MANPRINT* - AN EMERGING SYSTEMS PLANNING METHODOLOGY

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ABSTRACT: *This article examines a new concept in system analysis. According to its developers, MANPRINT is an umbrella concept encompassing human factors, engineering, manpower, personnel, training, health hazards assessment and system safety. The focus of MANPRINT is on total system planning. It examines how the management of material is influencing material system design and associated support requirements so that developmental, nondevelopmental and product-improved systems can be operated and maintained in the most cost effective and safest manner consistent with manpower, structure, personal aptitude and skill, and training resource constraints of the organization. A key point of the methodology is that it emphasizes front-end planning. As currently used by the Department of Defense, MANPRINT integrates system training and material development with personnel resources, capabilities, and constraints during all phases of the life-cycle of material systems.*

KEYWORDS: Information Systems Planning, Materials Acquisition, Personnel Integration, System MANPRINT Management Plan (SMMP)

OVERVIEW

Systems are everywhere. But they just don't happen; they must be created. The systems development life cycle is an organized process for developing and maintaining systems. It helps establish a long range systems plan because it gives an overall "shopping list" of processes and subprocesses needed to develop a system (Kozar).

There are many variations of the basic development life cycle. An international conference reviewed 13 "information system design methodologies" (Olle et al). MANPRINT is not a new idea, however the concept does represent a new methodology. MANPRINT is the Manpower and Personnel Integration in the Material Acquisition Process. This effective methodology was developed by Dynamics Research Corporation in their "HARDMAN" project and adopted by Department of Defense acquisition specialists in 1987. The purpose of this paper is to explain the methodology and provide some insights on how it can be adopted by an organization who desires a long range blueprint for a cost effective approach to future information systems planning. Not all factors may apply to all organizations, but I am confident that a majority of information planners will find the guidelines useful in their future planning needs.

INTRODUCTION

The Planning Stage

Planning is the process of determining ways and means to accomplish a task. The basic and "must do" action for any planner is to visualize the objective in terms of: What, when, where, who, why and how. The planner then uses analysis and a reverse- planning technique of working back to the present and outlining the many tasks and actions that have to take place - and at the right time - to reach that objective. This straight forward approach has been reliable for planners in the past but somehow does not appear to work in long range planning of information systems.

Whether we like it or not, a great deal about future information technology is unknown and it does hamper our long range planning efforts. We can conjure a number of future information scenarios, but are we willing to commit our organization's resources to those future visions? Yet, as information planners we are asked to commit ourselves one, or

*MANPRINT was developed in 1987 by Dynamics Research Corporation of Wilmington, Massachusetts and first applied in the HARDMAN (hardware-manpower) contract with the United States Navy.

even five, years in the future so that organization resources may be allocated to information systems and training. If I were to guess on the form of future planning efforts, one thing appears certain: future planning will take an opposite view of our current information planning methodologies. In fact, I see future plans for both equipment and training taking the form of an umbrella concept encompassing human factors, engineering, manpower, personnel training, health hazard assessment and system safety. It's focus will be aimed at the complete life cycle system management of the organization's resources and will influence system design. It will focus on the most cost effective manner of operation consistent with manpower, personnel, attitudes and skills and training resources constraints of the organization. That is almost the opposite way that organizations currently plan for their information resources.

Components of MANPRINT methodology

MANPRINT refers to a comprehensive management and technical effort to assure total system effectiveness by continuous integration into acquisition of all relevant information concerning the following areas.

1) Human factors engineering
2) Manpower
3) Personnel
4) Training
5) System safety
6) Health hazards

MANPRINT is focused on total system performance, organizational effectiveness, and manpower and personnel utilization. According to Senn, viewing the life cycle as a total system allows the analysis of the life cycle from a systems point of view.

MANPRINT Philosophy

The philosophy of the MANPRINT Program is to have an organization and industry take necessary actions to answer the question: Can this person with this training perform these tasks to these standards under these conditions? This technique differs from the current techniques in that they emphasize building structural models of systems that facilitate communication with the user, (i.e. task definition etc.) and have a thorough understanding of the problem before starting to solve it, and determine the cost impact on the organization prior to full development. (DeMarco)

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MANPRINT Goals and Systems Performance

According to the literature, MANPRINT includes the following goals and system performance objectives:

* Integration of all actions in the material acquisition process affecting human performance and reliability. This includes human factors engineering, manpower levels, personnel requirements, training requirements and methods (including training devices), system safety, and health hazar.

