

FOOTPRINT: ONE SMALL STEP FOR MPT

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ABSTRACT

Each of the military services are implementing new forecasting methods for Manpower, Personnel and Training (MPT) requirements of major new systems. The primary aim is to make better trade-offs in weapon system design and control MPT resource increases. Footprint is a project under the direction of the Soldier Support Center, in support of Manpower and Personnel Integration (MANPRINT) objectives. An integrated data base has been developed which will enable combat developers to quickly assemble pertinent MPT information early on in the weapon system acquisition process.

INTRODUCTION

In the summer of 1986, the Defense Training and Performance Data Center (TFDC) began the development of an automated MPT data integration technique under the sponsorship of the Army Soldier Support Center (SSC). The goals of this project, referred to as "Footprint," were to develop an automated tool in support of up-front analysis which utilizes existing data bases, and which could quickly display the training related characteristics of an existing weapon system or end item. The compiled data could be produced as a series of standard MPT reports aggregated either by predecessor system or by Military Occupational Specialty (MOS).

The underlying premise of Footprint is that the MPT profile of the predecessor system is the best data available prior to and during the early Concept Exploration phase. The importance of having a reliable MPT baseline during the Concept Exploration phase is underscored by studies which suggest up to 70% of the life cycle cost of a new weapon system is fixed at the end of this phase. Ironically, the greatest opportunity to influence the development of a new system occurs when MPT analysis has traditionally been at its lowest level of intensity.

While comparability analysis methods, such as HARDMAN, are useful techniques to forecast specific MPT impacts, they have a major shortcoming. Because HARDMAN is a complex and time-consuming process, it typically does not yield results until after various design options have been evaluated in detail. Although comparability analysis permits the DoD

program manager to predict MPT impacts accurately, they may predict increased MPT requirements after it is too late to change system design without dramatic cost increases.

The Footprint methodology provides a comprehensive profile of predecessor systems at the earliest phase of the Weapon System Acquisition Process. Footprint MPT reports contain both historical and projected authorizations of selected MOS, along with many other training, performance and force structure issues. These reports provide a practical starting point for the development of the new system, since these are primarily the resources that will be impacted by its deployment. Although the MPT requirements will change as a result of a host of variables such as accessions, MOS restructuring and demands of the new program, there is a need to carefully manage these fluctuations in order to remain within resource limits.

In addition to individual service concerns about the MPT price tag of a new system, Congress has become increasingly active in 1986 and 1987. Section 1208 of the Defense Authorization Act of FY 87 makes it imperative that the services provide the Secretary of Defense and Congress with a comprehensive manpower estimate including training resources, prior to approval for entry into Full Scale Development of a major new system. This requirement coupled with on-going programs to speed up the acquisition process will place Program Managers (PM) in the difficult role of estimating, programming and controlling MPT resources to a much greater extent than ever before. The use of automated

<u>NEW SYSTEM</u>	<u># PRED</u>	<u># MOS</u>
Armored Family of Vehicles (AFV)	36	83
Advanced Anti-Tank Weapon System - Medium (AAWS-M)	1	3
Advanced Anti-Tank Weapon System - Heavy (AAWS-H)	4	5
Multi-Channel Communication Objective System (MCOS)	2	4
Frequency Hopping Multiplexer (FHMUX)	2	4
Electro-Optic Test Facility (EOTF)	9	6
TOTALS	54	105

Table 1. Relation of New System to Predecessors and Associated MOS

data base tools such as Footprint combined with existing MPT analysis techniques, will be essential in supporting new program planning and justification in the coming era of fiscal austerity.

#### SCOPE OF THE FOOTPRINT PROTOTYPE

The scope of the Footprint prototype was limited to integrating existing Army data sources to produce a series of standardized reports for 3 to 5 new system acquisitions. The Army Vice Chief of Staff, the Commander of the Army Soldier Support Center, and the Commandants of the Army Infantry and Army Signal Schools, were briefed on the Footprint concept. To test the concept they selected six new weapon systems, in the concept exploration phase, as candidates for the Footprint prototype. These new systems are shown relative to their number of predecessors and associated MOS in Table 1.

