MANPOWER PERSONNEL AND TRAINING (MPT) AND THE SYSTEMS ENGINEERING PROCESS

James E. Brown

ASD/ENET
Wright-Patterson AFB, OH

ABSTRACT

The 1987 National Defense Act has had a significant impact on the acquisition of weapon systems. Congress recognized that weapon systems need to be designed with future resources in mind, particularly manpower, personnel, and associated training (MPT). Since the cost for increases in training and personnel came after the weapon system was fielded, Congress now requires the full cost projection prior to full scale development and again before production. The Air Force MPT responses came in two thrusts: first, the establishment of the ASD/ALH MPT organization and second, the establishment of a program for integrating MPT into the acquisition process. The purpose of this paper is to tell how ASD Engineering (ASD/EN) plans to implement MPT into the acquisition of weapon systems through the systems engineering process. MPT trade studies will be accomplished on all ASD weapon system acquisitions with the goal to achieve MPT optimization within the system design.

INTRODUCTION

The concept of engineering consideration of MPT in weapons systems design is not new. However, the formal discipline of requiring an integrated consideration of MPT in the weapons system design process may be new. Past weapons system designs have considered manpower – personnel – and training, but frequently considered them separately from one another.

Manpower refers to the numbers of people required to operate and maintain the weapons system. When skills are

assigned to manpower slots personnel is defined. That is, personnel refers to the skills and skill levels required to operate and maintain the system. Training refers to the system peculiar training required to operate and maintain the system.

In the past, personnel was the linchpin that drove manpower numbers. Training was the recipient of all the decisions that had been made in determination of manpower and personnel. The interactive impact of one major factor upon the other was rarely considered. The MPT initiative represents an effort to insure that MPT is considered in an integrated fashion during the weapons system design process. That is, to insure that trade studies and sensitivity analyses of the impact of MPT decisions are conducted during the weapon system design to optimize operability, maintainability, reliability, automation, etc. The purpose of this paper is to discuss factors that required engineering to place increased emphasis upon MPT in the design process and to discuss what is being done to implement MPT in the systems engineering process.

DISCUSSION

A. Need for Increased Emphasis

The issues identified in this discussion are not presented in any order of importance but rather represent a group of issues that collectively led to the MPT mandate and the DOD response.

1. Congressional concern over user-friendliness of new weapon systems. In the early 1980s several Army weapon systems such as the Stinger Missile and Seargent York

(Point Defense Gun System) were introduced for evaluation. Results of tests on both of these weapon systems indicated that more design attention needed to be given to the population of personnel expected to operate the systems and the impact of these factors upon design of the weapon system. In short, increased training could not make up for design deficiencies.

2. Declining birth rates. The declining birth rate in the USA during the 1970s and 1980s will mean fewer available males and females for the services during the 1990s and beyond 2000. Full employment and declining birth rates have forced the services to consider the available manpower pool and population demographics in the design and fielding of new weapon systems.

3. Congressional irritation over unplanned training and manpower costs. Congress has expressed concern that they are tired of getting the bill for training and increased manpower after a weapon system is fielded. New weapon system acquisition programs are being closely scrutinized to insure that these factors are considered earlier during the design process.

4. Department of Defense (DoD) reaction to needs. The Army has responded to the MPT initiative with their Manprint program which has been in operation for approximately six years. The Navy has a similar program called Hardman. Both programs are well established and supported.

The Air Force MPT initiative has been implemented with two thrusts. First, the establishment of ALH as the MPT organization and secondly, the establishment of an Air Force-wide IMPACTS program. The acronym stands for

Integrated Manpower, Personnel and Comprehensive Training/Safety. The issue of safety has been recently added to MPT as an integration issue.

In 1988, DoD issued Directive 5000.53 titled, "Manpower, Personnel, Training, and Safety (MPTS) in the Defense System Acquisition Process." This document will result in development of regulatory documentation developed by each of the services to implement the directive.

5. 1987 National Defense Act. A major stimulus in the establishment of MPT as a design consideration was the 1987 National Defense Act (as amended by 1989 National Defense Act). This act (now Title 10 USC, Section 2434) has made some significant changes to acquisition of weapon systems. A major change was the requirement to provide Congress with manpower estimates for major weapon systems in the acquisition process for Milestones 2 (Full Scale Demonstration) and 3 (Production). The law requires that for weapon systems acquisitions to proceed into either Milestone 2 or Milestone 3, the Secretary of Defense must provide a manpower estimate to the House Armed Services Committee and the Senate Armed Services Committee at least 30 days (10 days if no significant impact) before approval to proceed into that phase. The manpower estimate must include total personnel (military, civilian, and contractor) required to operate, maintain, support, and train the system. This law is applicable on all major weapon systems after 31 December 1986. The law also specifies that those weapon systems acquisitions in which Congress has an interest shall also fall under the manpower reporting requirement. To implement the law, HQ USAF tasked HQ USAF/PRME to provide guidance and direction. Presently, the Using Command will be the agency responsible for consolidation and reporting manpower numbers to HQ USAF/PRME. Figure 1 depicts the sequence of the process.

