessibility of equipment components when repairs and maintenance tasks must be performed; consolidated R&M plans that can be used to track progress towards the achievement of contractually stated R&M requirements; and an Air Force wide coordinating group (the AF Coordinating Office for Logistics Research) to ensure that new ideas that would improve reliability and maintainability are being put to work in an expeditious fashion.

Organizational centralization is another way of guaranteeing that positive and negative incentives will play a role when disconnects and unexpected consequences do take place--especially at the aggregate systems level. In the Navy, manpower, personnel and training are all consolidated under one Vice Admiral. This kind of organizational consolidation undoubtedly helps the Navy to get things done, and it is possible that the Air Force will eventually consider a similar organizational change at some point in the future.

DISCUSSION

Complicated as it may seem, MPT integration is only part of a larger picture. Ideally, the present paper would have included equipment and

logistics as well as manpower, personnel, and training (with the resulting term being MPTE&L). There are advantages, however, in approaching MPTE&L integration gradually. It is difficult enough to incorporate a single additional software system or data base into an existing system. The complexity increases by a considerable amount if several subsystems are incorporated at the same time; and the current problems at the aggregate systems level are with MPT integration, not MPTE&L integration.

The current Air Force plans are in between those of the Army and Navy in scope and complexity. The Air Force seems to be moving towards a system that is more complex than the bare-bones Navy HARDMAN system--but considerably less complex than the very ambitious Army MANPRINT system. The general feeling is that there are advantages in implementing a complex system gradually and in phases rather than all at once.

Fortunately, the Air Force MPT community is now willing to integrate the various systems. A recent research requirement for MPT integration was sponsored by representatives of seven different organizations, all of which have something to say about MPT plans and policies in the Air Force. With this kind of support, we predict a bright future for MPT integration.

CONCLUSIONS

There are several ways of meeting the challenge of MPT integration in the Air Force. One approach is to consolidate and integrate MPT guidance. Consolidated regulations and procedural guidelines are an essential first step in this direction, but shared data bases and information systems are also important. Another approach is to use computer-assisted technology to help solve MPT problems. MPT planning can be greatly facilitated by computer assisted MPT tradeoff methods, multi-source input aggregation, and aggregate MPT management systems. These computer assisted information systems can help avoid future disconnects by making certain that each part of the MPT planning system is kept up to date regarding the subsystem implications of the changes that are being proposed by other players in the MPT planning process. The third approach is a motivational one. Weapon systems contractors need to be given specific incentives and goals to anticipate MPT requirements at an early stage; and aggregate systems MPT managers need to be given specific incentives and goals for avoiding information delays and unexpected consequences for other parts of the aggregate MPT management system. These three approaches are currently being pursued, and MPT planning systems in the Air Force are expected to improve dramatically during the next few years as a result.

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