#### OVERVIEW OF THE ARMORED FAMILY OF VEHICLES

The AFV Task Force (AFVTF) located at Ft. Eustis Va, is headed by MG Robert J. Sunell, former Program Manager for the M1 Tank program. The objectives of the AFV program include developing and fielding a force capable of defeating the threat of the 1990's and beyond. The reduction of overall system and force Operation and Support (O&S) Costs is a primary goal. The AFV will be operated throughout the theater by combat, combat support, and combat service support units. The AFV fleet will be the basis of the total Army armored vehicle inventory from the mid 1990's to the next generation of AFV. The AFV will replace the entire range of currently fielded and projected armored vehicles through active Army, Reserve Component (RC), and Army National Guard (ARNG). The AFV will incorporate modularity, component commonality, common battlefield signature, common vehicle electronics architecture, and multiple system capabilities. There are currently 29 AFV roles and mission requirements within the emerging family concept. These are listed in Table 2.

Future Armored Combat System  
 Engineer SAPPER Vehicle  
 Directed Energy Weapon Vehicle  
 Armored Ambulance  
 Line-of-Sight Anti-Tank Vehicle  
 Advanced Field Artillery System  
 Cannon  
 Multiple Launch Rocket System  
 Armored Maintenance Vehicle  
 NBC Reconnaissance System  
 Mortar Weapon System  
 Armored Recovery Vehicle  
 Future Command and Control Vehicle  
 Armored Security Vehicle  
 Combat Mobility Vehicle  
 Light FACS  
 Infantry Fighting Vehicle  
 Armored Reconnaissance Vehicle  
 Fire Support Team Vehicle  
 Line-of-Sight Air Defense Vehicle  
 Nonline-of-Sight Air Defense/Anti-Tank Vehicle  
 Combat Earth Mover  
 Armored Rearm Resupply and Refuel Vehicle  
 Armored Smoke Generating System  
 Combat Gap Crosser (Bridge)  
 Armored Medical Aid Station  
 Elevated Target Acquisition System  
 Intelligence and EW Vehicle  
 Combat Excavator

Table 2.  
AFV Roles and Mission Requirements

In the words of an AFVTF spokesman, "The successful culmination of the AFV program will depend on the ability to create a common integrated perspective of one Army". The AFVTF is chartered with restraining the creation of additional MOS, and must strive to merge existing MOS. In fact, the AFV Justification for Major System New Start (JMSNS) specifies that, "No increase in manpower resources will result from the AFV program." This is particularly significant when considering that the AFV will directly impact at least 83 MOS associated with 17 proponent schools or up to 5% of the active duty Army population. Assessing the potential impacts on these personnel, and developing strategies to minimize the costs associated with the AFV MPT are issues directly supportable by Footprint.

## DEVELOPMENT OF THE PROTOTYPE

### Identification of Data Elements, Formats and Data Sources

With Army concurrence and support, TPDC proceeded with the identification of data elements, data sources, and report formats which would best help the AFV Task Force and Army PM's determine the MPT characteristics of the predecessor systems. The first step was to determine what information was required by MPT data users in the early phases of acquisition cycle. A series of interviews were conducted with a variety of Army personnel including Combat Developers, Training Developers, and Logisticians at Ft. Benning, Ft. Gordon, Ft. Bliss, Ft. Eustis, Ft. Knox, Ft. Belvoir and Ft. Lee. Table 3. summarizes the MPT data areas that were described as a high priority by the interviewees.

#### MANPOWER ELEMENTS

Military Occupational Specialty (MOS)  
Additional Skill Identifier (ASI)  
Language Identification Code  
Manpower Authorizations  
Manpower Requirements

#### PERSONNEL ELEMENTS

Primary MOS  
Duty MOS  
Gender  
Education Level  
ASVAB Composite  
AFQT Score  
Mental Category  
Standing Height  
Sitting Height  
Kneeling Height  
Functional Arm Reach  
Color Vision  
Acuity Vision  
Weight  
PULHES

#### TRAINING ELEMENTS

Training Location  
Course Prerequisites  
MOS Required  
Class Size  
Annual Class Capacity  
Class Length  
Number of Graduates  
Instructor Contact Hours  
Tasks Taught  
Student/Instructor Ratio  
Training Type  
Number of POI Hours  
Number of System Specific Hours  
Number of Instructors

Table 3.  
MPT Data Survey Findings:  
High Priority Items

The survey also examined how the data was used in the system acquisition process in order to identify the most efficient means of displaying the

standardized report formats. The results consistently identified the set of MPT data needed for completing the MANPRINT Target Audience Description (TAD). Other MANPRINT related events identified through the interview process which consistently require MPT data as inputs are Early Comparability Analysis (ECA), Human Factors Engineering Analysis (HFEA), HARDMAN Comparability Analysis (HCA), and New Equipment Training Plans (NETP).

