

ADA 086155

LEVEL III

Research Product 80-4b

Human Performance in Continuous
Operations: Volume II.

Management Guide

Manpower and Educational Systems
Technical Area

December 1979

DTIC
SELECTED
JUL 3 1980

DDC FILE COPY

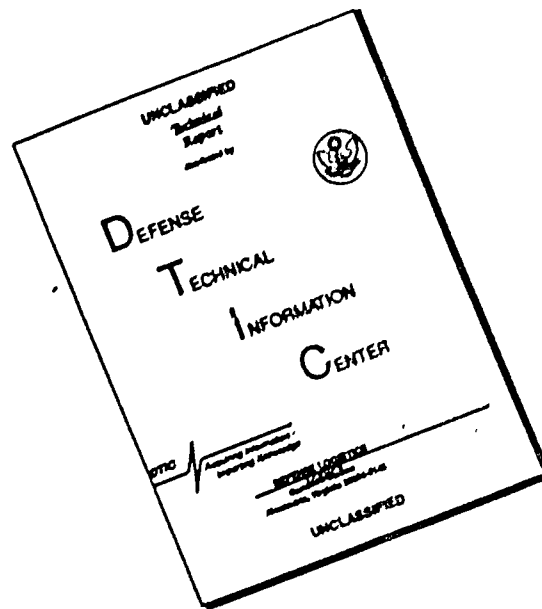


U.S. ARMY RESEARCH INSTITUTE for the BEHAVIORAL and SOCIAL SCIENCES

Approved for public release; distribution unlimited

80 7 1 063

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the
Deputy Chief of Staff for Personnel

JOSEPH ZEIDNER
Technical Director

FRANKLIN A. HART
Colonel, US Army
Commander

NOTICES

DISTRIBUTION Primary distribution of this report has been made by ARI. Please address correspondence concerning distribution of reports to: U. S. Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-TP, 5001 Eisenhower Avenue, Alexandria, Virginia 22333.

FINAL DISPOSITION This report may be destroyed when it is no longer needed. Please do not return it to the U. S. Army Research Institute for the Behavioral and Social Sciences.

NOTE The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM															
1. REPORT NUMBER Research Product 80-4b	2. GOVT ACCESSION NO. AD-A086155	3. RECIPIENT'S CATALOG NUMBER															
4. TITLE (and Subtitle) HUMAN PERFORMANCE IN CONTINUOUS OPERATIONS: VOLUME II. MANAGEMENT GUIDE.	5. TYPE OF REPORT & PERIOD COVERED Technical Jan 1979 - Sep 1979	6. PERFORMING ORG. REPORT NUMBER															
7. AUTHOR(s) Felix F. Kopstein, Arthur I. Siegel and Lawrence B. Wilson Halim Ozkaptan (ARI)	8. CONTRACT OR GRANT NUMBER(s) DAHC 19-77-C-0054																
9. PERFORMING ORGANIZATION NAME AND ADDRESS Applied Psychological Services, Inc. Science Center Wayne, Pennsylvania 19087	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 2Q163743A774																
11. CONTROLLING OFFICE NAME AND ADDRESS Combined Arms Combat Development Activity Fort Leavenworth, KS 66027	12. REPORT DATE Dec 1979	13. NUMBER OF PAGES 156															
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Research Institute for the Behavioral and Social Sciences, 5001 Eisenhower Avenue, Alexandria, VA 22333	15. SECURITY CLASS. (of this report) UNCLASSIFIED	16. DECLASSIFICATION/DOWNGRADING SCHEDULE															
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited																	
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) (18) ARI (19) RP-4-4B																	
18. SUPPLEMENTARY NOTES None																	
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <table border="0"> <tr> <td>Human Performance</td> <td>Continuous Operations</td> <td>Behavioral Implications</td> </tr> <tr> <td>Unit Effectiveness</td> <td>Performance Degradation</td> <td>Performance Analysis</td> </tr> <tr> <td>Personnel Management</td> <td>Human Factors</td> <td>Individual Development</td> </tr> <tr> <td>Unit Development</td> <td>Training Requirements</td> <td>Battlefield Management</td> </tr> <tr> <td>Training</td> <td>Performance Maximization</td> <td>Resource Conservation</td> </tr> </table>			Human Performance	Continuous Operations	Behavioral Implications	Unit Effectiveness	Performance Degradation	Performance Analysis	Personnel Management	Human Factors	Individual Development	Unit Development	Training Requirements	Battlefield Management	Training	Performance Maximization	Resource Conservation
Human Performance	Continuous Operations	Behavioral Implications															
Unit Effectiveness	Performance Degradation	Performance Analysis															
Personnel Management	Human Factors	Individual Development															
Unit Development	Training Requirements	Battlefield Management															
Training	Performance Maximization	Resource Conservation															
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Guidelines are presented for the management of human resources relative to maximizing unit effectiveness during continuous operations. Concrete "ground rules" for personnel management are presented vis-a-vis continuous operations. Steps to take prior to actual combat are given along with methods for controlling performance degradation during continuous operations. Projected soldier effectiveness as a function of battle length and type of unit are presented.																	

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

403 774

Research Product 80-4b

Human Performance in Continuous
Operations: Volume II.
Management Guide

Felix F. Kopstein, Arthur I. Siegel,
and Lawrence B. Wilson
Applied Psychological Services, Inc.

and

Halim Ozkaptan
Army Research Institute

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333

Office, Deputy Chief of Staff for Personnel
Department of the Army

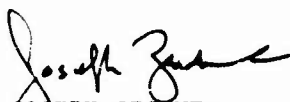
December 1979

FOREWORD

Night and continuous operations place new and unique demands on operating personnel. Effective doctrine and tactics cannot be formulated unless human capabilities and limitations in this environment are understood and accommodated through equipment aids, new operating procedures, and special training, as well as revised manning and rotation cycles.

The most recent product of ARI research on Human Performance in Continuous Operations consists of three volumes. This document, Volume II, provides a Management Guide on how to minimize expected performance decrements during continuous operations. Volume I presents Guidelines to the military user on expected human performance capabilities during continuous combat. Volume III, Technical Supplement, depicts the technical aspects of the development and background data for the information contained in Volumes I and II, and describes the methods for predicting performance degradation. Together they update and replace ARI Research Product 79-8, "Human Performance in Continuous Operations Guidelines", and Technical Report 386, which provided background data. The three volumes provide a body of general and highly specific information about the soldier's tasks on which degraded performance can be anticipated during continuous operations. Such information will be useful to tactical planners, training specialists, and design engineers.

The research was conducted under Contract DAHC 19-77-C-0054, as part of Army Project 2Q163743A774, Man-Machine Interface in Integrated Battlefield Control Systems, FY 1978 Work Program. The research was supported by CACDA/CATRADA at Fort Leavenworth, Kansas, which was the TRADOC sponsor. Special thanks are due to Colonel Robert N. Morrison, Major Michael G. Jones, and Major Robert O. Livingston for their recommendations and cooperation.


JOSEPH ZEIDNER
Technical Director

Accession For	
NTIS GRA&I	☒
DDC TAB	☐
Unannounced	☐
Justification	
By _____	
Date _____	
Approved _____	
Dist	Availa for special
A	

PREFACE

This volume attempts to bring into focus various concepts and considerations important for managing human resources relative to the continuous operations concept. The continuous operations concept has been variously defined. Regardless of definition, the concept implies application of combat power at about the same level of intensity and efficiency throughout the 24 hour day and for extended periods. Accordingly, the soldier will be required to carry out the functions of combat, both day and night, in any weather, and without let up. In this context, the human element will be a dominant factor in the success equation. This Manual attempts to describe human resources management actions which will help in the maximization of the human element factor.

The Manual is intended as an adjunct to a companion volume, Guidelines-Human Performance in Continuous Operations. The companion Guidelines give details about the performance decrement to be anticipated during continuous operations. The present Manual attempts to show how the effects of such performance decrement may be minimized through appropriate management action.

As a set, the two volumes complement one another. Each provides a separate information substrate which will be valuable in achieving and maintaining readiness for continuous operations and in successfully carrying out continuous operations during combat.

A third volume, Background Data for Human Performance in Continuous Operations, summarizes the data and findings of the scientific literature on which both of the other two volumes are based. Its content and format are primarily oriented toward the technical scientific user rather than the military operational one.

The present Manual is organized into several sections. First, a set of "rules of thumb" for human resources management relative to continuous operations is presented. Chapter I describes more fully the purposes of the Manual. Chapter II describes how performance can be expected to decline over a period of continuous action. Chapter II also discusses general strategies which can be employed, such as task reallocation and proper personnel selection, to reduce the extent of the performance degradation. Chapter III presents methods managing human resources problems. Chapter IV tells how to assess such problems and Chapter V gives additional information about how the diagnosed problems may be managed. Chapter VI presents a set of case examples which attempt to exemplify the information presented earlier. Each chapter is believed to be self-contained. Chapters may be consulted individually or the text may be read as a whole.

Appendices contain certain basic and summary information whose background and details are given in Guidelines - Human Performance in Continuous Operations. The summary graphs and tables project the overall degradation of human resources that can be expected over the course of 120 hours of unbroken combat operations.

Quite obviously, the development of a comprehensive text has depended on the contributions of a number of persons. We express our indebtedness to Major M. Jones, Major R. Livingston, and Colonel R. N. Morrison, CACDA/CATRADA for their perceptive comments and early recognition of the human resources issues arising out of continuous operations in future warfare.

Felix F. Kopstein
Arthur I. Siegel
Lawrence B. Wilson

APPLIED PSYCHOLOGICAL SERVICES, INC.
September 1979

RULES OF THUMB
FOR
HUMAN RESOURCES MANAGEMENT RELATIVE TO
CONTINUOUS OPERATIONS



The following facts, principles, and recommendations are taken from or based on diverse recent studies of human resources issues in continuous combat. Elaborations, explanations, and more detailed guidance can be found in the chapters of this Manual which follow these rules of thumb.



RULES OF THUMB FOR HUMAN RESOURCES MANAGEMENT
RELATIVE TO CONTINUOUS OPERATIONS

- Be aware that psychological, rather than physiological, exhaustion is the critical problem in any extended operation.
- When extended operations are involved, anticipate and check to assure that:
 - (1) deviance from SOP and doctrine is controlled
 - (2) cross-checking does not decrease
 - (3) communications effectiveness is maintained
 - (4) decision making is not transferred to group members
 - (5) interpersonal conflict does not increase
 - (6) attempts to "leave the scene," physically or psychologically, do not increase.
- Sleep loss fatigue in continuous operations impacts most on cognitive, decision making, and vigilance tasks. Fatigue due to sleep loss impacts least on highly practiced, physical, or manipulative activity. Assure sleep for decision making personnel.
- Sleep deprivation fatigue depresses the ability to react quickly to the demands of unexpected events and to remember complex details. Anticipate events, develop pre-event solutions, and minimize reliance on memory.
- Well learned and physical tasks are highly resistant to deterioration due to lack of sleep, but tasks with a cognitive or vigilance component are quite susceptible. If possible, organize the combat activities with this in mind.
- The performance of decision makers and those whose jobs involve primarily cognitive skills will be more susceptible to degradation than that of more labor intensive jobs. Rest the leaders.
- Stress tends to be cumulative: combat stress adds to the effects of pre-combat stressors (social, family, etc.) so that a "break-down" level is reached in less time. Assign stress inducing tasks accordingly.
- Commanders (leaders) regard themselves as least vulnerable to sleep-deprivation effects, but, in fact, the tasks they perform are most vulnerable. Make important decisions when you are rested.

- Arousal, due to the "excitement" of combat, does very little for maintaining high levels of performance and may, in fact, degrade it. This effect is most pronounced with mental decision making tasks, but applies as well to heavy physical labor. Anticipate and correct for the effects of degraded performance over the period of a continuous operation.
- Stimulants capable of significantly countering exhaustion invariably degrade the quality of intellectual and high skill motor performance. Do not administer stimulants.
- Concentrate human resources management actions on tasks that are considered critical to combat mission achievement.
- Do not rely on the performance capability of only a few key individuals. This is a dangerous and unworkable policy in continuous operations; it must be possible to rely on everyone to perform as required.
- Do not develop a policy of maintaining the best man for the job in that position at all times.
- Evaluation of team performance should identify the weakest link--person or task. Use the results to strengthen the team.
- Effective and efficient human resources management is contingent on careful, detailed analysis of required effort. Perform the required diagnosis now.

(1) to this end, derive specific and detailed performance objectives for each mission.

- Assessment and evaluation should serve to diagnose factors needing management attention rather than being ends in themselves; the ultimate criterion is demand for performance in actual (not simulated) continuous combat operations.

(1) evaluators at all levels should be given wide latitude and encouragement to ensure that the long range goals of training have been attended to as well as the specific "indicators" designed to quantify readiness. Random selection, by the evaluators, of personnel, tasks, vehicles, etc. would be a step in this direction, as would the use of a large number of personnel from a similar unit as evaluators.

- Use ARTEP evaluations to diagnose deficiencies for combat operations rather than as a performance criterion in themselves.

- Use personnel files to acquire some of the information required for human resources management.
 - (1) use SQT scores in the personnel file as the best initial indicators of individual competence in a MOS.
- Use tactical (training) exercises to evaluate important, mission relevant individual capabilities (e.g., target detection, orientation) and to select personnel for key roles.
- Use individual and team performance records to isolate trends in performance capability.
- Emphasize performance. Variability of performance may be due to a current morale/motivation problem, but this problem is of lesser significance for combat performance than low proficiency.
- Make "sleep discipline" as much a part of unit evaluations as light or sound discipline.
- Rate commanders on their long term response to unit deficiencies.
- Provide some positive immediate incentive for commanding to eliminate the necessity of commanding for promotion.
- Train beyond initial task mastery to produce automaticity, rapidity, and reliability of performance and to counteract debilitating influences of continuous operations.
- Remember that repetition of task performance, i.e., without diagnostic guidance on how to improve, will not assure high and enduring performance capability.
 - (1) Practice should emphasize: (a) what has not yet been mastered sufficiently and (b) what may be fading due to disuse (forgetting).
 - (2) Practice should progress from the "easiest" to the most "difficult" circumstances of task and mission performance.
 - (3) Training must include all aspects of combat performance and include practice under all circumstances.
- Make field exercises, including evaluations, of sufficient duration to ensure the need for shift working. Anticipated duration should not be public knowledge.

- NBC conditions, realistically simulated, must form part of training practice.
 - (1) emphasize NBC protective measures, especially in regard to measures other than protective masks, and also on operating for extended periods in protective gear.
- Emphasize real cross training.
 - (1) cross training is essential at all levels, command included, if any kind of shift work is to be possible (and significant reinforcements from CONUS will certainly not arrive fast enough to avoid shift work), or if the unit is going to survive the inevitable losses of key personnel.
- Prioritize training efforts, including cross training, by relative task vulnerabilities.
- Reemphasize the teaching responsibilities of senior NCOs, as opposed to administrative or supervisory duties, especially in nonclassroom situations such as naturally occurring lulls in field training.
- Use peer instruction as an effective technique for cross training.
- Use "teach back" as a technique for assuring mastery.
- Use feedback of information about correct/incorrect performance, praise, and individual recognition to help learning.
- Make it clear to subordinates at all levels that ability to learn from mistakes is valued, rather than avoiding mistakes at all cost.
- Use time off more often as reinforcement for rapid, competent work. As it is, work slows to meet the required hours.
- Use group identification (esprit) and acceptance as incentives to achieve high performance.
- Encourage the design and use of performance supports or job aids.
- Strive to open informal channels for the flow of information (including adverse, critical information) upward and with the fewest intervening filters.
- Assure that communications (orders) are free of ambiguity and of equiv-
ocality (two or more possible interpretations).

- Provide all soldiers in key communications roles with a standard M17 protective mask, as well as the tanker's M25 model if necessary, to ensure rapid, accurate communications while in position as well as during movements.
- Leadership that combines power (strict orders) with authoritative direction is most called for as passivity and docility increase with the length of a continuous operations.
- Achievement of unquestioned authority requires the combination of leadership (best knowing what to do) with power (coercive reprisal).
- Emphasize a strong esprit (you can't let a buddy down).
 - (1) creation of unit as opposed to personal morale should be given high priority.
- Make the organization's goals clear to every member of the organization. Show each individual how his goals relate to organizational goals.
- Use constructive, purposeful, and well explained training activity to build morale and relieve boredom.
- Morale, stamina, and will to "keep going" are lowest between 0200 and 0600. Schedule with this in mind.
- Neuropsychiatric casualties will occur in a ratio of about one to every four individuals in action.
- Consider eliminating some of the nonmission requirements currently in force. Alternately, make it possible to fulfill these requirements en masse instead of one or two SM at a time, thereby transforming a nagging drain into an opportunity to further group cohesion.
- Recreational use of drugs (e.g., at a party) is far less likely to be a crucial factor in later continuous operations than habitual, addicted use. This applies as well to the use of alcohol.
- During continuous operations, short naps should be taken by everyone; encourage the practice at all levels of command; the display of sleep self denial as an example of self control by command positions is extremely counterproductive. Sleep for leaders is by far the most critical because of the high sensitivity of decision making and other cognitive tasks to fatigue. Emphasize the importance of sleep in sustained operations, orally as well as in writing, by example as well as by decree.
- Especially after the second day of continuous operations, assign men to tasks in parallel. For example, post sentries in pairs, even if this means allowing one to sleep.