* Developing equipment that will permit effective operator material interaction within the established performance limits, training time, operator aptitudes and skills, physical capabilities, and physiological tolerance limits.

* Determining and evaluating requirements for overall system performance requirements based upon capabilities and limitations of user performance.

* Developing and applying methodologies to analyze human factors engineering, manpower levels, personnel, training, system safety, and health hazard issues in an integrated manner.

* Developing, maintaining, and using data bases containing human factors, human performance, manpower, personnel training, system safety, and health hazard information.

* Selecting, defining, and developing operator material interface characteristics; work space layout, work environment, and effective transfer of operator-maintainer skills for similar tasks on similar equipment. The process of developing and defining a work environment includes detailed analyses of the proposed environment on the health and safety of operator and support personnel. Analysis of the work environment also include consideration of the physical and cognitive demands on personnel based on the operating tempo of the unit in both a training and combat environment.

* Determining human performance requirements for new systems and product improved systems and matching available human aptitudes with training concepts (including training devices and publications) to produce required skills.

* Providing basic operator material system task sequence data to describe, develop, and assess the human performance required in the system.

Figure 2 provides a comprehensive overview of the MANPRINT goals and systems performance objectives.

Industrial/Educational Applications

MANPRINT, to be used successfully in an industrial or educational environment, must be considered and integrated during all phases of the life cycle planning for a new system. The MANPRINT effort for a specific system is initiated when the decision is made to meet an organization's deficiencies by purchasing automated

equipment. Several considerations involve recognizing that:

* MANPRINT in this early phase considers the human element in terms of manpower, capabilities, skills available or achievable.

* Exploration of available technologies and methodologies begins during this phase. Research required to support the training requirement will be conducted to resolve critical training issues. Research to identify what human attributes correlate to successful performance on a given function or tasks may be undertaken.

* The target audience description will be prepared.

* The total organizational and equipment system into which the new equipment will be integrated must be carefully and thoroughly defined.

Requirements/Technology Base

MANPRINT analyses must be accomplished in sufficient detail prior to initiation of system purchase to provide a baseline against which technical approach alternatives and resulting MANPRINT implications can be compared. Additionally, estimates of personnel cost and projection of the cost of retraining personnel with the required aptitudes will be explicitly considered in cost effective analysis and selection of the best technical approach. Cost effectiveness of training programs will be specifically addressed to determine savings resulting from decreased organizational cost. This differs somewhat from the conventional approach in that early requirements are tied to cost effectiveness (Yourdon).

For equipment with a prominent human interface, it is critical to collect and evaluate human performance reliability data to determine whether the proposed system concept will deliver the expected performance using personnel with no greater aptitudes and no more training than planned. Where the conceptual system is a drastic departure from the current system, action must be taken to assure that MANPRINT issues are highlighted and given emphasis in subsequent phases. Also, during this phase, application of various training methodologies and exploration of available training technologies will continue.

Validation

The requirement to conduct a continuing training requirements analysis as part of the validation phase will be documented. The following should be completed at the end of this phase:

* Development of an initial training strategy.

* Identification of special training requirements.

* Special human factors engineering characteristics and training considerations peculiar to the system will be addressed. Operator performance specifications and consideration of personnel aptitudes and skills will be stated.

* User representative participation in preliminary system choice comments are required.

System Plan

The culmination of the above research is the System MANPRINT Management Plan (SMMP). The SMMP is a planning and management guide. The SMMP will be used by all activities involved in system acquisition to ensure MANPRINT issues are addressed throughout the system's life-cycle. The SMMP documents the data that is available or must be generated, how and when the data will be generated, and how it will be employed to address MANPRINT issues and concerns. It provides the proponent with documentation that all available data have been examined and a plan or program established to address MANPRINT concerns throughout material acquisition. This methodology is consistent with the Computer Aided Software Engineering approach (CASE) and does utilize a data dictionary as a central respository for data about the system being developed.