After determining which MPT data elements and report formats were needed, it quickly became apparent that a large number of data sources would be necessary to provide complete support in the early acquisition phase. At this point, in order to remain responsive to the AFV milestones, the focus of the prototype effort shifted to fulfilling the greatest percentage of MPT data needs with the most appropriate subset of existing data sources. Data sources were reviewed for content, completeness, and accessibility. Of those Army and DoD sources identified, five were selected to demonstrate the capabilities of the Footprint prototype.

The selected data sources were the Army Training Requirements and Resource System (ATRRS), the Personnel Management Authorization Document (PMAD), the Army Enlisted Master File (EMF), the Military Entrance Processing Command (MEPCOM) Accession File, and Army Regulation (AR) 611-201. The EMF and MEPCOM tape extracts were obtained from the Defense Manpower Data Center (DMDC). Using the results of the Army interviews as a guide, key data elements were identified in each source.

### Data Extracts, Programming, and Report Generation

After the data elements within each data source were identified and data file extracts obtained, the process of determining exactly how the required report formats were to be generated was addressed. Figure 1 is a conceptual view of how the separate file extracts were merged to form a single Footprint reference file. In the process of developing this reference file, several key file design issues were considered:

- (1) Which data elements allow the merging of data from one file extract with data from another extract?
- (2) How can the various file and data formats be used to form a single set of report formats while preserving the data integrity of each data source?
- (3) What required MPT data elements are not visible in the file extracts, but can be discerned utilizing the existing data?

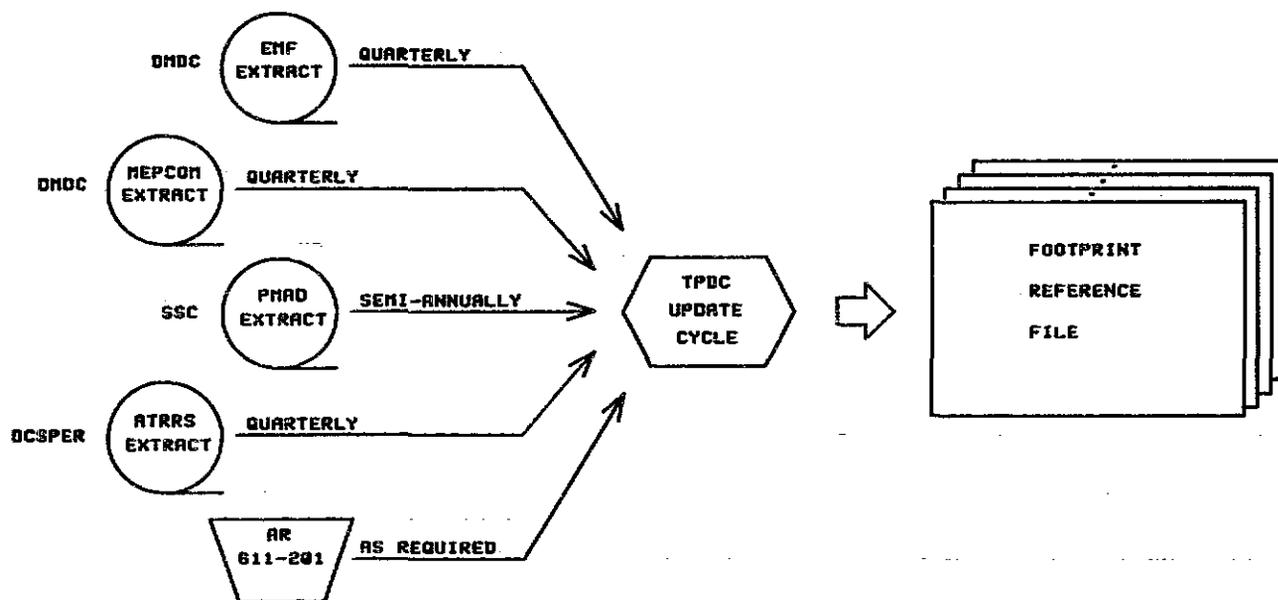


Figure 1. Footprint Reference File Update Cycle

(4) Based on the magnitude of the data file extracts (approximately one gigabyte or one billion bytes), how can the report formats be generated in an efficient and cost effective manner?