- Identify people possessing specific abilities well in advance of the operation. Assign tasks in accordance with these abilities.
- During the operation, assess the current ability of each person. Make assignments in accordance with current ability.
- Don't underestimate the degree of performance degradation, use the Guidebook--Human Performance in Continuous Operations to determine the anticipated degradation.
- Plan your operation in view of performance-degradation.
- Have realistic, long term, continuous operation training exercises.
- Mix rested with unrested men. Platoon partially and not whole units. This implies considerable cross training.
- Match the planned effort to available human resources. Scale down effort required and performance expected for each day of continuous operations.
- Ammunition loaders, and similar "physical labor" duty positions need the least sleep, while the most should go to leaders, technical information processors (FOs, FDC personnel, coordinators), and duty positions involving cognitive (thinking, problem solving) tasks.
- Expect vigilance (e.g., detecting enemy movement) to be marginal after 48 hours of continuous operations.
- As exhaustion mounts (48+ hours), leadership must be more and more assertive; directive communications (orders) will need to be simple and leave no discretion to recipients.
- Training for leadership positions (at all levels) should include human resources planning for extended continuous combat operations.
- Orientation capability for individual persons, teams, and units operating under the worst possible conditions (darkness, exhaustion, stress) should be meticulously preplanned and implemented.
- Make achievement of automaticity in the performance of critical tasks (doing them correctly while "asleep") a goal of training and a part of training evaluation.
- Rotation of roles (switching of duty responsibilities) should be a planned part of training.
- Expect to find after 24+ hours of continuous operations that:

- (1) performance on routine, monotonous tasks will show rapid and severe decrements
 - (2) newly learned and not well practiced skills will be more affected than those that have become "second nature"
 - (3) while recall of newly learned material (discrete facts) is impacted, there is little effect on old material
 - (4) with progressive sleep-loss, brief intermittent lapses in perceptual performance (acquiring targets, detecting movement) will increase in, both, frequency and duration.
- Be aware that communications tasks suffer from sleep loss fatigue in two ways:
 - (1) time required for sending information and number of mistakes will increase, though mistakes may be corrected.
 - (2) in receiving information, errors of omission will increase.
 - You will find wide individual differences in performance after sleep-loss unrelated to intelligence or personality.
 - Sleep-loss has a negative effect on people's mood or disposition: they become depressed, hostile, irritable, etc.
 - With increasing sleep-loss performance becomes uneven more than being uniformly depressed.
 - After extreme sleep-loss (48+ hours) double check any reported observations, because hallucinations are more possible.
 - Take into account that fatigued and pressured persons will try to maintain performance on their primary tasks at the expense of poorer performance on secondary tasks.
 - If possible, a 12 hour period preceding continuous operations should be spent sleeping or kept free of any duties.
 - Note that task rotation in a cross trained team will reduce performance deterioration most for routine tasks and least for complex, decision making tasks; much cross training practice cancels out the latter effect.
 - Mild physical activity, such as walking around, can temporarily alleviate sleep loss effects.

TABLE OF CONTENTS

	<u>Page</u>
CHAPTER I - INTRODUCTION	1
Continuous Operations	1
Focus of this Manual	1
Uses of this Manual	2
Human Resources Concept	3
Task Capability	3
Taxonomy	4
Perceptual-Motor Abilities	5
Mental Abilities	5
Social Abilities	6
Quantitative Expression of Capability	7
Management Controls	8
CHAPTER II - HOW ABILITIES AND PERFORMANCE DECLINE	11
Fatigue Due to Loss of Sleep	11
Military Experience with Sleep Loss	11
Efficiency and Survival	13
Behavior	13
Leadership	14
Fatigue and Vision	17
Fatigue and Hearing	18
Fatigue and Perceptual Speed	19
Diurnal Rhythms	19
Diurnal Rhythms and Numerical Facility	20
Diurnal Rhythms and Reasoning	20
Light and Darkness	21
Darkness and Vision	21
Light Level and Dynamic Precision	26
Light Level and Hearing	26
Stress	27
Stress and Reasoning	27
Stress and Memory	28

	<u>Page</u>
Stress and Perceptual Speed.....	29
Stress and Motor (Movement) Speed	30
CHAPTER III - STRATEGIES FOR HUMAN RESOURCES MANAGEMENT	33
Performance in Continuous Operations	33
Assessment and Diagnosis	33
Determining Current Status	34
Diagnosing Deficiencies	35
Management Approaches to Reducing Discrepancies	36
Task Allocation/Re-Allocation	36
Selection	37
Training	37
Cross Training	38
Performance Supports.....	38
Overview	39
CHAPTER IV - ASSESSMENT OF HUMAN RESOURCES	41
Assessing the Individual	42
Personnel Files	42
Physical/Physiological Characteristics	43
Aptitudes	44
General Aptitudes.....	45
Language Aptitude.....	45
Achievement	46
Skill Qualification Tests	46
Consistency of Achievement.....	46
Other Achievements.....	47
Other Personal Information.....	47
Behavioral Tendencies	47
Integrating Information.....	48
Interviews	49
Diagnostic Guidance	51
Atmosphere for Guidance	52
Followup	53
Assessing Groups/Teams/Units	54

	<u>Page</u>
Individual vs. Team Performance	54
Organization of Individuals and Activities	54
Measures and Records	55
Diagnosis of Team Deficiencies	56
Practical Guidelines to Team Diagnosis	56
Observation and Subjective Assessment	57
Attitudes/ Morale/ Motivation	60
Combat Readiness	61
Empirical Estimates	61
Synthetic Estimates	62
Estimating Performance Under Various Combat Conditions ...	64
CHAPTER V - CONSERVING AND MAXIMIZING HUMAN RESOURCES.	67
Attaining High Performance Capability	67
Allocations of Duties to Positions	67
Selection for Duty Assignments	69
Sensory Ability	69
Motor Ability	71
Cognitive Ability	72
Summary	72
Performance Supports	73
Performance Aiding	73
Other Factors	74
Leadership	74
Communication	76
Motivation and Morale	78
Summary	80
Setting Group Goals	80
Competition	80
Self Esteem	81
Maintaining High Performance Capability	81
Cross Training	82
Task Load Sharing	83
Redundancy of Performance	84
Distribution of Performance	85

	<u>Page</u>
CHAPTER VI - CASE EXAMPLES	89
General Scenario	89
Specific Situation	90
Defensive Order	90
Initial Sequence of Events	91
Types of Examples	91
Platoon Action 1 - Repelling an Attack from a Battle Position	92
Case 1--Mechanized Platoon	92
Case 2--Tank Platoon	94
Case 3--FIST	96
Case 4--Artillery Battery	97
Platoon Action 2 - Creating and Defending a Strongpoint	98
Case 5--Mechanized Platoon	99
Case 6--Tank Platoon	100
Case 7--FIST	101
Case 8--Artillery Battery	102
Platoon Action 3 - Disengaging and Occupying a New Battle Position	103
Case 9--Mechanized Platoon	103
Case 10--Tank Platoon	104
Case 11--FIST	105
Case 12--Artillery Battery	106
APPENDIX A	109
Critical Task List	111
Projected Effectiveness (E) for Critical Combat Tasks	119

LIST OF EXHIBITS

<u>Exhibit</u>		<u>Page</u>
1	Partial Checklist for FDC Performance.....	59

CHAPTER I

INTRODUCTION

The purpose of this Manual is to provide guidance toward the effective and efficient management of human resources in the continuous operations situation. The guidance is either technical guidance, or it is derived from technical human factors considerations. It is not to be confused with approved doctrine, nor should it be viewed as modifying such doctrine. Rather the contents of this Manual present issues for consideration and suggestions for coping with them. However, the appropriate management decisions must take into account other factors. Accordingly, the information presented is only part of the totality on which an optimal command management decision may be based.

Continuous Operations

The continuous operations concept is not new, nor has the optimal conduct of operations at night or over a long period been fully determined. Certainly, in continuous operations, human capability will be degraded to a level below that which is usually found in the human factor of the total success equation. The question then is one of the degree to which this capability is degraded during continuous operations and of how and to what degree the degradation can be counteracted. This Manual is addressed to these conditions and to these issues.

Focus of this Manual

Military planning and management have been largely oriented toward attrition in overall combat mission capability resulting from personnel casualties and materiel loss. Continuous operations accentuate the need to consider additionally an attenuation of mission capability that derives from the progressive diminution in or degradation of the performance of each and every member of a fighting military unit. When operations extend into the hours of darkness, for example, visual capability is severely reduced. This decreases the ability to process color encoded information, reduces distance vision, interferes with orientation and communication, and so forth. Decrease in the ambient temperature at night reduces muscular mobility and, especially, the facility for fine manipulations. These are but a few suggestive examples. As operations continue without let up into subsequent days and nights, these and other decremental effects are intensified by the cumulative buildup of physiological fatigue and sleep loss. The military capability of any given unit after four or five days of intensive continuous operations will be far below the level that existed during the last ARTEP based evaluation exercise or at the beginning of the continuous operation. This will be true even if the unit in question was to suffer no losses in materiel and personnel.

What are the uses of an exhausted military unit? What reliance can be placed on such a unit's ability to perform its functions? How can the remaining potential of a unit or combination of units be estimated realistically at any stage of a continuous operation? To what extent and by what means can the cumulatively degrading effects be offset? These and similar questions are basic to careful military planning and to effective military management.

The intent of this Manual is to provide some of the answers to these questions in a form that is useful to the military planner and manager. In doing so, the Manual draws on the data, analyses, and findings of research to identify and evaluate those factors which emerge during night and continuous operations and adversely affect human performance. The Manual interprets this information for the military planner/manager. It explains the nature of these adverse factors, how they operate, and what can be done to cope with their effects. While the actual management of these factors remains the problem of the individual planner/manager, the Manual suggests useful procedures for attenuating the impact of human performance degradation on night and continuous military operations. The Manual considers the full range of activities that might be considered--from the pre-combat training stage through the combat stage itself.

Uses of this Manual

This Manual will be found useful to anyone exercising military command responsibility from the lowest level of combat organization to, perhaps, battalion level or even beyond. Human resources and the effects of their degradation interact with command and management considerations at all levels of the command hierarchy. For that reason, it will similarly be found useful by persons who perform staff and planning functions. Last, the Manual will provide much useful information and significant suggestions to military elements responsible for defining personnel functions, specifying duty allocations, delineating training development, and designing devices that support human performance.

The Manual will be useful when contingency plans are prepared that include the possibility of night and continuous operations. This usefulness will extend to the time when such plans are implemented and the problem is one of management of such operations--whether in tactical exercises or actual combat. However, the applicability of information in this Manual is by no means limited to acute situations. Rather, it will also furnish important guidance to efforts to increase effectiveness under many adverse conditions. This guidance will be similarly useful when considering diverse technical developments in support of any or all of the previously mentioned purposes.

Human Resources Concept

Human resources include all of the components in a military organization's capability or effectiveness that relate to human beings and human characteristics. Whatever the nature of the military organization, it is considered to have certain capabilities with respect to missions or mission objectives. Some of these capabilities derive from weapons and their characteristics. Others derive from logistics. Still others may derive from the way the logistics of the unit are organized. In short, the overall mission capability can be analyzed into its component factors and the relation of these factors to each other, i.e., their organization. The reverse is also true. Each of the component factors--the relevant properties of men and material--can be synthesized into an equation for predicting capability with respect to given mission objectives. Human resources are the aggregate of the human factors in such an equation.

In discussing human resources and their management in this Manual, the emphasis is on performance. Can and will the individual or group do what is required to achieve the specified objectives? Individuals, singly or in combination, must carry out their assigned tasks successfully. The degree of success in task execution is a factor (variable) that enters into one side of the equation of which the other side is mission success. In turn, analogous equations govern the degree of success for any given component task. Human resources, in this sense, are equivalent to the performance capability of the aggregate human component in the overall military unit. Their effective management is a matter of knowing the variables that govern task performance and manipulating them appropriately. "Capability" implies a future potential for actual performance and not necessarily a momentary actuality of performance. The issue is whether the individual, team, or larger unit can/will deliver the requisite performance when called on to do so. Performance capability equates with the concept of combat readiness.

Task Capability

Just as a military unit's performance capability or readiness is the product of specific task capabilities possessed by individual members of the unit, each task capability is the product of a variety of underlying factors. These factors might be thought of as representing "subsystems" within the individual. For example, the ability to see is critical in a great many military tasks. To destroy an enemy target with a machine gun, the gunner must: (1) detect the target, (2) aim his weapon, (3) observe achieved hits and misses, and (4) observe achieved target destruction. While other abilities related to other "subsystems" also enter and determine success in this task, vision is clearly a major factor. Further, visual ability is not either present or absent, but is itself determined by several factors. The degree of visual ability is determined by such variables as ambient illumination (amount of light

present), the size and distance of the target, its contrast ratio with a background, the visual acuity of the gunner, and so forth. Abilities may be of a sensory (e.g., vision), motor (e.g., finger dexterity), or a cognitive (e.g., reasoning) type. A person may be born with them, or they may have been acquired after birth. They may be dependent on "hardware." Whatever their nature, abilities contributed by subsystems within each person are critical determiners of that person's task performance capability.

Abilities are not uniformly constant or fixed. For any ability, there are factors that tend to depress the degree of the ability that can be brought to bear, and with diminished ability task performance is affected negatively. For example, detecting enemy movement is one of the tasks of a Gunner and Carrier Team Leader (G/CTL) of an armored personnel carrier in the mechanized infantry. This task requires the G/CTL to detect whether or not an enemy target, such as a tank or BMP or other vehicle, is approaching the G/CTLs location. At times, this task may have to be performed on a very dark night. The visual ability of the G/CTL to detect the oncoming target in this situation is depressed by any one or all of these factors: (1) the target is too dim, (2) the target is moving slowly, (3) the target moves over a small distance only, or (4) the G/CTL uses (or must use) monocular vision. Not only will the effectiveness of this task performance be far less at night than during the day, but the degree of the visual ability that can be mustered and, consequently, the effectiveness of the task performance at night will be determined by these factors. We note that vision is by no means the only ability that can be depressed by adverse factors, nor is it necessarily the one that is most vulnerable to degradation.

For any given task there will be some existing abilities that are irrelevant while certain others will be critical to successful task execution. In the target detection example, finger dexterity will be irrelevant while vision is obviously critical.

Taxonomy

This Manual emphasizes those tasks performed by a limited set of duty positions in selected kinds of military units in the context of continuous operations. These restrictions define the set of relevant abilities, and they also define the set of factors that affect these abilities adversely. As part of the research whose data, analyses, and findings furnished the substantive information for this Manual, a taxonomy of relevant abilities was developed. The taxonomy includes perceptual-motor, mental, and social abilities.

Perceptual-Motor Abilities

- (a) Vision--the ability to detect visually objects and relations among objects such as movement or relative distances
- (b) Hearing--the ability to detect significant sounds amid competing sounds
- (c) Strength--the ability to move objects using the body and limbs
- (d) Impulsion--the ability to react quickly to light and sound by making rapid movements such as running and jumping
- (e) Motor Speed--the ability to maintain a high personal tempo and perform accurately using arms, hands, and fingers
- (f) Static Precision--the ability to maintain good body balance and arm steadiness while aiming
- (g) Dynamic Precision--the ability to maintain body balance and make accurate aiming movements while the body is in motion.

Mental Abilities

The mental abilities included in the taxonomy are:

- (h) Numerical Facility--the ability to add, subtract, multiply, and divide (including when they are part of other questions such as finding percentages or cosines)
- (i) Verbal Facility--the ability to use and understand written and spoken language
- (j) Memory--the ability to remember information such as words, pictures, and procedures
- (k) Orientation--the ability to orient in three dimensional space
- (l) Reasoning--the ability to apply rules to problems and to derive answers or decisions, or to combine units of information to form a rule or to produce a set of rules necessary to arrange things or actions in order
- (m) Perceptual Speed--the ability to compare letters, numbers, objects, pictures, or patterns, present or remembered, both quickly and accurately

Social Abilities

The social abilities included in the taxonomy are:

- (n) Social Coordination--the ability to coordinate activities with one or more members of a group or to give direction or orientation to one or more members of a group
- (o) Communication--the ability to transfer required and/or relevant information in proper depth and scope at the proper time.

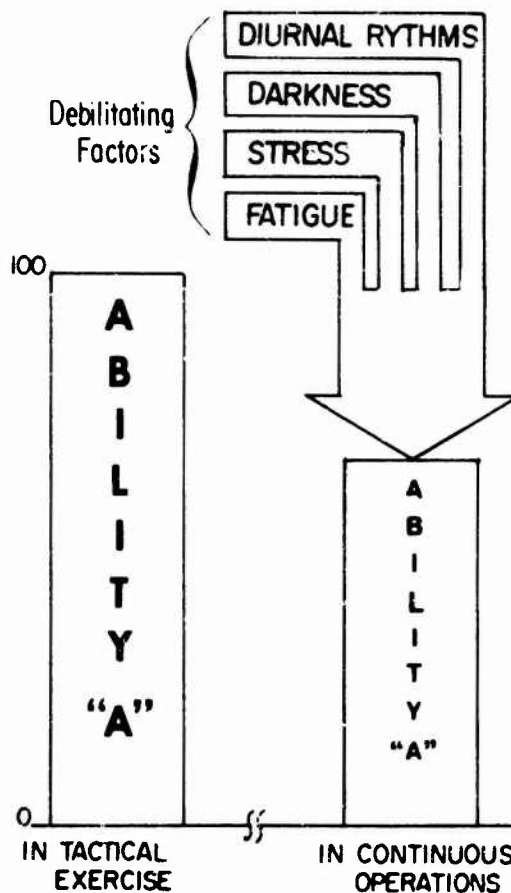
The scenario which provided the frame of reference for the research effort did not envision extreme cold. Accordingly, the adverse effects of very low temperatures have not been considered in detail. Continuous operations during other than winter seasons generate primarily four kinds of debilitating factors which affect abilities to a significantly adverse degree:

- (1) Fatigue--is induced by the continuous nature and the extended duration of the continuous combat operations situation. Mission duration entails both physiological (muscle) fatigue and sleep loss. The available scientific evidence suggests that sleep loss will significantly depress certain abilities.
- (2) Diurnal Rhythm--the normal cycles of wakeful activity and sleep. When these normal cycles are inverted or disrupted, internal bodily cycles are also inverted and disrupted with a consequent effect on abilities. The effects are independent of and additional to sleep loss.
- (3) Light Level--refers not only to extreme darkness at night, but also to twilight, rain, fog, and any other conditions that reduce visibility. All of these conditions drastically alter man's capability for assessing information about his environment.
- (4) "Mental" Stress--can be produced by an intensive work pace, the rate at which information arrives and must be evaluated, by high noise levels, by extremes of surrounding temperatures and, of course, by persistent severe threat to life or of injury. Stress of this type primarily affects cognitive (intellectual) abilities.