The SMMP also provides an audit trail. The SMMP will document the data sources, analysis, trade-offs, and decisions made throughout the acquisition process. The plan serves as documentation of what was considered and why it was or was not employed. The SMMP provides a source for continuity to lessen the impact of personnel changes on the MANPRINT effort. New personnel can review the SMMP and determine why and what tasks, actions, and analyses have or have not been scheduled and performed, what action must be coordinated and scheduled, and who is involved in the effort.

The SMMP is initiated prior to system acquisition when an information associated system problem arises. Early on during problem identification the SMMP will be vague and in some areas blank. As the acquisition process progresses, the plan will become more specific and definitive. Initiation of the SMMP follows a logical progression. The steps are listed below:

* Identify all potential date sources and analyses.

* Determine current guidance that is available.

* Determine whether a predecessor system (or reference components) exists.

* Examine the list of date sources and determine those which are appropriate for the effort being initiated, those readily available, and those which must be generated; also determine the availability of resources to generate this data. As the program progresses, data sources may be added or eliminated depending on requirements and resources.
* Review the acquisition strategy (which may be extremely vague at this time) and set priorities for when data must be available and when coordination to

have the date available must be scheduled.

System Application

There is a MANPRINT thought process which is applied to ensure MANPRINT is directed at optimizing total system performance by ensuring objectives, concerns, questions and solutions to user/system performance requirements are identified. For example figure 3 exemplifies how performance requirements, objectives, concerns and questions are examined to provide a solution to new system acquisition.

Checklist of MANPRINT and SMMP Components.

Description

a) **Description of the proposed materiel system.** Provide an overview including, but not limited to, the materiel deficiency being addressed, missions, operational environments, design versions or alternatives, and essential total system performance characteristics.

b) **Acquisition Strategy.** Briefly discuss the strategy to be employed.

c) **Agencies.** List the lead agency and all agencies expected to be involved in supporting the system acquisition.

Guidance

a) **Decisions.** List all decisions that will have a direct impact on the design and/or MANPRINT issues.

MANPRINT strategy

Objectives

List the MANPRINT goals to be achieved during the acquisition.

Data Sources and Availability

a) **Predecessor system.** Determine the predecessor or reference systems and components, if any. Consider predecessors for each component of the materiel system, training devices, and repair and support equipment.

b) **Early availability of data/risk analysis.** Discuss the types and importance of data and when it is to be available for inclusion in analyses. Determine its impact on the MANPRINT strategy to be employed and the associated level of risk incurred. Provide the rationale and background employed in deciding how to address MANPRINT issues throughout the acquisition life-cycle.

c) **Planned level of MANPRINT analysis effort.** Identify what and when analyses are to be conducted based on the availability of data and resources. Include how they will affect the risk incurred by the MANPRINT strategy employed.

Concerns

Discuss any issues of areas of concern that have been identified. These are issues to watch during the system's development.

Tabs

a) **TAB A--Data Sources.** List all potential data sources, the MANPRINT areas (manpower, personnel, training, human factors engineering, system safety, and health hazards) addressed and the data item's relative importance to the system's development. This will form the cornerstone for all analyses and planning.

b) **TAB B--MANPRINT Milestone Schedule.** Using a Gantt Chart format, display all significant MANPRINT tasks to be accomplished from research and exploratory development through first unit equipped.

c) **TAB C--Task Description.** For each task to be performed, list the following information (necessary for Tab B preparation):

* Task description (narrative).
* Rationale (why it is necessary).
* Resources (personnel and dollars).
* Time to complete (optimistic, normal, pessimistic).
* Responsible agency (lead agency). * Support agencies.
* Dependencies (tasks that must be completed prior to starting this one).
* Feeds (tasks that cannot start until this one has been completed).

d) **TAB D--Questions to be Resolved.** List any questions whose answers will influence the MANPRINT decisions and tradeoffs to be made. These should be detailed and be specific in nature as opposed to the broad areas of concern contained in the basic document.

e) **TAB E--Coordination.** List all organizations (departments), and activities with whom the SMMP must be coordinated.