MANPOWER REPORTING REQUIREMENTS

Figure 1

To implement the law, it is planned that the SPO (System Program Office) will serve as the conduit between the contractor and the using command. In this capacity, the SPO will task the Prime Contractor to perform the manpower analysis to arrive at estimates. SPO Engineering should insure that the contractor is tasked through the RFP to perform the technical analysis and trade studies to optimize MPT resource requirements within the weapon system design. They should insure that the contractor is proactively working and reporting how the system design is impacted by manpower and personnel constraints. The SPO will assist the contractor to interface with the using command to develop Manpower and personnel estimates based upon the weapon system design. The SPO will provide SPO manning manpower estimates and supporting commands will provide their estimates to the using command for incorporation into the overall manpower estimate submitted by the using command. The using command will consolidate the manpower estimate provided and submit the estimate to HQ USAF/PRME. Figure 2 shows the process that is envisioned.

6. Engineering awareness. With the formation of ASD/ALH in 1986 and the initiation of the Joint study between ASD/EN and ALH to determine roles and missions, senior engineering leadership became more aware that consideration of MPT in the Weapons System Acquisition Process made good design sense. Efforts subsequent to completion of the study in 1987 have focused upon implementation of MPT in the systems engineering process.

B. Implementation of MPT in the Systems Engineering Process

1. The Systems Engineering Process. The Systems Engineering Process is defined as, "A logical sequence of activities and decisions transforming an operational need into a description of system performance parameters and a

MANPOWER ESTIMATE PROCESS

Figure 2

preferred system configuration.” (1, 1974). As it is described, the systems engineering process is a way of controlling the engineering design process to ensure consideration of those variables that impact the design of a weapon system. It is not a specific checklist to be followed but rather an iterative manner of accomplishing design. Figure 3 presents the process described in MIL-STD-499A (2, 1988).

The process starts with inputs from the user who needs an operational capability to meet a deficiency (e.g., defeat a specified threat), take advantage of technological opportunities, or accomplish expanded missions. The inputs are then translated into system design characteristics to meet the requirements. Analysis and trade studies are performed to address all elements that might impact the system design. The trade studies address trade-offs within and across all system elements. Constraints imposed by external factors such as the operating environment, new technologies, organizational constraints, resource constraints, etc., are considered and the design is adjusted. The design criteria are then compared against the evolving design. The final output describes the effectiveness, cost,

schedule, and risk associated with the system.

Recently, Kordik (2, 1988) discussed the systems engineering process and how MPT fits within that process. He described the systems engineering process as, “the mechanism that correlates and integrates the diverse activities needed to field an effective and affordable weapon system.” He further stated, “MPT impacts all elements of the system. It must be reflected from developing subsystems that are simple to repair to simplifying the access to those subsystems. It is not just reflected in terms of maintenance task times but also in fundamental reliability parameters (e.g., induced failures). The ramifications are more than on system cost. They impact system effectiveness through sortie rate or system availability and even on weapon delivery accuracy as reflected through aircrew training or on maintenance crew training (e.g., proper alignment of bomb/nav system). MPT is an inherent design element no more and no less important than any other system element.” (Kordik, 1988). In this context, the process can be viewed as shown in Figure 4.

SYSTEM ENGINEERING PROCESS

Figure 3

SYSTEMS ENGINEERING PROCESS & MPT

Figure 4

As depicted, MPT issues are considered in relation to all the other trades that are made in the systems engineering process. M and P and T are traded against each other within MPT but are also traded against other design factors such as the air vehicle, avionics, maintenance aids, design of the propulsion system, cockpit layout, etc. The MPT trade studies should ensure accomplishment of comparability analysis (comparison with previous like-systems), mission analysis, and task analysis. The key is that all factors that impact design are traded to optimize the capability of the weapon system to accomplish its intended mission in its intended environment while minimizing required resources.