In continuous operations any person, regardless of his rank or responsibility, will be subject to performance degradation due to the impact of these debilitating factors. They will impact differently on different persons because of differences in duty position and task responsibilities (requiring different abilities), but no one is exempt from these effects.

Such a view is not unmindful of interpersonal relations and individual differences, but focuses primarily on the management control over the variables (factors) that determine individual and ultimately unit performance capability. The concept of management is itself an abstraction of the process for obtaining or maintaining certain desired conditions or outcomes or results. The absence of any ingredient (at least to some essential degree) either degrades the mission outcome (degree of effectiveness) or it lowers the probability that the objectives will be attained (reliability).

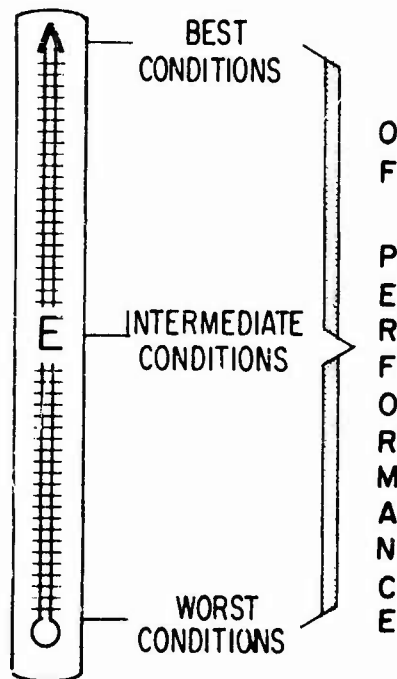
For practical management purposes, there is no real difference in these two ways of expressing a degradation of mission capability. In the first case, the degree of presence/absence of essential ingredients is expressed, and in the second case the probability that these essential ingredients will be available when needed.



The management objective is to obtain and maintain that human performance capability necessary for successful attainment of mission objectives.

Quantitative Expression of Capability

Throughout this Manual, human performance capability is expressed in terms of an index performance effectiveness "E." This index lies between 0 (zero) and 100. For practical purposes, E may be considered to be a percentage. For simplicity, the decimal point can be omitted. The percentage expressed by the value of E is a relative one. An E value of 0 (zero) does not imply an absolute absence of all performance capability (e.g., a fatality), nor does an E value of 100 imply absolute perfection. Rather the limits of 0



(zero) and 100 represent the worst conditions and the best conditions of performance respectively. The worst condition would be that in which all of the debilitating factors--fatigue, diurnal rhythm, light level, and stress--are impacting on critical abilities so as to degrade maximally performance capability, and the best condition would be that in which these factors are absent. The best condition might prevail at the beginning of a training exercise, and the worst condition might represent, perhaps, the fifth night of actual continuous combat operations. Any value of *E* between 0 (zero) and 100 expresses the "percentage" of effectiveness that can be expected when intermediate conditions prevail.

Management Controls

In the context of managing human resources during night and continuous operations, the index, *E*, serves a very useful purpose. In the most simple and general sense, *E* is the value which management seeks to maximize at all times. The value that *E* assumes is a function of--is dependent on--the variables (factors) that have been outlined. The way to maximize *E*, that is, to maintain the highest possible value of *E*, is to manage these variables appropriately. The question is how to "get a grip" on these variables. What the practical ways and means for forcing critical abilities to their highest possible levels and for counteracting the actual or potential effects of the debilitating factors? There are six major approaches to practical management control over these variables:

1. Selection. At least some selection can be exercised in assigning tasks to individuals. For example, existing scientific evidence indicates that there are two kinds of people: poor and good sense-of-direction-people. Those who have a poor sense of direction (and self reports are reliable indicators) show no improvement in their ability to orient themselves even after repeated exposures to the same environment or terrain. Accordingly, an obvious management option is to "select out" persons with a poor sense of direction and to entrust responsibilities for tasks involving orientation only to those who have the ability to a high degree.

2. Training. Training and overtraining tends to fortify performance against degradation. Training refers to practice under appropriate conditions (these conditions are discussed later), and overtraining refers to practice over and beyond an initial mastery. Overtraining and the resulting overlearning tend to assure that task performance will achieve a high degree of automaticity, rapidity, and reliability. For example, people with a good sense of direction improve their ability to orient themselves with more experience in the same environment. There is reason to believe, also, that the orientation ability of these people will improve generally, i. e., with reference to different environments, with continuing practice.
3. Redundancy. Two heads are better than one. Although this is not always true, redundancy can serve the purposes of management control. An arrangement in which, so to speak, one head can substitute for the other can provide important benefits. For example, a task might involve complex numerical calculations. If duty position B has been cross-trained with duty position A, and if the person in duty position A is no longer capable of making the calculations, the person in duty position B might substitute for A. More likely, in continuous operations, both persons will be about equally debilitated, though not to the level of being absolutely incapable of performing the calculations. If both perform the calculation (and agree), far greater confidence can be given to the result than to the result provided by only a single, debilitated individual. Clearly, the possibility of redundant calculations depends on two or more persons knowing--having learned--how to do them.
4. Task Reallocation. The distinct possibility exists that conventional or traditional allocation of tasks, and most particularly critical tasks, to certain duty positions may be such that the duty position can become "overloaded" under extreme conditions of continuous operations. The possible reallocation of task responsibilities that are both critical (to mission success) and extremely vulnerable to degradation is a management option that cannot be ignored. Such restructuring of duty positions through a reallocations of

tasks may produce increased effectiveness (E) in one or more duty positions. Sharing of task responsibilities between two duty positions may be of still greater interest. For example, vigilance in the detection of enemy targets tends to degrade greatly under continuous operations conditions. The task of looking for and detecting the enemy targets is one that might be shared.

5. Job Aids. The task load sharing concept can be extended to nonhuman devices. Devices of all sorts can serve, for example, to relieve the information processing load or the load on short term memory. A scratch pad on which the individual jots down information is an example of a very simple "device." A night vision device is more complex and sophisticated, but belongs to the same category. Job aids or performance supports all serve to take over some of the performance demands that strain the person's capacity. They can support perception (e.g., night vision device), muscular activity (e.g., lever), or intellectual efforts (e.g., calculator, slide rule).
6. Rest and Sleep. Distribution of performance demands is of particular importance in continuous operations. This refers most specifically to rest and sleep. While much of the demand for performance in combat may be outside the control of command/management, deft application of sleep and rest, when it is feasible, can strongly counteract the cumulative debilitating effects of fatigue.

CHAPTER II

HOW ABILITIES AND PERFORMANCE DECLINE

Continuous combat operations by their nature generate a set of environmental conditions whose effects are to depress critical abilities and to degrade performance capability. As the duration of these operations is prolonged, especially beyond 48 hours, sleep loss mounts and its cumulative effects become particularly degrading. Even during the first night of operations, the normal diurnal rhythms or wake-sleep cycles are disrupted and inverted. Night also introduces darkness and related visual difficulties. Finally, stress inevitably accompanies combat; threat to life, noise, pressure of time to complete tasks, social pressure, and the like are present.

To cope with the diverse effects generated by these environmental conditions their specific character needs to be understood. No amount of general guidance can cover all eventualities, nor substitute for the "feel" of the reality of exhaustion in a dark and stressful environment. This chapter provides a summary of the debilitating factors in the environment and their impacts on human performance. More detail can be found in the companion Guidelines--Human Performance in Continuous Operations.

Fatigue Due to Loss of Sleep

In the long run, the accumulated fatigue due to lack of sleep will dwarf the other debilitating factors. Sleep is an absolute requirement for humans. It can be postponed somewhat, but it cannot be eliminated. Loss of sleep essentially affects cognition, or, loosely, the ability to process information. When the brain "wants to go to sleep," thinking, learning, problem solving ("purely" cognitive processes) suffer along with the cognitive aspects of seeing (e.g., differentiating patterns), hearing (e.g., making sense of heard sounds), remembering (e.g., what exactly is to be recalled), recognizing (e.g., a terrain feature), and so forth. These cognitive aspects manifest themselves in a variety of ways not all of which can be predicted by common sense.

Sleep is essential for efficiency and survival.

Military Experience with Sleep Loss

Operations Early Call and Early Call II were nine day tactical defensive exercises carried out by experienced British infantry platoons.

The participants were observed and rated continuously by both military and civilian scientists as well as infantry company commanders. In Early Call, no sleep was scheduled for one platoon, only 90 minutes were scheduled a night for a second platoon and three hours were scheduled per night for a third. Military performance (shooting, weapon handling, digging, marching, and patrolling) was assessed throughout, as well as performance on a battery of pencil and paper tests on such things as map reading, encoding and decoding, short-term memory, and logical reasoning. The results showed that the platoons became militarily ineffective after approximately 3, 6, and 9+ days respectively. Well learned and mainly physical tasks were highly resistant to deterioration due to lack of sleep, but tasks with a cognitive or vigilance component were quite susceptible. A platoon of sleep deprived soldiers was able to maintain their speed of march cross country, to their ultimate detriment, since their platoon leader could no longer read his map properly. The formal testing basically confirmed this selective sensitivity, though map reading was affected far less than logical reasoning, encoding, and decoding. Followup studies have confirmed this, showing reductions to less than 50% of rested performance levels on these tests, with deterioration beginning after only one night without sleep. In addition, the occurrence of visual illusions was common enough so that the study recommended posting sentries in pairs. On the positive side, as little as 3-4 hours of unbroken sleep per night produced considerable improvements, both in military effectiveness and on the test batteries.

It is worth emphasizing that, although vigilance shooting performance declined dramatically, the ability to group shots on targets did not. Neither did a variety of weapons handling tasks: filling magazines by hand, loading and unloading rifles in standing position, stripping rifle to firing pin, and assembling rifle. Weapons handling tasks have been undoubtedly over learned to the level of extreme automaticity, i. e., almost literally being able to do it "blindfolded and asleep."

Group morale was high. The people participating in the study formed a cohesive group. Members of the group, as well as observers, agreed entirely on this point. Assessments of mood showed a steady decline of positive feelings and a steady increase in negative ones. No personality changes could be detected.

The summary points from a debriefing session following the deprivation exercise provide the "sense" of the situation. Platoons 10, 11, and 12 respectively were allowed no sleep, 1 1/2 hours, and 3 hours sleep per night. "Survivors" mentioned in the summary are those participants who did not elect to withdraw during the exercise.

Efficiency and Survival

1. There was general agreement that the training, morale, and teamwork of the Company were good and that, when tired, the soldiers made good use of well learned basic skills.
2. With regard to mainly physical tasks, Platoon 10 was thought to have remained effective for three days, the "survivors" of Platoon 11 (48%) for six days and the "survivors" of Platoon 12 (91%) were still thought to have been effective at the end of the sleep deprivation phase.
3. Vigilance and the more difficult and detailed mental tasks deteriorated most, whereas simple and well learned tasks suffered little.
4. The NCOs of Platoon 10 said that they felt that they could have continued for another day or so if the weather had been better, and Platoon 12 felt that they could have continued for some time. The "survivors" of Platoon 11 said that they too could have continued, but this view was not supported by the observers.
5. Several NCOs commented on the morale raising factor of knowing for how long they were expected to survive, and being able to pace themselves accordingly.

Behavior

1. As tiredness increased so did the frequency with which soldiers sat down and went to sleep and/or were at risk from subclinical exposure. At first their own NCOs got them moving again, but later on this was only achieved by the frequent intervention of Company HQ.
2. NCOs reported that, when their men were tired, it was difficult to initiate action after sleep or a meal-break, but that, once going, the momentum was fairly easy to maintain.
3. In the later stages of the sleep deprivation period, most soldiers felt that attention to detail was no longer required of them and personal hygiene suffered. Also, in order to stay awake, they smoked on the defensive position at night, thus reducing tactical realism.

4. The necessity of sentries being posted in pairs was strongly emphasized by both soldiers and observers.
5. Several commentators noted that, as tiredness increased, the soldiers' eyes became red and sore. However, this was often only temporary and, in spite of further sleep loss, the condition of their eyes often improved again.
6. The majority of NCOs and observers remarked on the friendly good humor of the Company throughout the exercise.

Leadership

1. The NCOs reported that they found a more friendly and relaxed leadership style to be more effective when dealing with tired soldiers. They quietly reminded, rather than ordered, their men to carry out a task.
2. Observers reported that the response to orders was good, although few were given in the later stages of the sleep deprivation period.
3. With increasing tiredness, a few of the junior NCOs ceased to act as leaders but rather concentrated upon personal survival. Conversely, some private soldiers emerged as natural leaders.
4. As sleep deprivation increased, 'O' groups were put off until the last minute and then rushed through, and models and rehearsals were no longer used in planning patrols.

The findings obtained from Operations Early Call are closely paralleled and confirmed by a second study. In this second study 44 cadets of the Royal Norwegian Military Academy participated in a ranger training course. One group was given no organized sleep for the five days of the course, while other groups got 3 and 6 hours of sleep respectively scheduled for the early morning hours of the third day. Each morning from 0630 to 0830, formal testing was conducted, using a variety of tests of both physical and mental functioning. While all the tests showed substantial and progressive decrements, of particular relevance are the findings that a "coding" test requiring the subjects to substitute digits for symbols for five minutes, using a code unknown until the test, and a "command memory" test, in which cadets were given two minutes

to memorize a standard military message, then asked to write it out an hour later after an especially strenuous physical task, were far and away the most sensitive. The average scores on both dipped to 65% of pre-course levels, and coding was significantly impaired after only 24 hours (command memory was not tested at 24 hours for some reason). By way of contrast, shooting (grouping at 25 meters) showed only a 10% impairment, and that not until the third day of the course. Reaction time, i.e., ability to react promptly to unexpected events, and visual vigilance also declined seriously after 48 hours without organized sleep. Measures of mood careened downward by 40%-50% from the beginning and clinical symptom observations confirmed this trend.

A third study, conducted by the U.S. Army Research Institute of Environmental Medicine and the Walter Reed Army Institute of Research had five man FDC teams from the 82d Airborne Division carry out an artillery combat scenario designed to simulate 86 hours of continuous operations (without actual movements). No team persisted more than 48 hours before opting to quit, though some were performing adequately at that time. In all cases, however, a striking division of effort appeared as time on task increased. Forced-paced activities, e.g., requests for fire from "forward observers" and "higher headquarters" consistently produced well-trained, orderly, and appropriate reactions, though multiple simultaneous fire missions did cause some difficulties as time wore on; however, it became apparent that the "cost" of this performance was increasing neglect of self paced activities like updating meteorological corrections, replotting targets relocated by survey or precision registrations, keeping the current tactical situation posted, plotting potential targets and "no fire zones," working up data for preplanned fires, updating records and logs, etc. This same distinction between forced paced and self paced activities can, of course, be applied to most other sections in a firing battery, and battalion headquarters as well, and the observed ARTEP performances revealed similar patterns. For example, gun sections continued to deliver timely and accurate fire, but security declined as fatigue set in: camouflage nets were set slowly or not at all, M60s not set up or not manned. Wire sections got "hot lines" between FDC and guns in rapidly, but lines to perimeter and the switchboard were omitted. Other examples will be apparent to the reader, and headquarters should certainly not be overlooked here, since good planning ought to be self paced, rather than a mere reaction to events.

A second important contribution of this study was the observation that the team's lowest morale, poorest performance, and quitting invariably occurred between the hours of 0200 and 0600. This is consistent with a large literature on biological rhythms, but more importantly, it suggests that the staying power of the unit may well depend in large measure upon when hostilities begin. Assuming sufficient warning time for the battalion to meet the traditional dawn attack fully armed, deployed and rested, only 24

hours of fighting would carry the unit through this early morning trough, probably enabling it to function effectively throughout the following daylight hours (i. e., through 36 hours) at least. A 2100 hours attack, however, would bring the unit up to the difficult 0200-0600 interval for the second time after only 29 hours of fighting. A midnight attack lowers this to only 26 hours.

A discussion of these observations by the U.S. Army Medical Research Unit - Europe stressed that:

"Further data could probably be assembled here, but it has been primarily this data, and our less formal observations of the same phenomena at work in field exercises which leaves us more convinced than ever that it is those in mentally, rather than physically, demanding jobs who are most at risk under conditions of acute sleep deprivation. Moreover, it is precisely these individuals, particularly the commanders, who most frequently believe they are the least vulnerable, if not completely immune."

The point is borne out and illustrated by the following account:

A psychiatrist recently accompanied a Field Artillery battalion from Fort Sill to Germany as part of REFORGER 78. Although this exercise was designed as a test of ability to deploy on short notice (96 hours), in practice the battalion had 2 months' notice, during which time they made extensive preparations. Among these were the identification of "non-deployables," and the request and receipt of 167 filler personnel from other battalions at Fort Sill. Despite this preparation, and what was characterized as "the slow pace of events in Germany," the more senior officers and NCOs were sleeping very little during the FTX. He describes the situation thus: "Tasks were delegated to the junior officers and junior non-commissioned officers, but often, responsibility was not. As a result, the more senior commissioned and non-commissioned officers would remain awake, often with little actual work to do, until all delegated tasks were completed." The psychiatrist suggests that, as a result, these critical duty positions would have very little in reserve with which to handle the additional demands of actual combat.

All of this points to the need for planning the operations with sleep loss effects in mind. Moreover, sleep should be allowed at all convenient times. Even if the sleep period is as short as 20 minutes, there will be some beneficial effect. The longer the sleep, the greater the benefit.