All of these issues were successfully addressed during the formulation of the Footprint reference file, and resulted in an integrated system that supports the generation of 27 unique report formats for any enlisted MOS.

Figure 1. also represents the "steady state" process of routinely receiving tape extracts (quarterly/

semi-annually) and updating the Footprint reference file. These tapes represent the most current automated data available, since the update cycle mirrors that of the data sources. In concept, any or all MOS reports could be produced systematically twice a year. If the need arises, "up to the minute" reports can be provided to the services in response to priority requests.

Table 4. lists the titles of the reports generated by the Footprint prototype utilizing the five specified data sources. The reports are grouped into three functional categories; Force

FORCE STRUCTURE

- Primary MOS vs Duty MOS
- Assignment Profile
- Gender Trends
- FY86 Year End Gender Profile
- FY86 Year End Force Structure
- FY86 Authorized Force Structure by ASI
- Authorized Quantities by Unit Identification Code
- Projected Authorized Assignment Profile
- Projected Force Structure Trends

PERFORMANCE INDICATORS

- Accession Quality Trends
- Accession ASVAB Trends
- Mental Category Trends
- FY86 Year End Mental Category Trends
- FY86 Year End Education Profile
- Years of Service Trends
- Retention Rate Trends
- FY85 Year End Retention Rates
- Qualifications for Initial Award

TRAINING PROFILES

- Quantity Trained by Training Type
- FY86 Training for MOS XXX
- Training Course Length
- Training Class Graduates
- Graduate Retention Rates
- Graduate Class Size

Table 4. Footprint Report Titles by Category

Structure, Training Profiles, and Performance Indicators. Each of the functional categories capture one or more aspects of the predecessor weapon system's MPT characteristics.

#### CONTENT OF THE FOOTPRINT REPORTS

A summary of the information contained in each of the 27 Footprint reports is provided below by report category.

Force Structure. These reports quantify the current and projected (required and authorized) composition of a specified MOS. The force is broken out by pay grade, skill level, ASI, Unit Identification Code (UIC), and/or Fiscal Year. Qualifications for initial award of the MOS area also included.

Training Profiles. The reports identify the One Station Unit Training (OSUT), Advanced Individual Training (AIT), as well as other training which has been or will be provided for a specified MOS and fiscal year. The number of enlisted personnel who previously graduated from a specified course and class is presented, along with the length of the class, the course attrition rate, and the percentage of class graduates who have stayed in the service subsequent to course completion.

Performance Indicators. Displayed are the historical trends, by fiscal year, of the population of a specified MOS. This includes mental category distributions, average aptitude scores, ASVAB score distributions (in the qualifying aptitude area), retention rates by pay grade, years of service trends, educational trends, duty location (CONUS versus OCONUS) trends, gender trends, and primary versus duty MOS distributions by pay grade. Further, the mental category distribution, average aptitude scores, ASVAB score distribution and gender trends are also displayed for all accessions of a specified MOS by fiscal year.

#### FOOTPRINT PROJECT STATUS

Footprint reports have been delivered to the U. S. Army Infantry School for the AAWS-M and AAWS-H, to the U. S. Army Signal Center for the MCOS, EOTF, and FHMUX, and to the Armored Family of Vehicles Task Force for the AFV. The reports were provided in two different formats, as complete sets of MOS data sets, and as complete sets of MOS reports grouped by system. The AFV Task Force has provided copies of the Footprint reports to its three prime contractors and asked them to consider their appropriateness as the MPT baseline.