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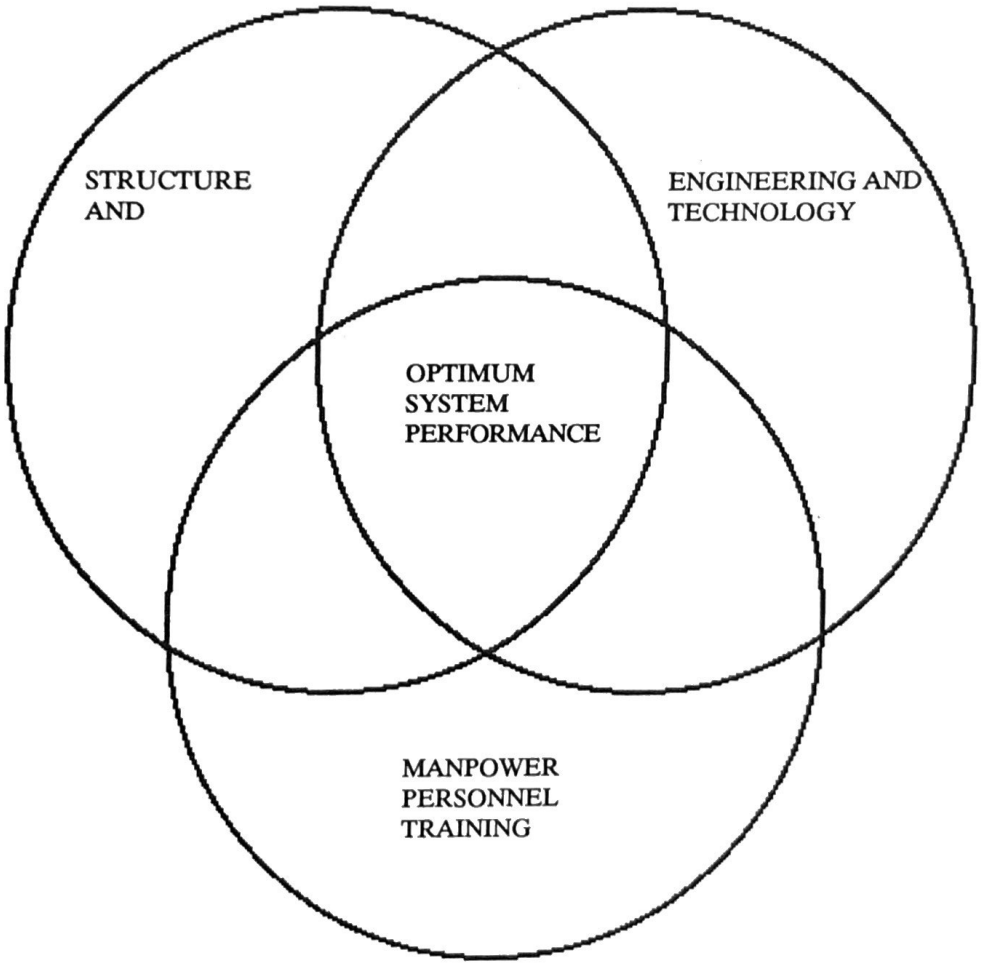
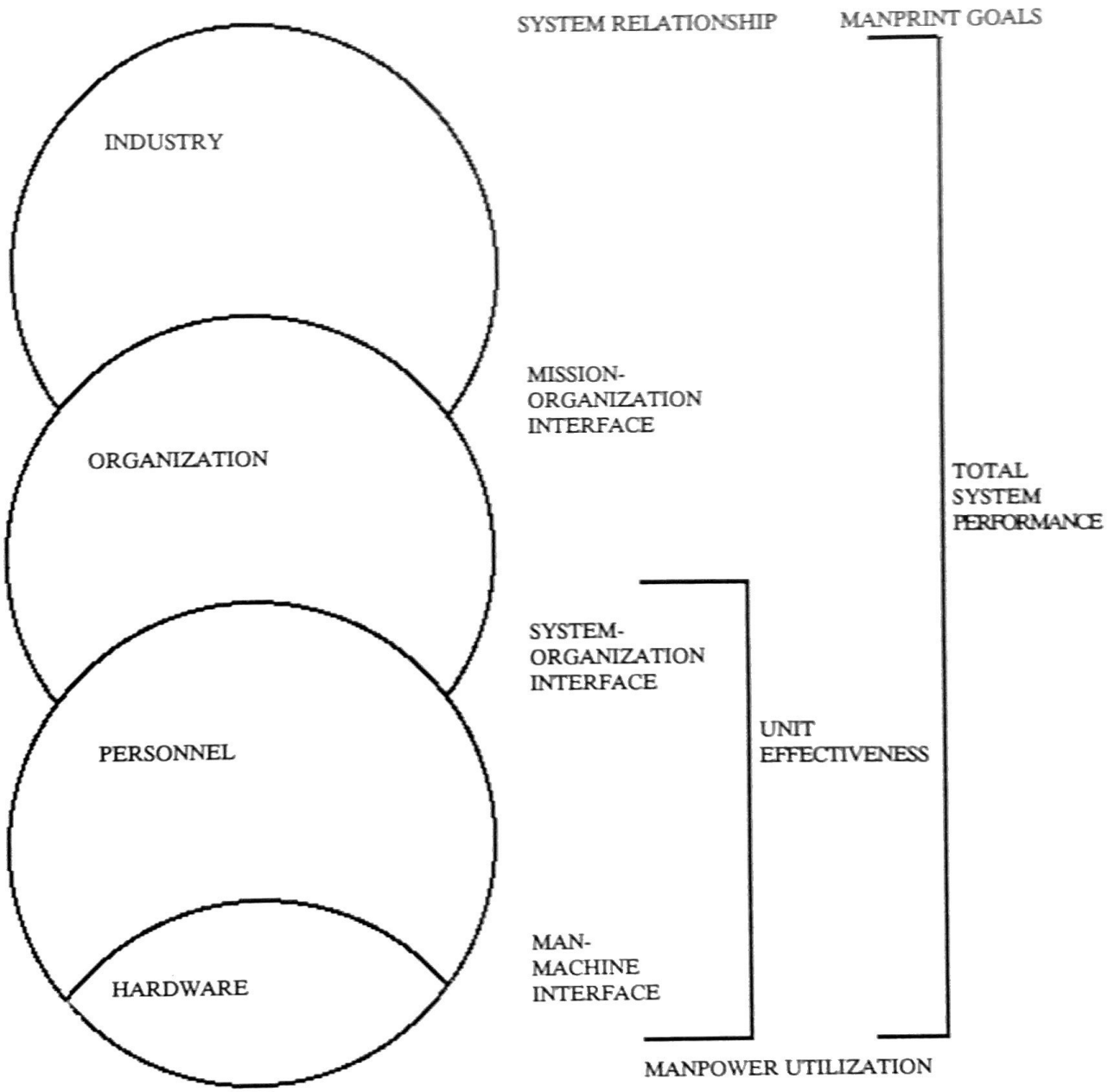
FIGURE 1