Fatigue and Vision

Fatigue depresses visual ability as related to tracking performance. One of the critical abilities required to fire effectively the .50 cal MG at a moving target from a moving vehicle or from a hull down vehicle is the ability to track visually a moving target. Tracking performance deteriorates with time on the task. Both, time-off target and number of times off-target (error) increase with prolonged execution of the task. The deterioration is progressive over time. The tracking performance of a fatigued gunner, then, will be less precise than that of a rested gunner.

Fatigue degrades proper visual function.

On the basis of an extracted estimate of a 25 percent decrement, the effects on the 50/50 hit rate distance as compared with baseline 50/50 hit rate distance for first round firing are:

	<u>Target</u>	<u>Baseline</u>	<u>Fatigued</u>
Stationary Vehicle	Point	500m	375m
	Armored	800m	600m
	Area	1000m	750m
	<u>Target</u>	<u>Baseline</u>	<u>Fatigued</u>
Moving Vehicle	Team-Size	300m	225m
	Squad-Size	500m	375m

The solution to this shortfall is to plan strategy such that effective ranges for successful completion of a mission are adjusted to allow for the decrease in hit rate distance. One such method would be to increase firing rates and to reduce reliance on first hit success when gunners are fatigued.

Fatigue also depresses performance in detection tasks. While vision would seem to dominate, other senses (notably hearing) support detection. The "real" task in detection is cognitive, i. e., to find something in the incoming sensory patterns that signals the threat (enemy

target, movement, etc.). For example, in continuous operations the Infantry Squad Leader will spend a great deal of time determining whether or not the enemy is present. The SL will use all of his senses, aided and unaided, as the situation requires.

Research shows that actual detection dropped nearly 20 percent over an hour long trial. However, the detection of combined auditory and visual signals was impaired less than 5 percent. Because the human perceptual system relies heavily on intersensory collaboration, combined auditory and visual signals were more frequently detected than by either sense above.

The implications are:

- 1) fatigue will cause a decrement in the ability to detect targets
- 2) fatigue will have a greater decrement on the visual detection of targets than on the auditory detection of targets
- 3) the detrimental effects of fatigue are dramatically offset by intersensory validation.

The appropriate response to the expected decrement in performance caused by fatigue is to train Squad Leaders to attempt to gain information about possible enemy presence by every sense available. In addition, the presence of multiple observers will increase the probability of detecting the enemy.

Additionally, the use of sensory aids, such as radar, sonar, thermal imagery, and others, will assist in intersensory validation and lead to a consequent increase in the probability of enemy detection. Finally, sound amplifying devices which would provide auditory augmentation in a manner similar to that provided by NVDs might be considered.

Fatigue and Hearing

Though it is understood that all senses combined in detection, there may be times when reliance must be placed on hearing alone. For example, Infantry Maneuver Team Members may be required to detect targets by ear alone after periods of sleep loss. A five hour auditory vigilance task that called for difficult auditory detection was preceded by diminished sleep on one or two nights. By the second night, performance dropped to 45 percent.

The effect of reducing sleep to three hours or less a night will have a marked deleterious effect on auditory vigilance. After one night of such sleep loss, the soldier's auditory detection ability will be impaired. After two nights of such sleep loss, the impairment will be more marked. Beyond the second night, one can expect further impairment.

The recommendations for correcting this shortfall are to reduce reliance on auditory detection, to coordinate the auditory vigilance of two or more soldiers, or to rely on intersensory validation.

As can be seen in this relationship, fatigue has far reaching effects. In general and wherever possible, a staggered sleeping schedule will help. The idea is to use personnel who are most rested for those tasks adversely affected by fatigue. Even brief, periodic catnaps just prior to engaging in such tasks, may be highly beneficial. Some adaptation during training may be necessary before individuals are able to catnap in noisy situations such as a moving APC.

Fatigue and Perceptual Speed

In continuous operations, many different kinds of duty positions will be required to perform perceptual motor tasks which involve rapid perceptual discriminations when sleep periods have been reduced. Perceptual motor performance in a test task was not affected to any marked degree during the first 17 hours. However, by 0900 of the second day, there was a 45 percent increase in errors.

Other performance also declines.

As sleep loss accumulates, perceptual-motor performance and perceptual speed will be impaired. Route markers may need to be two to three times more visible, in terms of size or brightness, for a soldier who has not slept for two or three days than for a well rested soldier. Ability to distinguish rapidly enemy tanks, vehicles, aircraft or movement from friendlies, or vice versa, will be degraded and unreliable. Reports of such observations will need to be carefully double checked.

Diurnal Rhythms

Upset diurnal rhythms (wake/sleep cycles) are likely to manifest their effects most at the earlier stages of continuous operations. First, a gradual adaptation to the changed wake/sleep cycle takes place. Second, the effect becomes overshadowed by sleep loss effects. Typically, performance impairments tends to increase with the number of hours spent

awake, but is subject to a superimposed variation from the influence of diurnal rhythms.

Diurnal Rhythms and Numerical Facility

Some tasks involve the use and manipulation of numbers. For example, the assignment of fire zones and targets is of this type as is the establishment of revised TRPs and range cards. Relevant data suggest that numerical performance may peak between 2000 and 2200 hours; similarly, performance will likely be lowest between 0200 and 0600 hours. Overall these effects and the degrading effect of the disrupted and inverted diurnal rhythm is materially greater during the initial 5 to 7 days of disruption than later.

The major keys to overcoming this problem are training and anticipation. The kind of training to correct this deficiency involves performance of the relevant tasks at varying times of the day. The need to conduct training operations as much at night as in the day may be the single most important training recommendation to emerge from the human performance literature.

Diurnal rhythms affect performance.

Anticipation of performance decrements that might result from performance of mental tasks out-of-phase relative to time-of-day is a helpful forewarning. Creating decision aids and devices for assisting in the performance of these and other mental tasks will contribute toward nullifying the negative effects of inverted diurnal rhythms.

Diurnal Rhythms and Reasoning

While more information is needed which bears directly on the debilitating effect of inverted/disrupted diurnal rhythms on reasoning, there is ample circumstantial evidence about the relationship. Especially because the effect seems to be similar to and combine with that of sleep loss fatigue, the observations regarding cognition in the previously described military studies probably apply. Particularly the interval between 0200 - 0600 hours may be the most vulnerable period.

Reasoning is certainly the principal component of or even identical with "decision making." In the light of what is known reliably about low mood and morale in the hours before dawn, some inferences can be made. Decisions made especially during the most vulnerable hours, are likely to be pessimistic. Depending on the nature and context of the decision, it may be either too conservative ("what's the use") or too risky ("let's go,

it can't get any worse"), but it will probably not be the best (optimal) decision. The patience to assemble all pertinent points for consideration and to consider the pro's and con's of each will likely be lacking.

Awareness of the effect may be the key to counteracting it. In training, decisions should be made during the vulnerable hours, and they should be later reviewed and objectively evaluated. In this way, a sensitivity to the depressant judgment effects may be developed as well as compensatory mechanisms.

Light and Darkness

Seeing in bright daylight is clearly different from seeing on a dark night. Many other conditions also affect visual capability: fog, rain, sleet, smoke, twilight, ice, glare. In addition, the human visual system is subject to transient influences, e.g., dark adaptation, flash blindness. In the dark we cannot see colors, but only shades of grey. Finally, whatever interferes with vision indirectly affects some other capabilities.

Darkness and Vision

Among an Infantry Squad Leader's most critical tasks is the direction of cover fire while moving to an assembly area. This task involves scanning wide areas under varying light levels in order to detect enemy presence and friendly element locations. Many factors operate to limit the ability to see under low light levels. One of the most important factors is the structure of the eye itself. The part of the eye that gives us our best vision can only operate at light levels equivalent to a full moon over snow or brighter. Below that light level, because the most sensitive part of the eye can no longer respond, the part of the eye that responds is about 30° to the outside of straight ahead. Detail vision is poor at night. When the light level is below that of a full moon on snow, vision is one tenth as good as in the daytime. All visual detail to be detected must be 10 times as great. For the squad leader (and for everyone using unaided vision), the task of detecting the enemy by unaided vision is at least 10 times more difficult.

One can increase the probability of detection by moving the eyes frequently. Training is indicated in this regard. But, if successful execution of this task requires performance near daytime levels, the use of a night vision device is imperative. Devices ranging from night vision goggles or scopes to flares, or even a pair of binoculars, will assist in overcoming the diminished vision.

The observer can also position himself to best advantage and should be trained to find positions which allow silhouetting of potential targets or maximizing the contrast of a potential target with its background. An

example of the latter suggestion would be positioning oneself so that the approach of enemy elements would be viewed against a background of ripened wheat rather than a cluster of trees, thus increasing the brightness contrast of the target and background.

It is also imperative that observers be dark adapted and remain so. Full dark adaptation takes a minimum 20 minutes.

A different sort of visual problem presents itself in firing on targets, perhaps, with a machine gun.

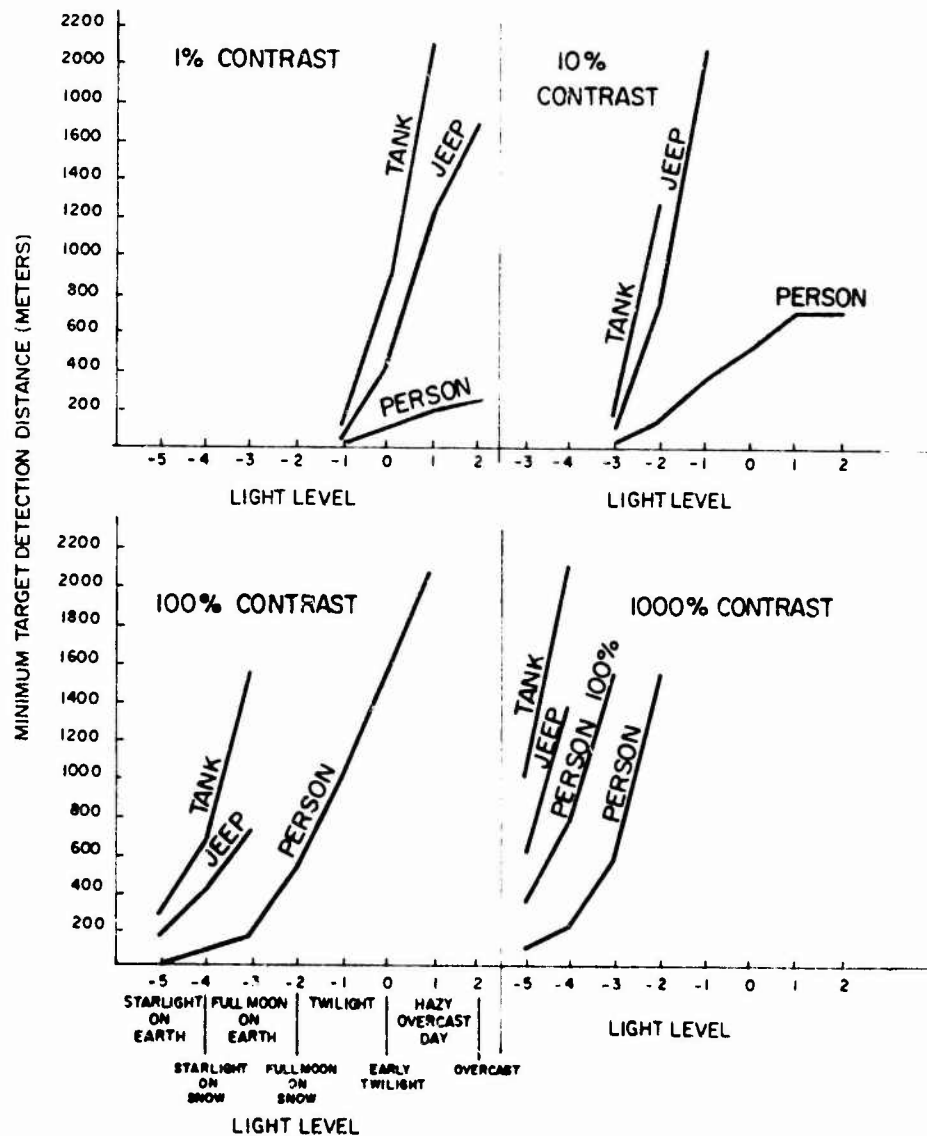
If effective fire is to be maintained, an accurate assessment of the points of maximum target vulnerability must be made. Several factors contribute to the likelihood of seeing a target well enough to fire effectively at the target. The set of graphs shows the effect of light level, target size, and contrast ratio on the visibility of targets. Visibility is expressed here as the distance from the soldier at which a target will be seen. The effect of the size of the target is shown by presenting visibility data for a large object (tank), a medium-sized object (jeep), and a small target (person).

To understand the meaning of these graphs, the term "contrast" needs to be defined. Values of percentage contrast from 1 to 10,000 are given here. The contrast value of 10,000 represents a target which is a little more than 100 times as bright as its background. For the value of 1,000, the brightness multiplier is a little more than 10; for the value of 100, it is 2. For the 10 percent and the 1 percent curves, the target is either brighter or dimmer than the background, with the difference between the target brightness and background brightness being 10 percent or 1 percent of the background brightness.

The graphs show the minimum distance at which the targets can be seen (99 percent of the time) at various background light levels.

The 1 percent and 10 percent curves represent the contrast that an enemy vehicle or soldier will present when he is attempting to avoid detection. Notice that at twilight, an enemy soldier or jeep will not be seen beyond less than 100m. Even on a bright but overcast day, an enemy soldier who is well camouflaged (1 percent) will be extremely difficult to see if he is beyond 300m.

Values of 100 percent contrast or greater would be those associated with a lighted target, either in a situation where the enemy is not attempting to avoid detection or as a result of artificial illumination provided, perhaps, by flares. Whether or not a contrast as high as 10,000 percent could ever be achieved on a battlefield has not been established. But, given such sharp contrast, even under starlight alone a person could be seen at 375m. Tanks and jeeps would present no problem at all up to 2000m.



On these graphs, when an object's visibility beyond 2200m is not limited by background illumination, the graph does not extend beyond the lowest background light level at which such light level does limit visibility within 2200m.

The implications for firing on targets are clear. At twilight light levels and below, targets cannot be effectively engaged at appropriate distances using unaided vision. There is now way of improving the situation since the limiting factors are environmentally imposed. The only solutions are to provide artificial target detection means (e.g., NVDs, radar, thermal imagery devices or other hardware) or artificial illumination (e.g., use of pyrotechnics).

Before a gunner fires on a target, perhaps, a moving target, he must detect it. Take the case of detecting the movement of such a target toward the gunner on a very dark night. The following factors may operate against the gunner in this situation:

- the target is too dim
- the target is moving too slowly
- the target moves over a small distance only
- the gunner uses (or must use) monocular (one-eyed) vision.

Existing research data fit the situation of a tank approaching from a distance of 284m at a speed of 9km/m. At that speed and with the tank's "shade of grey" or brightness (.001 ft. Lamberts), the tank would have to approach nearly 60m from the starting distance of 284m before the naked eye could detect it. If only one eye were used, the detection capability would be reduced by approximately 40%; the tank would not likely be detected until within 200m. On the other hand, if the tank travelled at 40km/hr instead of only 9km/hr, the time for detection would drop from about 1.33 seconds to about 0.5 seconds.

Use brightness contrast to your own advantage.

The major implication of these relationships is that when insufficient light is available for identifying the approach of an enemy tank (or any other moving target) by comparing its relationship to other objects, then the brightness (luminance) of the target and its speed will limit the ability of the gunner to detect its approach. In daylight, such movement could be detected in less than a third of a second. At night it could take up to six seconds to detect the movement. This amount of time could be critical if the target's movement will dictate the gunner's next response.

Suggestions for overcoming this problem include training in the use of minute cues such as the small change in size occurring because of an object's approaching a short distance, training in the use of nonvisual cues such as hearing, training in positioning oneself to allow contextual cues to be present against which an approaching object's movement can be viewed, or training to position oneself to take advantage of maximum ambient illumination, such as in a location from which the moon, if present, is most likely to cast the most light on an approaching tank.

Use night vision devices.

Another problem area concerns the effects of bright light flashes on visual performance. The problem is theoretically the same for the unaided eye as for the eye which is aided by a light intensification device. However, when using a night vision device, the problem becomes more serious. The effect of flashes of light on visual performance is called flash blindness. Flash blindness refers to the temporary decrease in visual ability which follows exposure to a short duration, high intensity light. At night, the flash from the enemy's or one's own fire may often be sufficient to cause flash blindness. Following a sufficiently intense flash, there will be a recovery period.

The highest flash energy will cause permanent blindness. The only encountering of such a light is witnessing a nuclear detonation with unprotected eyes. The lowest level corresponds roughly to a very minor flash, for example, a cigarette lighter being ignited. The more intense the flash, the longer it takes to regain full visual acuity.

Recovery time to see a dim target is longer than to see a bright target. A bright target at daylight light levels would be no less visible after a flash until the flash is intense enough to cause eye damage or blindness.

The problem of night vision devices which amplify or intensify the light received at the eye must be evaluated in terms of each specific equipment. The manuals for each device should be consulted to see if the flash blindness dangers are spelled out. But, they will certainly be greater with night vision devices than with the unaided eyes.

Several steps can be taken to diminish the effect of flash blindness:

- 1) Minimize the amount of time spent looking toward enemy locations at night; obviously, the less the time spent looking toward the possible source of a flash, the less the probability of being exposed to a blinding flash.
- 2) Immediately avert gaze at the first hint of a flash; if a soldier trains himself to do this, he can learn to avert his gaze in less than a quarter of a second. The light sensed by the eye will be much less and will not cause flash blindness.
- 3) The actual user should keep someone close at hand while he is using a night vision device who can immediately take over feeding vital visual information during any recovery period following flash blindness.