Subsequent to the deliveries, a Joint Working Group (JWG) was formed, comprised of representatives from the Army Office of the Deputy Chief of Staff Personnel (ODCSPER), Soldier Support Center - National Capital Region (SSC-NCR), and TPDC. Other organizations will be selected by ODCSPER, for representation on the JWG. One of the primary objectives of the group will be to work towards the institutionalization of Footprint within the Army as the Automated Target Audience Description Database. Additional areas approved for joint investigation are as follows:

The expansion of Footprint to the other areas required by the TAD guidelines, including anthropometric data, identification of high driver tasks, and performance data.

The expansion of Footprint to include Officer, Warrant Officer, Reserve, and Civilian personnel data.

The process by which the MPT data is "Up-Dated" throughout the acquisition process as more details are learned about the new system.

The best means of providing MPT data to Industry for use in designing the new systems within the specified MPT resource constraints.

#### POTENTIAL APPLICATIONS OF FOOTPRINT DATA

As the Footprint prototype effort began to produce reports and these were reviewed by Army data users, a number of potential applications were noted. Many of these will be used by the AFV Task Force and will support their decision process. The most significant of these are summarized below;

MOS to System Crosswalk. What MOS are associated with a particular weapon system or conversely, what are the various systems a specific MOS supports? (This capability will be provided by the Crosswalk project, which when completed, will serve as a front end to the Footprint).

MOS Restructuring. What is the composition of the present MOS, how are they distributed, and what kind of changes could be made to the organizational concept or force structure to reduce MPT requirements?

MOS Consolidation. When reviewing two or more MOS, what commonalities exist between them, what unique requirements can be eliminated, and what training packages can be consolidated?

Career Management Field Management. What is the status of the MOS relative to accessions, promotions, and

attritions? Which MOS are considered under populated or over populated relative to authorizations, requirements, and actual inventory.

Generic MOS Functions. When comparing multiple MOS with a common generic function (e.g., driving a vehicle), can training be consolidated, can manpower requirements be reduced, and can training locations be centralized to reduce training costs?

Weapon System - Manpower Trade-Offs. When summarizing the MPT of all MOS operating and maintaining a specified weapon system, can efficiencies of weapon system design eliminate undesired MOS requirements?

Distribution of Quality. When comparing the distribution of quality of a particular MOS, or group of MOS to the Army average, is an unequal distribution of personnel quality apparent? Is it significant?

Modification to Training Pipeline. When reviewing the training pipeline(s) associated with specific MOS or groups of MOS, can some high cost or lengthy courses be transitioned to on-the-job training, or embedded training, or can training be reduced through the use of job-aiding or expert systems?

Cross Service Data Exchange. Do comparable systems exist in the other services? What are their associated MPT profiles?

#### CONCLUSION

Results of the Footprint prototype have demonstrated that the integration of existing data serves a multiplicity of purposes that in most cases is quite different than those of the contributing data source. This synergistic effect enables the generation of a wide variety of MPT reports in a fraction of the time previously possible. It provides a historical perspective on various MPT facets which can be used to track MPT changes and reveal significant trends. It can serve as an automated means of modelling a vast number of variables in order to assess required trade-offs.

Initial discussions with services other than the Army indicate that not only is Footprint feasible for the other services, but that the burden of specific MPT requirements could be greatly reduced through the development of such a tool. Whether the tool is developed within each of the services or at a centralized data center such as TPDC, the resulting integrated data set presents a huge potential for identifying MPT constraints early on in the acquisition process.

But the Footprint project is not an end unto itself. The term Footprint

originally referred to the MPT profile of an existing system. The Footprint project has demonstrated that MPT data can be aggregated by selected MOS or MOS associated with a particular system. In other words, the MPT reports can also be provided on any MOS at any point in the acquisition process whether they are associated with the predecessor system, comparable system, or new system. Current efforts are focusing on an integrated approach which will interactively support existing analytical techniques. This capability may one day provide an automated means of generating initial MPT reports, updating and modelling variations, and projecting MPT estimates.

Footprint is one small step for MPT, but one large step towards improving the Weapon System Acquisition Process.

#### ACKNOWLEDGMENTS

The Footprint concept was envisioned by Dr. G. Thomas Sicilia, Director of the Defense Training and Performance Data Center. The term "Footprint" was adopted as a label for the prototype effort.

The tools and methodologies developed would not have been possible without the guidance and foresight of the Soldier Support Center and the leadership of Major General Maurice O. Edmonds and Colonel Richard H. Terrell.

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