2. Implementation within Engineering. To implement MPT within the systems engineering process, ASD Engineering has initiated several ongoing efforts.

a. Training for Engineers. Two forms of training are envisioned: Awareness training and MPT training for engineers. Since the completion of the joint study between ASD/EN and ALH, Awareness briefings concerning the MPT initiative and what it means to engineering have been provided to all ASD Engineering directorates, SPOs, ASD/XR (Deputy for Development Planning), and other organizations as requested. The purpose of these briefings has been to make engineers aware of the new initiative and to keep them informed of efforts to develop more detailed information to help them implement MPT. Training briefings are being developed to teach engineers their responsibilities and some of "how" to implement MPT in the design process. Care will be given to this training to avoid a "cookbook" approach to MPT implementation since each approach will have to be tailored to each specific program.

b. Documentation Development. To assist engineers in MPT implementation, several types of documentation are being developed. These are: an engineering MPT notebook, and MIL-PRIME / Integrity Documents.

In December 1988, a draft ASD Systems Engineering MPT Notebook was published (3, 1988). This notebook represents a compilation of articles from numerous authors

concerning MPT. Topics covered include: the systems engineering process, MPT documentation requirements, manpower and personnel, test and evaluation, training, reporting requirements and responsibilities, EN/ALH Joint Study results, MPT Acquisition Requirements, crew stations and human factors, Logistics Support Analysis (LSA), Instructional Systems Development (ISD), etc. The MPT documentation guidance contained within the handbook consists of tailoring guidelines for ITO (Instructions to Offeror) requirements and RFP preparation guidance concerning MPT issues to be considered. The notebook represents what is presently known about how MPT should be considered within each of the areas. A condensed integrated version of the engineering MPT notebook will be developed for distribution to engineers for use as a reference/training guide. To supplement guidance provided in the notebook, on-call assistance is provided by MPT experts within engineering.

To institutionalize MPT within the engineering community, consideration is being given to placing MPT requirements within existing MIL-PRIME/Integrity documents. Work is now in progress to accomplish this goal.

c. Tasking to Contractors. Throughout the engineering community there is a concerted effort to insure that contractors are tasked to address MPT issues in the weapon system acquisition process.

d. Development of Evaluation Standards for Source Selection. This is one of the more difficult issues to address. Work is underway within engineering to develop standards with which to assess contractor technical proposals concerning MPT. We are also working to develop "yardsticks" to measure how well the contractor is doing in consideration of MPT issues during a contract.

e. Research and Development. The need for better tools and knowledge to assist MPT integration and implementation became apparent during development of the ASD Systems Engineering MPT Notebook. Assistance has been requested from the R&D community at AFHRL to accomplish the necessary research.

f. SPO Support. The Chief Functional engineers (Structures, Avionics, Systems, and Support Systems) within SPOs will be trained in MPT implementation. In selected instances, MPT specialists will be provided to SPOs through collocation or home office support. Human Factors specialists and Training Systems specialists will bear the brunt of providing initial support. Training programs will relieve some of the pressure but some specialized support will be required for the near term and foreseeable future.

SUMMARY

The engineering community is working hard to implement MPT within the systems engineering process. We have made a great deal of progress during the past year and realize the importance of the MPT initiative. Even more progress will be made during the next year as current development efforts begin to pay off.

REFERENCES

1. Engineering Management, MIL-STD-499A, United States Air Force, 1 May 1974.
2. Kordik, John, "Systems Engineering Process", Tab 9, 2nd Draft Manpower, Personnel and Training (MPT), ASD Systems Engineering MPT Notebook, Dec 1988.

3. 2nd Draft Manpower, Personnel and Training (MPT), ASD Systems Engineering MPT Notebook, Dec 1988.

ABOUT THE AUTHOR

Mr James E. Brown is Lead Training Psychologist, Training Systems Division, Directorate of Engineering, Aeronautical Systems Division, Wright-Patterson AFB, OH. He holds a B.A. in Psychology from Marshall University and an M.S. in Industrial Psychology/Experimental Statistics from North Carolina State University and post-graduate studies at Arizona State University. For the past two years he has organized a core group of training systems analysts to actively address issues in training system acquisition. Until recently, he was designated MPT focal point for ASD Engineering (EN) where he headed engineering activities to implement MPT in the design of weapon systems. He was a prime contributor and editor in development of the ASD Systems Engineering MPT Notebook. Mr Brown provides home office support to the Advanced Tactical Fighter (ATF) SPO working the forefront of MPT issues in aircrew and maintenance training systems. He has over 28 years experience: 10 years in the aerospace industry and 18 years with the government. He has been a program manager, a principal investigator and researcher, and a technical advisor. He has over 40 publications.