Light Level and Dynamic Precision

Firing weapons at areas at night involves moving the weapon over various distances, loading the weapon, clearing jams, and other activities which require dynamic precision. In at least some cases, the ability to line things up, based on cues associated with hand-arm movements, will be crucial. It is well known, of course, that such a task is difficult. We rely heavily on visual feedback for most tasks involving manipulation. Tasks of this type are performed considerably better when visual feedback is present. Available information suggests that without visual feedback firing error might be roughly twice as high as with feedback.

There are several solutions to the problem of deficient dynamic precision in the absence of visual feedback. One solution is typically used for firing some weapons at night. The use of stake markers to delimit the area to be covered by the weapon is an excellent example of providing a tactile, non-visual cue that does not depend on movement feedback. The general ways of compensating for such deficiencies are:

- (1) design performance supports and arrange firing such that visual feedback or movement feedback are not necessary because of the provision of other feedback cues (auditory, tactile, or others)
- (2) provide artificial visual aids
- (3) practice the relevant actions to the point of over-learning so that each step requires no feedback.

This last suggestion can be understood by the example of a pianist. The pianist uses auditory and movement feedback cues to learn a piece of music. But eventually the pianist overlearns the "task" to the point where playing the piece constitutes a "motor program." Once this motor program is initiated, it follows through to a conclusion without feedback.

Light Level and Hearing

Many tasks require spoken communication between leaders and team members or among team members. With near distance, being able to see the speaker's face becomes important in spoken communication.

There are at least two ways in which the listener could be rendered incapable of seeing the speaker's face: (1) the speaker's face is outside of the field of view of the speaker, or (2) the light is insufficient to allow the listener to see the speaker's face. Under most night conditions, the listener will not be able to see the speaker's face. (Radio communication possesses additional intelligibility problems.)

When background noise increases to levels louder than the speaker's voice, the ability to hear the speaker deteriorates whether or not the listener can see the speaker's face. The detrimental effect of background noise, though, is very much greater for the listener who cannot see the speaker. Hearing accuracy is reduced to near zero when the background noise loudness is 16 to 32 times greater than the speaker's voice. A truck or bus passing by at 20 feet or a pneumatic drill is 10 times louder than normal conversational speech. An elevated train is 32 times louder than normal conversational speech. An airplane engine (reciprocating) is 32 times louder than a shouting speaker. Seeing the speaker improves intelligibility by as much as a factor of ten.

Accordingly, a noisy battlefield environment at night will make voice commands nearly impossible to hear correctly even when these same commands could be understood in the daytime.

The major implication of this relationship is that at night reliance on verbal commands will be detrimental when background noise is high. The solution is to use a nonverbal command method. If giving away one's location is not a problem, a light cue might be appropriate. In other cases, the use of radio commands through headphones which attenuate the background noise might suffice. Other suggestions include developing and using a standardized, limited vocabulary, speaking louder or amplifying voice communication where appropriate, restricting briefings to the daytime, using written communications, and reinforcing speech with a sign language. The development of tactual or electrocutaneous signaling devices would also be helpful. Finally, the need to use commands in such environments can be eliminated or reduced by well thought out SOPs.

Stress

Stress is not actually a condition of the environment, but something produced by a variety of factors in the environment. No matter what the source(s) of the stress may be, the physiological (body) response to it is uniform. Also, stress from--say--a gnawing tooth ache simply adds to stress from--say--a dressing down from a supervisor. The psychological aspects of response to stress are less clearly understood than the physiological ones. For present purposes, it can be said that distress (produced by any source) probably acts as a constant distractor. At least with respect to cognitive activity it draws attention away from the task and tends to interfere with cognitive performance (information processing by the brain).

Stress and Reasoning

Consider any process that must produce a result (decision, answer) in a very short time and in which interruption (distractions) further reduce the "productive" time. If the process required the assembly of parts to

make a functioning whole, it is plausible that some parts will be left out (perhaps the smaller, insignificant ones). The final assembly may look whole, but will not function as it should.

Available information indicates that decisions about taking one or the other course of action are based on fewer of the available, relevant facts. Also, there may be a tendency to give greater weight to negative or unfavorable evidence. In short, the decision reached likely will not be the best decision that could be made.

The implication is that decisions made in the stress of battle will not consider all that is pertinent and may tend to be pessimistic. The recommendations for coping with these problems are essentially the same as those mentioned in connection with diurnal rhythms.

- In training, make decisions under stress (time pressure, distractions) and review and evaluate these decisions later.
- In battle, make a "mental list" of pertinent considerations before entering the decision process; if possible, consult others on pertinent facts and their weight.

Stress and Memory

The constantly changing battlefield conditions during continuous operations differ from the usual because the inability to use night periods to assess the status of the battle imposes on all personnel, especially those with command responsibility, the need to commit information to memory frequently. This constant process of memorization must take place during the battle in which the leader and the personnel must engage in a host of tasks.

An enormous body of scientific evidence consistently confirms the interference with memory of interspersed or subsequent irrelevant activity. The more there is to be remembered, the greater is the degrading effect of interfering tasks. When two items are to be remembered, for example, a 12 second irrelevant task reduces correct recall to about 80 percent; when five items are to be remembered correct recall falls to 20 percent.

The following points should be remembered in connection with the memorization of information in the field:

- (a) the information to be memorized should be kept to as small an amount as possible, preferably two or three items at a time

(b) the rehearsal of information presented for memorization should take place in a favorable environment that does not require attention to irrelevant task

(c) wherever and whenever possible, memory aids should be provided and organized information storage and retrieval systems should be provided.

Because stressful activity has the most pronounced interference effect on memory, use of such aids (note pads, miniature tape recorders) is particularly recommended.

Stress and Perceptual Speed

In every battle, it is essential that a gunner coordinate his fire with that of other vehicles, maneuver team elements, and other support weapons (tanks, artillery, etc.). In continuous operations, the battle scene will be highly mobile. As teams move from position to position or platoons frequently relocate, the amount of information that the gunner must consider in order that he can quickly and accurately coordinate fire increases greatly.

Research shows that for tasks that require very quick responses, as the number of alternatives increases, so will the time it takes to formulate a response. There are times when, for example, the gunner may detect a possible enemy target. He must rapidly and accurately decide whether or not it is in fact the enemy, whether or not it is within his zone of responsibility, whether the target is within range, and whether or not he should engage the target. As the continuous operation wears on, the intellectual load involved in keeping track of who's who and who's where will create increasingly large numbers of alternatives to consider. What the gunner could do in less than two tenths of a second with only one alternative will take well over half a second with seven or more alternatives.

The soldier in continuous warfare will find that the continuously changing battlefield will increase the number of perceptual alternatives to be considered in tasks which require rapid processing of the information and extremely rapid responses, such as those often required of the gunner in coordinating his fire with that of other elements.

Frequent updating, integration, and summarization of the overall and specific battle situations, maximally informative range cards and TRP identifications, and well thought out and developed SOPs represent methods for minimizing the detrimental effect of this shortfall.

This last point, the preparation to be made beforehand, cannot be overemphasized. The thrust of the preceding remarks is that the soldier should be: (1) over trained for battle, (2) well versed and rehearsed in appropriate procedures, and (3) provided with the best decision making devices for updating in battle the appropriate responses.

The training might involve the use of battle simulators, case method study, and maneuver practice. The important point is that cognitive practice as well as performance practice must be given. Additionally, detailed briefings including specific discussion of possible alternative courses of action will be helpful.

In a continuous operation, also, the platoons and teams may need to relocate frequently. The resultant, ever changing battlefield will cause personnel to be exposed to the performance of a given task under varied circumstances. Of interest here is the question of the effect of this changing battlefield expectancy.

For example, in the detection situation, the percentage of targets detected is shown to depend on the perceived likelihood of a target being present. The actual number of targets does not matter. Their relative proportion influences expectation. This expectation, in turn, will influence the probability of detecting an enemy element. If the enemy was encountered often in previous movement, it is more likely that our forces will detect the presence of an enemy element in succeeding encounters. If, on the other hand, enemy encounter was infrequent, then the probability that our forces will detect enemy presence is reduced. Other things being equal (i. e., expectation is not the only factor in detection), for example, when the expectation is based on a 50 percent prior presence of a target, further targets will be detected roughly between 50 and 90 + percent of the time. When prior targets are present only 12 percent of the time, the likelihood of further target detection is in the range of only 50 to 70 percent.

One correction for this potentially dangerous effect is to advise personnel about how this expectation adversely affects their ability to detect the enemy and to communicate best estimates based on battlefield intelligence of the probability of enemy detection during a specific movement.

It may also be that specific programs can be developed in combination with specific aids, such as specially programmed calculators, which will assist soldiers in properly establishing probabilities.

Stress and Motor (Movement) Speed

Heat (e. g., in a buttoned up tank in the sun) will add to other continuous operation stressors such as, noise, changing battlefield, disturbed diurnal rhythms, and others, and high humidity aggravates matters further. Physical speed productivity drops dramatically when certain limits are exceeded.

There are two methods of dealing with this problem:

- (1) If the temperature, as measured here, can be kept within ideal limits, 65° to 90° , by artificial means, the problem is resolved
- (2) If the temperature cannot be controlled, tactics and SOP can be modified to minimize the effects of the shortfall.

A typical night battle, especially in winter, will be fought in temperatures which are colder than daytime battle temperatures. As the hands are exposed to colder temperatures, the hand skin temperature (HST) drops. As the HST is lowered, the hands become less efficient at almost any manipulative task. For example, the condition of weapons will have to be checked periodically or adjustments made to small parts of various kinds of equipment. By the time HST drops below 15°C (60°F), there is a sharp decrease (40-60 percent) in the efficiency of manipulating small and moderate sized objects.

The principal compensations for this decrement, unless the task can be performed with gloves on, is to be aware of its existence, to overtrain the task so that the associated decrement will be adding time to a minimum base time, and to provide some means of warming the hands before the weapons are to be checked (e.g., assuring that all persons wear gloves before the weapon check and checking weapons with gloves off). Where possible, procedures can be designed to allow more time for these tasks. Finally, in the case of temperature reduction associated with nightfall, routine manipulative tasks, such as this, can be scheduled earlier--before the temperature drops.

Don't underestimate the effects of stress on performance.

CHAPTER III

STRATEGIES FOR HUMAN RESOURCES MANAGEMENT

The effective and prudent management of human resources is a problem for military command/management generally. The problem becomes more acute with an extended continuous land combat operations. The demands of such an operation on human resources magnify ordinarily minor issues into critical ones. Maintenance of significant mission capability or the maximal capability will be very much dependent on proper anticipatory as well as concurrent management of human resources. Prior to actual operations, the objective is to maximize every conceivable facet; during actual operations the object is to maintain these resources at the highest possible level.

Performance in Continuous Operations

As stated earlier human resources may be equated with performance, and, more specifically, with performance in pursuit of mission objectives. For management purposes at least two concepts of performance need to be distinguished. Performance capability is the performance of some task that might potentially be performed when required, and also its quality and circumstances (possibly adverse) of delivery. Obtained performance is that part or percentage of the potential that is actually delivered in the combat

Human resources management maximizes performance capability.

situation. Assuming that capability has been maximized in advance, in the combat situation the objective will be to obtain 100% of that capability. As capability declines, the base for the percentage will shift, but the objective will remain the same. Each of these objectives require that the nature and extent of performance capability be understood together with degradation under the adverse conditions of continuous operations.

Assessment and Diagnosis

The first concern of management in designing a program aimed at achieving high performance capability is to assess the initial, existing state of capability. This defines the line of departure from which management action must progress. However, assessment's chief purpose is

Assessment and diagnosis form the first steps of human resources management.

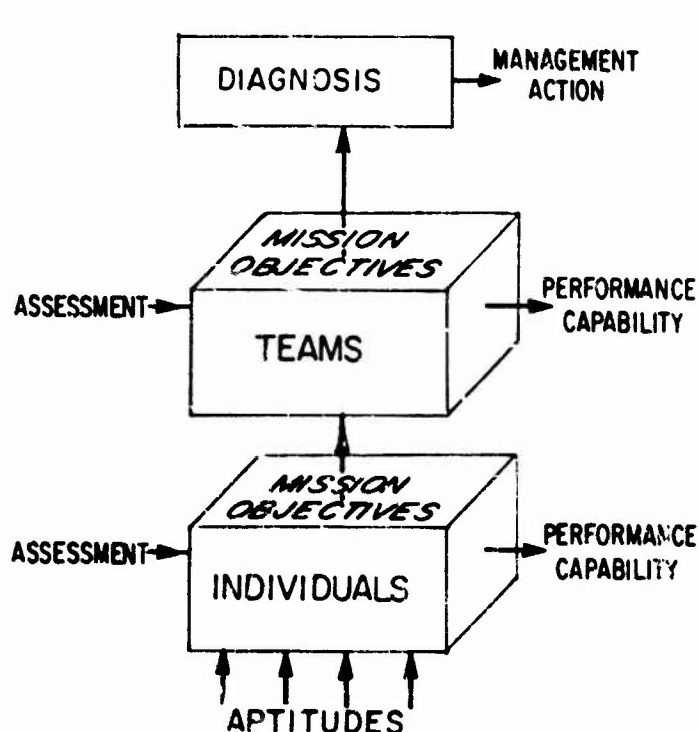
diagnosis of deficiencies so that corrective actions can be tailored precisely to requirements.

Determining Current Status

To determine the existing state of capability or potential capability, it is advisable to begin at the level of finest detail. High mission performance capability of a military unit is a function of high performance capabilities of component teams, their individual members, and "subsystems" of these individual persons. Hence, information about the latter constitutes the first set of prerequisites for overall mission capability.

Start the assessment at the bottom and work up.

The "subsystems" within the individual person are the aptitudes he possesses. For example, particularly good visual capabilities or orientation facility or physical strength. Acquired abilities, deriving from prior civilian or military training, are also important. In particular, the demonstrated achievements of an area directly related to various individuals' MOS and assigned duty positions (e.g., SQT scores) are a matter for management consideration. Adverse indications, (e.g., in aptitudes) suggest the limiting factors for overall achievement, or, in the case of proficiency, matters for individual attention.



At the next level of assessment, the performance of work-groups or teams or any organizational subunits should be considered. Relevant prior information about the individuals involved should be brought to bear. Similarly, information about each team, etc., acquired at this second level of assessment should be brought to bear on the third level, i.e., total unit performance.

Diagnosing Deficiencies

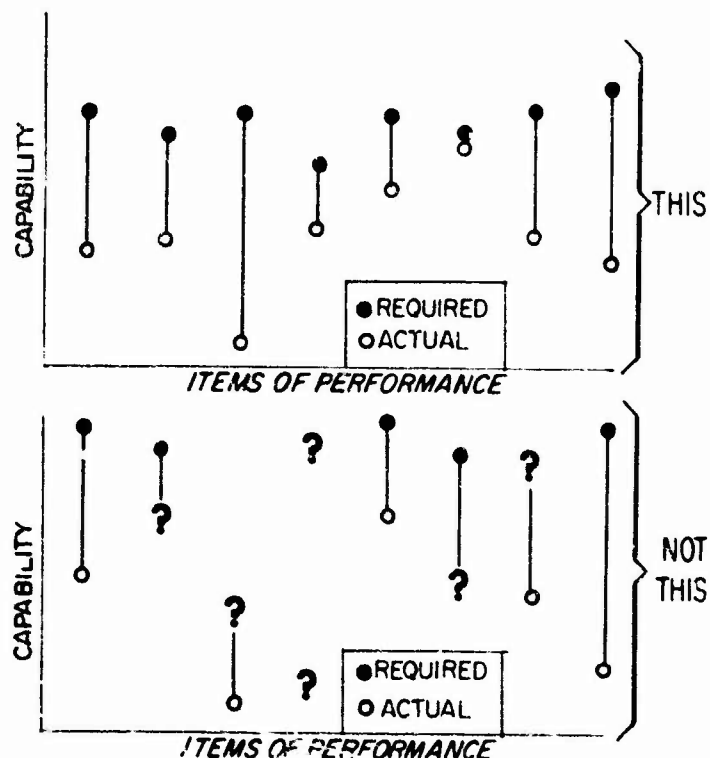
From the management point of view, the principal purpose of assessment is to provide the information required for diagnosis. The diagnosis, in turn, defines the sphere of management objectives so as to achieve requisite capability.

Deficiencies cannot be diagnosed unless both performance objectives and current performance capability are known. The diagnostic analysis will be more precise, and the management action will be more effective and efficient as the precision and objectivity of the statements of objectives increase. Vague objectives curtail possible management effectiveness.

Develop objectives and keep them specific.

While mission performance standards (objectives) are given with exceeding precision in ARTEPs, they need to be analyzed for implied performance standards of component teams and/or individuals. Also, the full range of circumstances under which tasks may need to be performed needs to be considered. For example, performance of a given task to the ARTEP standard in a training exercise does not equate with its performance in extreme darkness on--say--the third night of continuous combat operations. In summary, performance objectives need to specify all that will be required and all the circumstances in which it will be required.

Clearly, well defined and complete objectives are the necessary counterpart to the assessment of the actually existing state of capability. When matched against each



other, these two specifications, i.e., what is required and what is, reveal the discrepancies to be removed. Note that any specific item of significance that is not included in the objectives, in the assessment, or in both is likely to be mistakenly overlooked in subsequent remedial management action. For instance, a specified objective for which degree of attainment is unknown may be mistakenly thought to be perfectly attained. Similarly, an assessed state of capability in some task for which no objective is specified may be given, no further attention, because there is no awareness of inadequacy.

Maintain accuracy, thoroughness, and completeness.

Effective and efficient management action to maximize human resources depends on detailed and accurate diagnosis of deficiencies. No action can be taken where awareness does not exist. Obvious deficiencies are likely to be eliminated with no great difficulty and may lead to the belief that all is well and under control. However, less obvious deficiencies may be the crucial factors that determine endurance of high capability in continuous combat operations.

Later chapters contain more detailed guidance on practical approaches toward these ends.