MANPRINT - An iterative and mutually interdependent process to improve total system performance. This includes tradeoffs among:

* Structure and environment
* Manpower, personnel and training
* Engineering and technology

FIGURE 2



TOTAL SYSTEM CONSIDERATIONS

MANPRINT is focused on total system performance, organization effectiveness, and manpower and personnel utilization.

FIGURE 3

SYSTEM PERFORMANCE REQUIREMENTS	MANPRINT OBJECTIVES	MANPRINT CONCERNS & QUESTIONS	SOLUTIONS
NEW SYSTEM TECHNOLOGY (ROBOTICS &AND AUTOMATION)	REDUCE MANPOWER	CAN MAINTENANCE TASK BE ACCOMPLISHED?	MANPOWER AND AND TASK ANALYSIS
TASKS PERFORMED CORRECTLY 95% OF TIME	TASKS PERFORMED CORRECTLY BY CANDIDATE	CAN CANDIDATE PERFORM TASK ON NEW SYSTEM?	TASK ANALYSIS AND TRAINING
PREDECESSOR REQUIRED 40 WEEKS TO ACHIEVE PERFORMANCE STANDARDS	REDUCE TRAINING TIME BY TWO WEEKS	WHAT TASKS ARE COSTLY IN TRAINING TIME?	TRAINING ANALYSIS

MANPRINT in this example demonstrates one facet in the thought process of ensuring performance standards and competencies while reducing manpower.

AUTHOR'S BIOGRAPHY

Dr. Richard Cardinali is Chairman of the Management Information Systems Department at Central Connecticut State University in New Britain, Connecticut. He has 17 years experience in system analysis and design with the United States Army, and has taught MIS undergraduate subjects for the last six years. He has authored several journal articles in the MIS field.

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