Management Approaches to Reducing Discrepancies

As indicated, the detailed and noted discrepancies between required and presently existing capabilities define the area of needed management action. This might be called anticipatory management of human resources, since it strives to minimize potential later demands. With respect to anticipatory concerns there are principally five avenues of approach.

To be forewarned is to be forearmed.

Task Allocation/Re-Allocation

Reallocation of tasks or responsibilities to different duty-positions constitutes the first potential approach to human resource conservation. The object is to achieve the most efficient distribution of responsibilities under all imaginable conditions of degradation.

Allocate tasks so that they will be performed by the least degraded persons.

In practice, it may seem that the possibilities for such allocations and reallocations are severely restricted. First, MOS structures, policies with respect to line of command, and traditional views on assignment of responsibilities constrain reconstellation of teams and units. Possibly traditional views should carry least weight in striving for a maximum of effectiveness and efficiency when one is concerned with a nontraditional combat situation. Second, the actual implementation of task reconstellation is likely to exceed existing capabilities. However, an alert and sensitive management may be able to implement such solutions. A third consideration, especially with respect to performance in continuous operations, is the view that in the same environment and over the same length of time everyone's performance is likely to degrade similarly. This view fails to consider the existence of personal, individual differences, differences in the nature of task demands, and also, does not consider the possibilities of joint task performance.

An analogy with a team sport (e.g., baseball) is useful. The coach, in such a case, is also restricted in the reallocation possibilities, but he can and does make use of them in "fine-tuning" the team for peak performance. Reallocations need not be for tasks in their entirety. Sharing of some task responsibility can, at times, lead to better, more reliable performance. At other times duplication of task performance (e.g., for a calculation, relating terrain to a map, etc.) will guarantee a greater, reliability than performance by only a single, possibly exhausted person.

Selection

Place square pegs in square holes.

As for task reallocations, the possibilities for selecting the right person from available personnel to fit the responsibility are restricted. However, they are again, not totally frozen. Differences exist among individuals in various characteristics. Visual and/or auditory detection capabilities are among such characteristics. These characteristics play a very critical role in combat. Especially, night vision is likely to be of major importance. Differences in individual ability will manifest themselves primarily at the extreme limits and can be exploited beneficially. The ability to orient is another combat-important trait in which people differ significantly. The existence of such characteristics in people may not correspond with their assigned roles and status. Judicious selection is possible and may be exceedingly beneficial.

Training

It will come as no surprise that training is probably the single most effective way to achieve the highest possible performance capability. What

is less well and less widely understood are the techniques of training that produce the desired result. Mere repetition of task performance is not sufficient to guarantee that all expectations will be met.

The analogy with sports serves to make the point. The athlete will not achieve top competitive form unless his coach astutely diagnoses the aspects of his athletic performance which needs to be improved and, at the same time, can make it clear to the athlete the best program for improving his performance. A task must be practiced under all conditions and in all circumstances in which it may have to be performed. In short, the conditions of training (at some time) must match the worst expected conditions of continuous operations.

Extended training beyond the point of mere mastery serves a vital purpose, although the beneficial effects are usually not evident until the criterion conditions of performance prevail. Extended training beyond initial task mastery (over-training) assures extremely high reliability, automaticity, and rapidity of performance. It is the most powerful management tool for counteracting the debilitating effects of fatigue, disrupted diurnal rhythms, stress, etc. on performance.

Over train.

Cross Training

Cross training is a key to many management options. In principle, the cross trained person can perform responsibilities of another duty position when the incumbent is exhausted, overloaded, or for any reason unable to perform them. Among the options already mentioned task reallocation (possibly only under special conditions), task sharing, and parallel task performance are contingent on cross training. In actual combat, task rotation or alternation assume that cross training has taken place, and are themselves key options for managing rest, sleep, and recuperation.

And, cross train.

Performance Supports

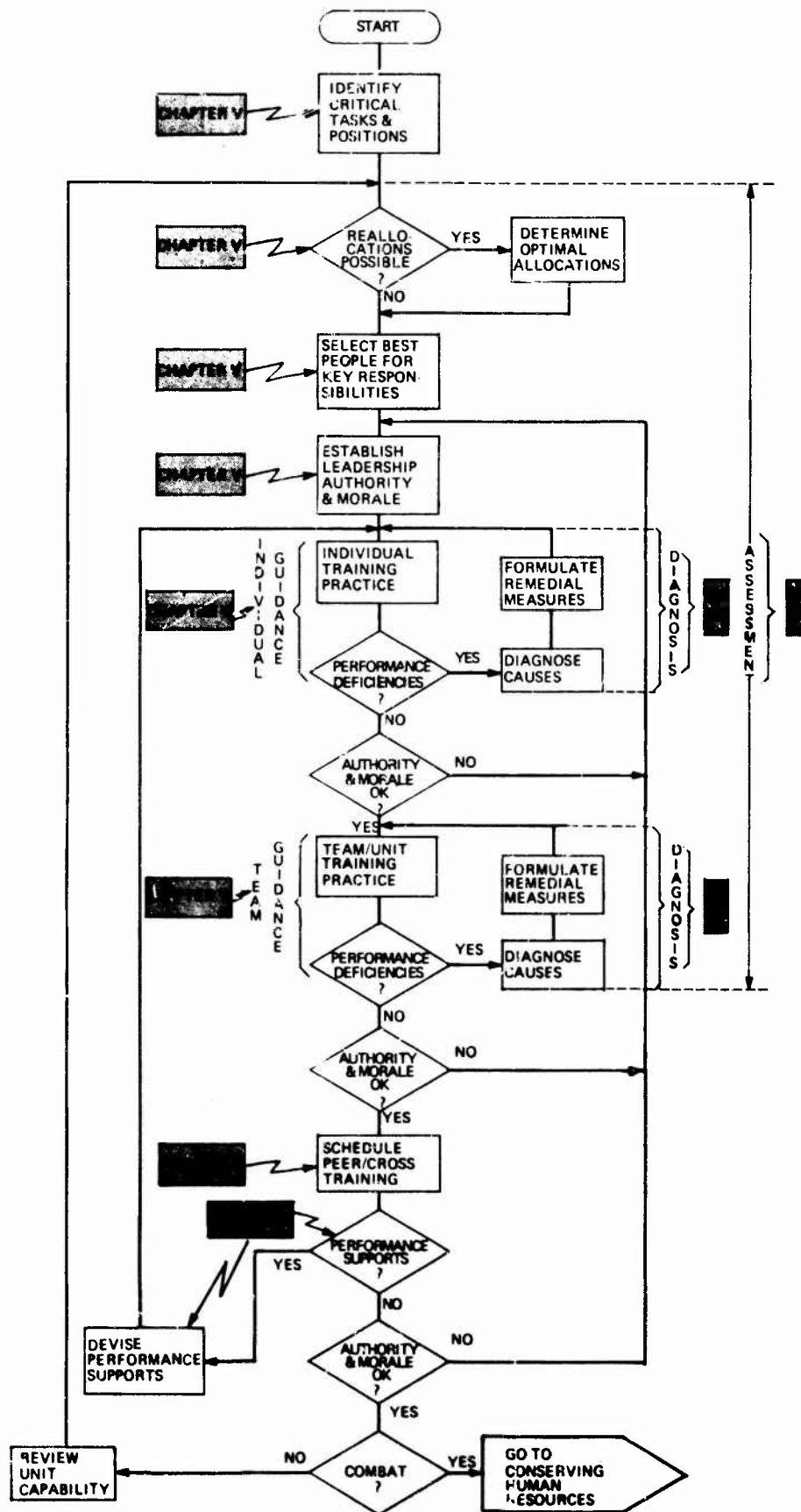
Performance supports are means and devices by which work load (demand) can be lightened for the performing person. In a more narrow sense, performance supports are particularly designed to raise sensory (e.g., vision at night) and cognitive (e.g., judgment of distances) performance to a "better" level than is possible without the aid, or to sustain it at

a high level for a longer period. Some performance supports are available as standard equipment (e.g., NVDs) while others need to be conceived, designed, and implemented locally. Performance supports can be or become extraordinarily useful. Creativity in conceiving or using them should be encouraged.

Provide job aids.

Overview

The diagram which follows provides a schematic overview of the human resources management process in anticipation of the demands of continuous combat operations. The particulars are contained in succeeding chapters as noted on the diagram.



CHAPTER IV

ASSESSMENT OF HUMAN RESOURCES

When managing any sort of resources, it is essential to establish "what is there to begin with." No management process can begin unless the actually existing values for each resource, dimension, or variable over which control (i. e., management) is to be exercised has been ascertained. For instance, one cannot start an artillery barrage without first assessing the status of one's own ammunition.

Before you go some place, you should first determine where you are now.

This principle is generally accepted and practiced with respect to material resources. It applies as well to human resources. However, the means for assessing the true status of human resources are not so generally familiar. This chapter discusses some of the ways and means of human resources assessment. A wide variety of information acquisition methods is discussed. No one person or organization will want to employ all methods in all cases. The method(s) of choice will depend on the available resources and time.

Select assessment methods in accordance with available capability.

Previously we pointed out that human resources' management amounts to some controlling influence over the variables that determine human performance and behavior. The categorization--the grouping or clustering--of these variables for purposes of effective and efficient command/management control should derive from the objectives and the logic (organization) of management.

Programs must relate to objectives.

Each individual amounts to an organization of abilities, attitudes, emotions, etc. and each of these components, including their organization itself, constitutes a management variable. We are concerned here with how these individual factors will affect the soldiers performance during continuous operations.

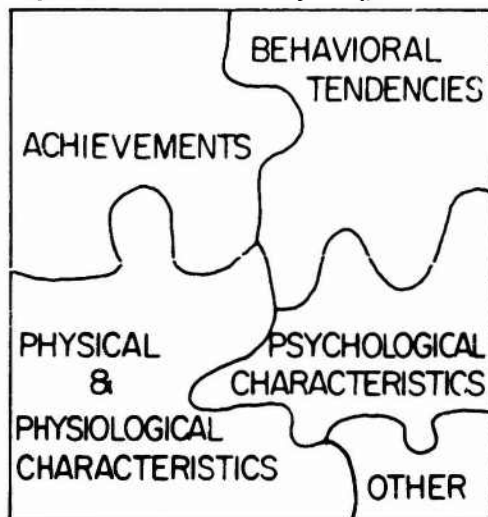
For management purposes the skin envelope need not invariably be seen as the boundary for grouping behavior or performance variables. There are man-machine combinations which amplify human muscular capability (e. g., a fork-lift), while others (man-computer) amplify human

intellectual or information processing capacity. Also, two or more persons may perform a task in an integral manner. Or, again, performance of either an individual or a team may vary--depending on how (order, organization) the task is executed.

Command/management objectives are diverse and not specifically predictable, whereas individuals and groups present a uniform reality. Therefore, a coherent discussion of assessment must fall back to the individual level.

Assessing the Individual

The psychological and physiological assessment of persons constitutes a very considerable field of professional knowledge. The present discussion will be confined to those techniques that are feasible in an operational military organization.



ASSEMBLE THE REQUIRED INFORMATION

personnel files can be broadly classified as falling into four categories: (1) selected physical and physiological characteristics, (2) selected psychological characteristics, especially aptitudes, (3) acquired characteristics or achievements, and (4) characteristic behavioral tendencies. The list which follows shows some of the contents of the enlisted personnel file by each category:

Contents of Enlisted Personnel File

(grouped by category of information)

1. Physical/Physiological Characteristics

Physical Profile Code

2. Psychological Characteristics

Aptitude Test Indices (in DA Form 201)
Language Ability Indices

Personnel Files

Consult personnel files.

First and perhaps foremost among the sources of information about an individual is preexisting information about the person. A substantial amount of pertinent information is contained in personnel files and is readily accessible to the military manager.

3. Achievements

Record of Civilian, Military and Correspondence
Schooling (in 201)
Last Skill Qualification Test (SQT) Score (in DA
Form 201)
Skill Identifiers Code
Proficiency/Hazardous Duty Code

4. Behavioral Tendencies

Efficiency Reports
List of All Awards Received (in DA Form 201)
Award Orders
Article 15 Records
Courts Martial Papers
Promotion/Reduction Orders

5. Other

Personal Photograph
Letters of Recommendation for Induction
Travel Orders
Assignment History (in DA Form 201)
Next Assignment Preference (in DA Form 201)
Reenlistment Papers
Security Clearance
Disposition of Personal Effects and Insurance

The items included in the "other" category of the list are of secondary importance. For example, the individual's assignment history and/or his preference for a next assignment might be very revealing, but not immediately relevant to the overall management of human resources in the context of continuous operations. Also, photographs or the actual personal appearance of an individual are notoriously poor indicators of anything including physical strength or stamina and should not be used to assess the individual.

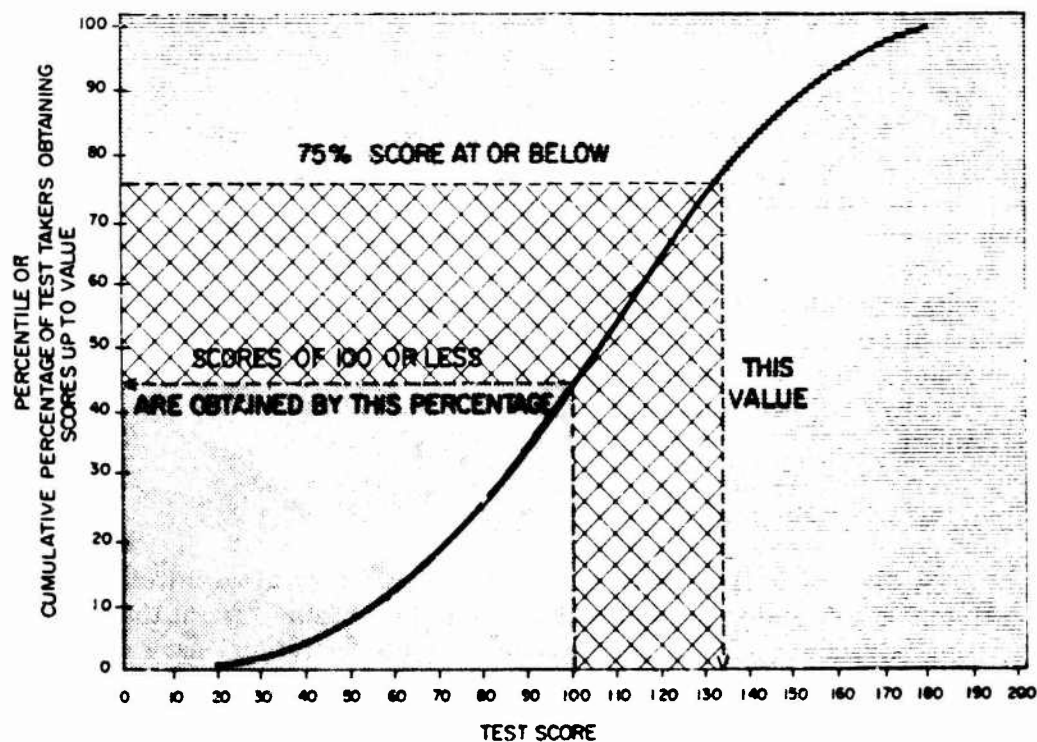
Physical/Physiological Characteristics

A far more valid indicator of physical/physiological characteristics pertinent to job and task performance can be obtained from the Physical Profile. Or, prolonged acquaintance with the individual as a member of a military unit may yield information which is superior to a past, brief physical evaluation. This conviction may be justified in many, though not all, cases. Some physical conditions are not immediately obvious. For example, specific defects in the acuity of the eyes and ears can be subtle and manifest themselves only under specific conditions. Color blindness may exist in a person who has otherwise exceptionally "sharp" vision.

Color blindness--the inability to distinguish between red and green and, in some cases, other colors--could be advantageous by making an individual less subject to deception by camouflage. On the other hand, color blindness will disqualify the person from selecting color-coded objects, e.g., fuzes for artillery projectiles. At the very least, information such as that in the Physical Profile should be treated as an alerting indicator--a flag--for further observation and confirmation or disconfirmation.

Aptitudes

Aptitudes are the critical underlying ingredients that determine potential performance capability. An analogy is the gear ratio, four-wheel drive gearing, ground clearance, etc. that determines the potential ability of vehicles to navigate across rough terrain. Such features are not necessarily immediately and manifestly evident, nor are they invariably brought into play. These characteristics provide the potential for performing rather than the performance itself. In humans, the potential may even be for the development (e.g., through training) of the performance capability rather than for the performance capability directly.



Aptitudes exist to varying degrees. Tests of aptitudes attempt to measure the degree to which an aptitude is possessed by a person somewhat as a thermometer measures the temperature in a room. However, a score on an aptitude test can not be interpreted as easily as a temperature. In the case of aptitudes, the scale will be specific to each aptitude and to each test for it. Thus, a score of 80 by itself does not tell anything about the degree of the given aptitude that is present. To interpret such a score we must know, at the very least, the range of measures obtained by it (e.g., 75-150, 0-100, 20-180). In addition, we should know something about the distribution of scores that have been obtained. This makes it possible to translate the obtained score to a percentile or a standard score that expresses the percentage of people who obtain scores of equal, greater, or lower magnitudes.

The latter practice is followed in the case of the aptitude scores recorded on DA Form 201. Because of changes in relatively recent times, these aptitude scores may have been obtained with, at least, two different measuring instruments: the Armed Forces Qualifying Test (AFQT) or the Armed Services Vocational Aptitude Battery (ASVAB). Either set of scores will have been converted or "normalized" and further classified into categories. For the broad assessment purposes under discussion here, either the category or the relative magnitudes of scores obtained by the unit personnel in question can be compared to determine who possesses the highest (available) degree of a given aptitude. If, on occasion, a more detailed explanation and score interpretation is desired, the organization's personnel specialist should be consulted.

Test scores suggest specific aptitudes.

General Aptitudes

Apart from aptitudes for specific occupational areas (e.g., electronics, automotive maintenance, etc.), there are scores for general aptitudes. These general aptitudes, such as, mathematical/numerical, verbal, spatial orientation, may be of the greatest interest.

General aptitudes are also important to individual assessment.

Language Aptitude

In addition, there is available the Language Ability Index which may have relevance not only for foreign languages, but also for the mastery of formal (computer) languages and coding or cyphering schemes generally.

Achievement

Tests of achievement differ from tests of aptitude. Achievement tests do not measure potential for performance. They measure actually achieved performance levels. For example, a high Language Ability Index indicates that the person who obtained it should be able to master--say Russian--with relative ease and in a relatively short time. A high achievement test score in Russian means that the person who obtained it has mastered some or even all aspects of the Russian language very well.

Achievement scores measure present performance level.

An important distinction in types of achievement (or proficiency) test scores is that test scores which are normatively referenced indicate the individual's achievement as compared to his peer group. For example, he may have achieved a greater proficiency in Russian than two thirds (66 percent) of all others in his class or of students of Russian generally. However, this does not indicate whether or not he could effectively interrogate a Russian POW, or translate a Russian document. A test score that is criterion referenced provides such an indication. It expresses the degree to which the individual is able to attain a specifically defined level of performance, e.g., can translate Russian military technical documents, or can formulate simple questions in Russian and comprehend spoken Russian replies.

Skill Qualification Tests

Skill Qualification Tests (SQTs) are criterion referenced. They measure the person's qualifications for the various specialized duties by: (1) identifying the essential tasks of the MOS at given levels, (2) specifying the range of conditions under which these tasks may have to be carried out, (3) analyzing the activities of each task, and (4) establishing the observable indications that each task is being carried out effectively and efficiently. Hence, the last SQT score recorded on Form 201 is an excellent indication of the person's qualification(s) level and degree of competence in his MOS.

Consistency of Achievement

Where prior SQTs and their dates are recorded, they can provide useful, additional information. For example, do all or most recorded SQTs indicate a comparable degree of competence at each successive level, or is there a high degree of variability? At issue here is the consistency of achievement rather than the degree of proficiency that is indicated. Similarly, the pattern of the intervals between successively recorded SQTs indicates the rate of skill acquisition. Interpretation of

Consistency counts.

these patterns will be discussed below with other indicators of general behavioral tendencies.

Other Achievements

Achievements or accomplishments include records of civilian, military, and correspondence schooling. This information provides an indication of possible ancillary or additional areas of skill possessed by the person under consideration. Also, the quality of achievement in each type of training may be evaluated. Was the training provided by an institution of good reputation? Did it result in adequate mastery of the subject-matter in question? It may or may not be possible to answer these questions from information on the record. This information is available, it should be given a lesser credence than SQT scores. Educational/training achievement scores, as a rule, tend not to be very well standardized, i. e., statistically compared to the attainments of all people (successive "classes," in different geographical areas, etc.) who receive the training. Also, they are rarely, if ever, criterion referenced in the precise sense in which SQT scores are.

Other Personal Information

Two other personal information items are available in personnel file--the Skill Identifiers and the Proficiency/Hazardous Duty Codes. The information provided by these items is reasonably clear cut. It is useful, but relatively gross information which need not be given detailed discussion.

Behavioral Tendencies

When considering the information about general behavioral tendencies contained in the personnel file, one must consider differences in the quality of kinds of information or evidence. Sometimes the distinction is put in terms of "hardness" of evidence. What is meant is the: (1) precision, (2) validity, and (3) reliability of information. Rumors, for example, are unreliable information, because no two sources will agree entirely nor tell the same story on successive occasions. A testimonial from a supervisor that a given individual is "a good man" or "a willing worker" is interesting, but does not guarantee that devices maintained or repaired by that individual will function properly. A SQT score, for example, will be a more valid indicator.

Give priority to "hard" evidence.

Measures of physical capacity, achievement, and even of aptitudes constitute reasonably "hard" evidence. That is, relative to other evidence, they tend to be precise, valid and reliable. Efficiency reports are often less "hard." On the other hand, they provide a type of information which is not considered by the previous items. For instance, a person with high aptitude(s) and substantial competence in his specialty may fail to "keep his nose to the grindstone" and vice versa. A consistent lack of serious application to duties may predict an early collapse under the stress of continuous operations. Lacking other evidence, the possibility of that person's early deterioration in continuous operations must be entertained. The evaluator must stay with the available evidence. However, for this illustration, as well as for all information discussed so far, the references drawn must be regarded as tentative or provisional. So long as further pertinent information either for corroboration or disconfirmation can be obtained, the "final judgment" i.e., decision leading to action, must be held in abeyance. Patterns may stabilize or disintegrate as new data are added or perspective is altered.

The whole may not equal the sum of the parts.

Integrating Information

How does evidence pattern evaluation apply in the category of general behavioral tendencies information in personnel files? First, there is the question of consistency vs. variability in efficiency reports. Variability suggests either variability of behavior in the person being rated, or variability in the rater(s). If the latter can be ruled out, there is evidence of a lack of performance consistency in the person under evaluation.

Efficiency reports do not stand alone. Has this person received any awards? What was the nature of the award and how was he cited? Does this corroborate or contradict the pattern of efficiency reports? Conversely, there may be adverse information in the file. Has there been an action under Article 15, or has there been a court martial? For what reason? How do the various facts relate to each other?

The efficiency report information should also be integrated with other information to obtain an evaluation of the consistency of past achievement. For example, good efficiency reports, in conjunction with high obtained SQT scores, suggest intelligence, quick learning ability and a likelihood that the person will be able to master the exigencies of continuous operations.

Good proficiency reports in conjunction with low or moderate obtained scores suggest serious intent and persistence, though without much know-how.

In dealing with personal data in relation to other available data, the number of possible combinations is very large. The attempt has been to sketch the overall approach or the ways of thinking about available information. Remember that patterns of data and all "soft" information require interpretation and interpretation is subject to misinterpretation and error. Therefore, such interpretations should be treated as provisional and subject to revision.

Interviews

The personal interview is among the oldest techniques for assessing an individual. Information in the personnel file may be supplemented by personal interview to yield greater insight into possible problem areas. Interviews can be used to excellent advantage, although the technique is

Supplement the information in the personnel file with interview information.

frequently abused. The purpose of the interview is to elicit information and to provide an opportunity for some behavioral observation (e.g., answers very slowly, volunteers information) by the interviewer. Abuse of the technique arises primarily out of misconceptions about the limits of both possibilities. Specific answers or statements by the interviewee and specific observed behavior constitutes the objective data--all else is interpretation. Interpretation, as pointed out previously, may well be misinterpretation, and this is especially true for an interviewer without professional training and extensive experience. For the present purposes, the discussion will be confined to the objective, fact-finding interview for the purpose of evaluating the person for a potential role or roles in continuous operations.

Interviews are sometimes distinguished as being structured or unstructured. In the fully structured type, the specific questions are prepared in advance and no deviation from the prepared questions is permitted. In the unstructured type of interview, each successive question is formulated by the interviewer as the interview proceeds along its course. In either case, the objectives of the interview--the information to be obtained--should be carefully and specifically preplanned. In the unstructured interview, the nature of each area to be inquired into should be determined by the interviewer's objectives. Obviously, any interview is likely to be a blend of the structured and unstructured approaches.

The information objectives of an interview can range from a specific fact to broad categorization. For example, one may want to know whether the interviewee is able to speak and understand German well enough to serve as a communication link with a German military unit.

At the other extreme, one may want to know whether the interviewee is resourceful and able to find ways to solve unexpected problems when they arise under unusual circumstances. Planning for information of the first type is simple and obvious. Planning for acquiring information of the second type requires more careful reflection and preparation. First, the interviewer must define "resourcefulness" for himself. Second, he must ask himself how he will "know it when he sees it," i.e., what are valid, objectively observable indicators of resourcefulness. It will be well to

Interviews must be preplanned.

list all points of any type to be covered in the interview, whether or not this list will be used physically (to support memory) or memorized. For "broad" items not only the item itself should be listed, but also the accompanying indicators and/or counter-indicators.

Depending on the personal leadership style of the interviewer, the occasion(s) and setting of the interview can range from very formal to very informal. For example, the interviewee may be scheduled to appear in the interviewer's office at a specific time and for a specific duration; or, the interview may take place over several opportune occasions in relaxed circumstances, possibly in an on-the-job setting. The quantity and quality of the information obtained are likely to vary with the degree to which the interviewee is put at ease and made to regard the interview as part of overall organizational planning.

Particularly in the case of a "broad" item, neither the total question nor the full answer can likely be formulated in a single item. For example, with regard to resourcefulness, the issue might be opened with a request for self appraisal and presented in a context of organizational interdependence in combat. A summary question might be included which specifies the circumstances under which resourcefulness may become a critical issue. Repetition gives the interviewee an opportunity to reflect at greater length, and the details define the information being sought from him more precisely.

Once a question or other response eliciting statement has been expressed by the interviewer (an item on his list), he must prepare to receive the response. Most often this will go beyond a simple "yes" or "no." What is the manifest content of the response, and what is not included? Expectations or preconceptions should not lead the interviewer to "hear" what was not said. When a judgment (e.g., self-evaluation as to resourcefulness) is asked of the interviewee, it may be revealing to obtain next his

own confidence in his judgment. Perhaps, the requested judgment pertained to his spatial orientation capabilities and the reply was "pretty good." The next question might be: How sure are you on a scale from 1 to 10, where 1 stands for "hardly believe it myself" and 10 for "sure as one can be?" The expressed degree of confidence in the judgment adds a dimension to the obtained information. Now the question becomes one of the credence which the interviewer can give a judgment (or any answer) or the confidence expression or both. The best technique is to ask for corroborative information. For example, the interviewee who asserts with high assurance that his orientation capabilities are excellent should be asked to provide an actual example (e.g., describe an incident in which you depended on your orientation capabilities).

Hypotheses about the person may occur to the interviewer in the course of the interview. Of these, the relevant ones can be tested through suitable questions and requests for specific instances that illustrate what has been asserted. The object of the interview is to collect information. The evaluation and interpretation of obtained data from an interview should take place after it is over.

The purpose of an interview is to elicit information.

Diagnostic Guidance

It is unlikely that any actual performance assessment will reveal only uniform perfection. There will be significant discrepancies between the desired performance quality and the actual state of individual performance capability. The management objective is to eliminate or reduce the discrepancies as much as possible. We shall not, at this point, consider the issue of how best to secure the intelligent cooperation of the individuals concerned, but assume that it exists. The concerns of this section go beyond assessment as such, but are such an integral aspect of it that they must be discussed in this immediate framework.

With the assumption of intelligent cooperation, the analogy with coach and athlete is again appropriate. It is the object of the coach to

Assessment results lead to corrective guidance.

assess the athlete, compare his present status with the ultimate requirements, and guide the athlete in his attempts to overcome his shortcomings. The coach must diagnose the specific shortcomings and, in the more refined sense, diagnose what brings them about. He must be able to tell the athlete precisely what he is doing improperly and exactly how it should be done correctly.

In the assessment of individuals relative to the requirements of a given unit during continuous operations, specific shortcomings will be

Derive specific shortcomings relative to continuous operations.

revealed. Telling the person to "try harder" will not produce an improvement. The person in question has no idea about what he must do or how he must do it to improve. He needs detailed and specific diagnostic guidance.

Set up a plan for overcoming the shortcomings.

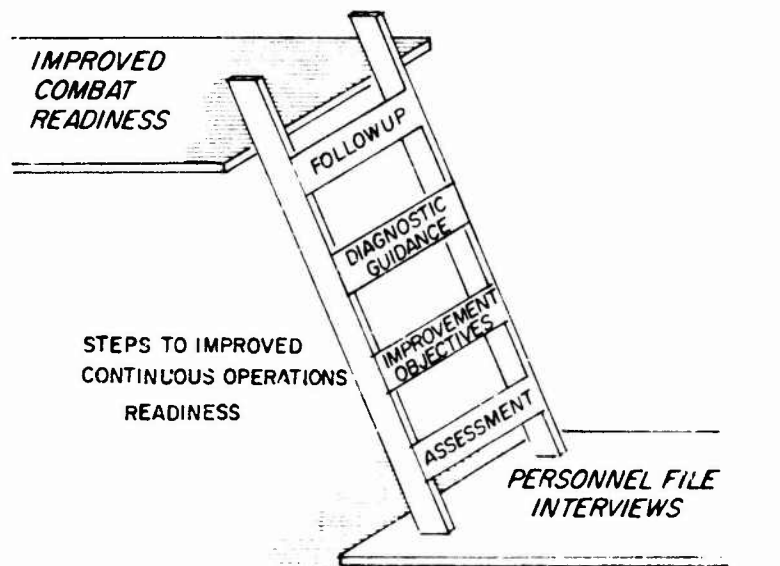
Management procedures to employ include the following. First, determine exactly what aspect is deficient. Second, analyze what might produce this result. Third, clearly explain the required corrective actions to the person in terms of what he must do or how he must do it.

At times, detailed diagnostic analysis is a matter that is far from obvious. It may present a real puzzle. The approach to a solution is to trace through the problem minutely with attention to desirable criteria and required personal characteristics. The object is to find the cause of the failure. If the individual does not possess a personal required characteristic (e.g., numerical facility) one course of remedial action is indicated. On the other hand, if the individual lacks a given knowledge or skill but possesses the required personal characteristics another course of action is indicated. Personality problems and social interactive problems represent other issues.

Atmosphere for Guidance

Providing effective diagnostic guidance requires a willingness on the part of the performing person to reveal his ignorance or inadequacy to his evaluator. So long as he perceives the evaluation (assessment) as threatening to his interests (e.g., leading to a poor efficiency report), he will have to "cover up." The atmosphere for diagnostic evaluation and guidance, then, must be carefully prepared so as to foster cooperation. This goes beyond casual verbal assurances (which may not be trusted) and will be discussed later under the topics of morale and motivation.

Each guidance session should result in an agreed on set of improvement objectives and a plan for achieving these objectives. For example, it is not enough to tell a soldier that he is too fat and that you doubt his ability to move fast after two days of continuous operations. In this case, the agreed on objective might be a two pound per week weight loss over the next 10 weeks and the plan might be a diet as prescribed by proper medical authority.



Set up a plan.

Followup

Once an assessment, diagnosis, and a remedial course of action have been derived and agreed to by the involved individual, appropriate followup must be completed to assure that progress is being made towards the derived goals. For any serious attempts at longitudinal development it is advisable to establish some systematic scheme or record keeping. The progress may be plotted to determine trends or variability. The records should then be analyzed periodically.

Follow up on the plan.

Trends evident from performance records can be of various kinds. The obvious and desired one is a trend of steady improvement. The reverse is also possible, and the appropriate management action(s) will be more or less self-evident. A declining trend might be due to a faulty diagnosis, lack of application on the part of the individual involved, or it might signal a morale problem. A constant level might suggest that some limit on improvement has been reached. That limit may be absolute (e.g., a personal characteristic is limited), or further improvement may require a significant change in surrounding conditions (e.g., heightening morale, motivation).

Trends need not be uniform. Longitudinal records may display some variability. Some moderate variability is to be expected. A high degree of variability is another matter. Such a variability equates with unreliability of performance, since it cannot be predicted what level of performance will be furnished when it becomes of critical importance. The causes of evident high variability of performance should be investigated. Variability of performance should not be confused with normal cyclical variations that are correlated with seasons, holiday periods, and the like.

Assessing Groups/Teams/Units

A very great deal of what has been said in the course of discussing the assessment of individuals applies to groups as well. The reference to the coach-athlete relationship continues to be appropriate for the team. However, as the assessment of the individual player differs from the assessment of the baseball team, the assessment of the individual soldier differs from the assessment of the military unit.

Individual vs. Team Performance

Individuals, as pointed out earlier, constitute a biological entity. They appear to the outside observer such as, the assessor as integral units. There are fleeting recognitions of the fact that each of these outwardly integral units (persons) is actually an organization of subsystems. We speak, for example, of eye-hand coordination or thinking before speaking. The way the subsystems are organized and function in the individual person in any given task is far from obvious, but constitutes a problem for complex scientific analysis. In team performance, the components (persons) and their organization are far more observable, although the true nature of their interactions is often far from obvious.

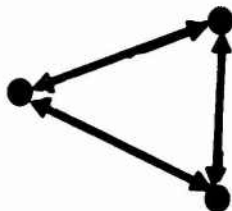
The performance of a team is not the simple sum of the performances of each team member. Any team sport illustrates this point. Military teams, like football teams, strive to accomplish cooperatively specific objectives or results through organized activity. In order to fire a given round, a 155mm crew must select shell type and charge and fuze, mate the shell and fuze, set the fuze, load the round, and so forth. The separate activities or individual tasks must occur in some order and may be performed by the same and/or by different team members. The ability of a team member to perform is, at times, dependent on whether another team member has completed his part. The degree of success in achieving the objectives of the team task depends on organization and individual action.

Organization of Individuals and Activities

The central aspect of assessing team performance, as opposed to individual performance, is the determination of interdependencies. There

is an organization of individual persons and an organization of activities (individual tasks), and the two are not identical. It is chiefly the interdependencies among people as they perform tasks that are of interest and use in team assessment.

Any type of organization can be conveniently represented in graphic form. In particular directed graphs or digraphs are very useful. Digraphs consist of points and lines, and the lines have directional arrow-heads attached to them. For example:



Points need not literally be points (dots). For instance, small circles can be substituted, and labeled to indicate a person or a task. Graphic representation of the process of team performance suggests the points on which inspection (i. e., observation, assessment) should focus. Like a blueprint a team-task-graph or diagram has many diverse uses in the observation and evaluation of performance.

Measures and Records

At the basic level, assessment of team performance amounts to assessing individuals and their interactions as they perform in an environment. The managers intent on achieving and maintaining the highest possible levels of effectiveness and efficiency deprives himself of sensitive assessment and diagnosis by confining team assessment to only the individual. Team procedures and coordination can be improved sometimes through careful analysis of interactions and the related continuous operations environment.

Team assessment should not be simply thought of as identifying the person on the team with the least competence. The weak link can be a situation which requires particular accuracy or speed or rapid judgment. When such weak links exist, for example, in extended continuous combat operations, the effectiveness of the team as a whole deteriorates or disintegrates.

The discussion of diagnostic guidance of individual performance mentioned the need to determine where and why performance goes off the track, and how to get it back on the track.

For teams, the diagnostic problem is more difficult. Proper information may not be communicated. One team member may possess low ability and depress the performance of the total team. There may be social interactive problems. The team leadership may be poor. The team may not have practiced together sufficiently. We emphasized at the outset individual performance improvement because individuals form the basic building blocks of teams. However, no amount of individual ability can be assumed to assure team success. Assuming individual proficiency, the team's function as a unit must be examined.

Teams are composed of individuals who are interdependent.

Assessment, diagnosis, and guidance are more important for team performance management, than for individual performance management. Where, when and how do errors occur? Are they shrinking so as to fall within acceptable tolerance limits? What should these tolerance limits (performance standards) be in the light of overall team or mission objectives?

One type of performance measure that has not as yet been mentioned is time or speed of performance. Often the ability itself to perform a task correctly is inadequate, if the task cannot be performed within some time limits. Time limits or standards may be imposed by circumstances (e.g., completion of two activities must be synchronized), or they may derive from a management objective.

Diagnosis of Team Deficiencies

ARTEPs provide the set of significant military team tasks and the standards of performance. Assessment of military team performance is largely fixed and standardized. Therefore, this discussion of team-performance assessment elaborates and amplifies on guidance contained in particular ARTEPs. Principally, ARTEPs fall short of guidance in how to pinpoint the root causes of deficiencies so as to bring corrective management action to bear.

Maintain flexibility in diagnostic approach.

Application of the various techniques described heretofore can be of considerable help toward that end. As for individual diagnosis, considerable flexibility in approach is warranted. Diagnosis should be viewed as a challenge for imaginative problem-solving.

Practical Guidelines to Team Diagnosis

A few practical guidelines can be given.

Establish what is desired or expected.

As much as possible, the setting of goals should not be arbitrary, but should be based on good and sufficient reasons. The goals should be clearly and, if possible, quantitatively formulated (not "fast," but "within 5 minutes"). Unless goals have been carefully defined there will be no criterion or standard for comparison.

Measure the specifics of actual performance properly and accurately.

Measures used should correspond to those for which goals have been expressed. It will not do to specify hits on a target, but to count instead the number of rounds fired. Also, whenever possible the measure of performance should be exact (objective) rather than loosely estimated.

Compare actual performance with prespecified criteria (goals, standards).

Without objective comparisons, the discrepancy between required and achieved performance cannot be established. Note must be taken of the nature of the discrepancy and of its extent.

Identify discrepancies.

Where do discrepancies occur? In the case of performance by a team, this means that observed discrepancies are related to specific individual characteristics, subsets of characteristics, or between individual links which are weak.

Lastly, the question is how these discrepancies occur. Do they occur uniformly, or only on some occasions? What are the circumstances under which they are observed? What are the clues for constructing a "theory" to account for them or how they are produced?

Observation and Subjective Assessment

The entire presentation of approaches to assessing human resources so far has emphasized accuracy and objectivity. In practice, the time and resources required for detailed objective assessments may not be available. This will be the case when a military organization is under strong pressure to achieve high capability in minimal time. At such times command/management must resort to shortcuts and approximations to previously presented techniques. Principally, this means that quick observation and judgment must substitute for lengthy deliberate measurement and analysis.

The fact that compromises must be made should not be interpreted to mean that previously outlined considerations can be abandoned. It is still necessary to decide what needs to be observed and what the criteria

for each observation are. Inevitably, the number of observations made is likely to be smaller than under more favorable conditions, and the accuracy, validity, and reliability of each performance assessment will be lowered. In making a compromise for the sake of necessity, it is desirable to pay the least possible price for it.

Pay the least possible price for compromise.

Paying the least possible price translates to minimizing the effects of bias, inconsistency, and inadvertent omissions from consideration which are characteristic of all subjective evaluations.

In principle, the considerations underlying subjective appraisals of performance are no different from those underlying objective appraisals. Perhaps the chief difference is the degree of observation. In an objective performance test, a measurement or score is obtained--perhaps 80 or 135 or 52. In subjective performance evaluation the "score" is either "checkmark" or "no checkmark" (Yes-No, 0-1, OK-Not OK, etc.). A list, called a checklist, is developed of all those aspects of performance that can be and should be observed. The list serves at once as a reminder of what needs to be rated and as a guarantee that the same aspects of performance will be observed in each case.

In practice, items on a checklist will be far fewer than the items in a comparable performance test. In short, on a checklist, each observational item should be the outcome of a whole task or of a major observable step within a task.

To illustrate a practical checklist as applied to a military team performance assume the following situation. A field artillery fire direction center receives a call for fire (CFF) from a forward observer (FO) and is to calculate the firing data. Since computer support (e.g., FADAC) is not available, computation must be carried out with range deflection protractor (RDP), graphical firing table (GFT), etc. ARTEP standards require completed calculations for the initial round within 45 seconds from receipt of complete CFF. A partial checklist is shown in Exhibit 1.

Sometimes, the necessity for making some observational judgment about the magnitude, quality, or extent of what is being observed cannot be avoided. For instance, the observation in question may pertain to the selection and marking of a concealed route to a subsequent position. If there is a variety of potential routes offering different degrees of concealment (from all angles) and protection, the quality of judgment (selection) exercised cannot be described by a "yes" or "no." Nor will it do merely to judge whether the route selection was adequate or not, because the objective is to obtain the highest possible degree of safety and the best possible concealment.

Exhibit I

Partial Checklist for FDC Performance

	<u>Yes</u>	<u>No</u>
1. Battery Computer begins recording CFF within 2 seconds of receiving first element.	_____	_____
2. HCO begins to plot target within 2 seconds of receiving third element.	_____	_____
3. VCO begins to plot target within 2 seconds of receiving third element.	_____	_____
4. HCO announces Rg and Df within 25 seconds from end of CFF.	_____	_____
5. VCO announces site within 30 seconds from end of CFF.	_____	_____
6. HCO has Angle T ready within 45 seconds from end of CFF.	_____	_____
7. Computer announces QE 45 within seconds from end of CFF.	_____	_____

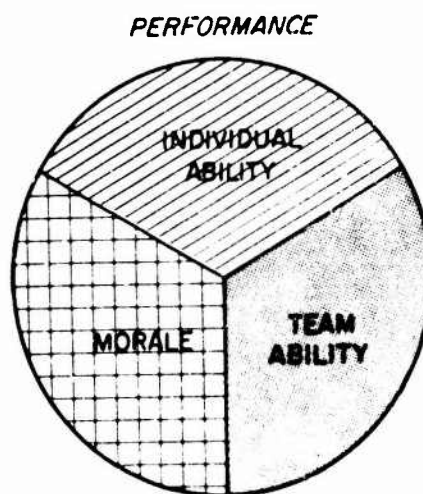
Whenever judgment about the extent of any observation must be made a rating scale is needed. Rather than characterizing the observation in the simple "yes-no" fashion, the scale represents the extent of an observation or judgment. Such a scale must have two end points representing respectively the best (most) and the worst (least) possibilities. In addition, there must be something for recording observations that fall between the two extremes.

Attitudes/Morale/Motivation

Keep tabs on morale.

So far the concern has been with the assessment of existing performance capability and with factors (aptitudes) underlying it. However, getting the best performance requires people who are able and willing to carry out their mission. To this point, there has been no discussion about the assessment of "willingness." Yet, this factor will be over-riding in the continuous operations situation. For practical purposes, it can be said that continuous operations success will depend on attitudes, high morale, and strong motivation. Where these conditions exist most or all members of the organization are willing to subordinate their needs and desires to the requirements of the organization and its mission(s).

A sensitive, detailed assessment of prevailing attitudes, morale, or motivation imposes technical requirements of a high order. Therefore, such a precise and complex assessment is not feasible in the operational military organization. However, a reasonably accurate impression about the general state of morale in a unit can be readily obtained.



The first question is, once again, the by now familiar one: how shall we know high (low) morale when we see it? What are the outward, observable manifestations of high or low morale? For example, when morale is low, it can be expected that there will be a high incidence of major and minor disciplinary infractions. They arise out of the unwillingness of personnel to subject themselves to organizational requirements. The incidence of AWOL will be relatively high and widespread (different people go AWOL). Assigned work tasks will be poorly performed (though requisite competence exists) or left incomplete. Unfavorable rumors will be circulated. Interpersonal conflicts severe enough to come to the attention of command/management will be relatively frequent. Personal hygiene may be poor.

When morale is high, the opposite is likely to be true. Rule infractions will be very low as will be incidents of bickering. Circulating rumors will have an expectant note. Tasks will be completed to high standards and in short order. Solutions will be found to technical problems that arise, and technicians will show signs of trying to improve their own skills without urging.

Most likely the assessment of morale is easiest and most clear-cut when it is at either of these two extremes. Intermediate levels may be more difficult to assess. All of the indicators that have been mentioned are relative to ill defined limits. (What is the lowest/highest possible level of morale?) Some of the suggested indicators (e.g., incidence of rule breaking) are clear and quantitative. Others (e.g., favorableness/unfavorableness of circulating rumors) require some judgment.

It may be apparent from the discussion how directions and degree of attitudes, morale or motivation may be assessed with respect to specific items or indicators.

Combat Readiness

In general, combat readiness refers to the existence of a level of performance capability in a military organization enabling it to carry out combat missions effectively. The nature and conditions surrounding the expected missions need to be specified to assess an actual state of capability. For example, a capability may be demonstrated by requiring a tank platoon to move in orderly fashion from one battle position to an alternate position in a combat exercise. However, this provides no guarantee of similar effectiveness on the fourth night of actual, continuous combat operations.

The remaining portion of this chapter presents approaches to assessing likely capabilities in circumstances that cannot actually be created. Whereas prior sections provided practical guidance, here the object is to explain the background and meaning of "barcimeters" that have been developed.

Empirical Estimates

Empirical estimates of combat readiness or capability or effectiveness are those based entirely on actual experience and observation. Such estimates are obtained, for example, in Army training tests based on ARTEP guidance and standards. In effect, this amounts to a performance test on a very large scale and one that is applicable to a large military unit. The background, techniques, and procedures for these are either familiar or can be obtained from other sources. Also, all of the previously discussed approaches to assessment apply.

As pointed out already, empirical estimates that are not based on actual combat experience have their limits. The training or evaluation exercise cannot reproduce the true stress of battle, nor can such exercises push men and machines to their extremes. At these limits,

Performance may degrade below training levels during continuous operations.

the highly improbable event becomes probable and must be expected--if anything can go wrong, it will. Empirical estimates, therefore, can be relied upon only with respect to combat conditions ranging from fair to ideal.

Synthetic Estimates

Synthetic estimates are those based on an abstracted representation--a model--of the military organization. The behavior of this model under extreme conditions can be calculated so as to provide an estimate of effectiveness. Most often the effects of extreme conditions are calculated in terms of attrition in men and material. Not until very recently has consideration been given to degradations of human performance capability itself under the influence of adverse conditions associated with extended continuous combat operations. This is a shrinkage of human resources due not to sustained casualties, but to "wear and tear" of people.

Four factors attendant on continuous combat operations have been identified as the principal (but not the only) contributors to performance

Factor 1: sleep loss.

degradation. The first and dominant factor is fatigue resulting from sleep loss as operations continue without let-up. Another factor is the disruption

Factor 2: diurnal rhythm disruption.

or inversion of normal diurnal rhythms. These are the bodily rhythms associated with the normal cycles of waking and sleeping whose disruption is most often encountered as "jet lag." These cycles will be seriously upset when operations are continuous over several days. The darkness of night (also twilight, fog, rain or snow) is another major factor.

Factor 3: visual deprivation.

Lastly, there is a stress factor arising out of threat to life and limb, noise, pace of operations and so forth.

Factor 4: stress.

The presence of these factors limits certain abilities essential to the performance of a great many combat tasks. As an obvious example, darkness limits the ability to see and this degrades performance of any task in which vision, especially distance vision, is an essential ingredient. Needless to say, fog, rain, snow, etc., can also interfere with vision. What may be less obvious, but established by scientific research, is that the fatigue of lost sleep also depresses the visual ability.

An intensive survey of scientific literature established that the four adverse factors adversely affect some abilities that are important in most military combat tasks. The table summarizes the impacting debilitating factors, the significant abilities that are affected, and which abilities are degraded by which factors. Explanations or definitions of

SUMMARY OF FACTORS DEGRADING CRITICAL ABILITIES

	Degrades →									
		Communication	Dynamic Precision	Hearing	Memory	Numerical Facility	Orie itation	Perceptual Speed	Reasoning	Vision
FATIGUE (SLEEP LOSS)			✓		✓	✓	✓	✓	✓	
DIURNAL RHYTHMS					✓			✓		
DARKNESS, etc.		✓	✓			✓				✓
STRESS	✓			✓			✓	✓		

the adverse factors and of the abilities are given in Chapter 1. A check mark in the table means that the given ability is degraded by the given factor. The absence of a check mark means that the ability is not significantly affected by the factor in question.

What the table does not show is the degree to which any given ability is depressed by an impacting factor and to what extent the factor

must be present before significant degradation occurs (how dark must it be before one cannot see how far). Also, the table does not show how far an ability can be depressed before task performance becomes significantly degraded. However, this information was obtained through a systematic survey of scientific literature. In the accompanying Guidelines, all of the information was used to develop a synthetic estimate of the performance capability or combat effectiveness remaining after the degradation due to impacting factors is subtracted.

The quantitative expression of remaining human performance capability is the index of performance effectiveness "E". This index lies between 0 (zero) and 1.00. For simplicity the decimal can be omitted so that the value of E resembles a percentage. For practical purposes, the index E might be considered to be a percentage of effectiveness. If this is done, one may ask: Percentage of what? The percentage expressed by the value of E is a relative one. An E value of 0 (zero) does not imply an absolute absence of all performance capability (e.g., a fatality), nor does an E value of 1.00 imply absolute perfection. Rather the limits of 0 (zero) and 100 represent the worst conditions and the best conditions of performance respectively. The worst condition would be that in which all of the debilitating factors--fatigue, diurnal rhythm, darkness, stress--are impacting on critical abilities in such a manner as to degrade performance capability, and the best condition would be that in which these factors are absent. Thus, the best condition might prevail at the beginning of a training exercise, and the worst condition represents, perhaps, the fifth night of actual continuous combat operations. Any value of E between 0 (zero) and 100 expresses the "percentage" of effectiveness that can be expected when intermediate conditions prevail.

E is calculated in a mathematical synthesis (model) of the impacting factors, the abilities, how they relate to each other, and similar matters. The model assesses the average level of performance to be expected in specific tasks or in a given duty position under specified conditions. E can be calculated not only for a specific task, but for that task within the context of a particular combat mission. E can also be calculated for groups such as, maneuver teams, squads, platoons, artillery gun crews, and the like.

Estimating Performance Under Various Combat Conditions

Task performance degradation is not uniform across tasks.

Calculations for a great many tasks, duty positions, military organizations and conditions have been made. Their complete tabulations are contained in Appendix A. These tables show that performance of some tasks is extremely resistant to degradation, while for other tasks perform-

ance can be expected to be reduced to very low levels. For example, a squad leader in a mechanized infantry platoon may normally perform such tasks as, "adjusting firing as necessary" and "directing relocation fire" proficiently and effectively (E=100). After 5 sleepless nights of continuous combat operations, in darkness, and under extreme stress, effectiveness of performance is expected to degrade 99% (E=01). On the other hand, a Tank Platoon Leader will experience only nominal degradation of performance in operating the intercom/radio under comparable conditions (E=100). Even a task whose performance might be expected to decline ultimately to very low levels will not show alarming degrees of degradation immediately. For example, after 24 hours of continuous combat operations, while demand on the gun crew is light, a section chief will be able to lay a 155mm howitzer with high effectiveness (E=92); under heavy demand (including incoming enemy fire) and, after 120 hours of continuous operations, performance of that task will be very seriously degraded (E=08). Under light demand the degradation will be far less so (E=65).

The tabulated values of E apply on average to the average soldier performing a given task, or occupying a given duty position. By extension they apply to the average military organization of the type for which they are tabulated. Individual differences, whether in persons or groups (units, organizations), are not considered. Obviously, some people will be able to resist the impact of debilitating factors better and for a longer time than anticipated in the Appendix A tables; but, an equal number will be more debilitated, and in lesser time.

The tabulations provide a "barometer" of the kind of performance effectiveness that can be expected. The E value is an approximation, because it applies to an average and, also, because it is a projection rather than a set of actual (empirical) measurement. These tabulations can be used to excellent advantage in the management of human resources. E values should be viewed relative to each other rather than in an absolute sense and small differences (less than about 10) should be disregarded.

CHAPTER V

CONSERVING AND MAXIMIZING HUMAN RESOURCES

The capability to sustain effective combat operations depends entirely on the resources available. Therefore, resources need to be stored, conserved, and expended in the most cost/effective way. With respect to material and equipment resources, the acquisition is largely a matter of logistics of optimal stockpiles, rates of expected resupply, and so forth. Human resources differ from material resources in two major ways. First, the stockpiling of performance capability is not analogous to that of stockpiling material, and the effect is different. Second, human resources are self conserving and self healing to some extent.

All resources have an absolute or practical upper limit. In the case of human resources, the problem for command/management is to push performance capability as close as possible to that limit. Thereafter, the object is to hold the inevitable decline to a minimum and to achieve as much self restoration as possible. Good management techniques can make a substantial difference in the degree to which these objectives are achieved.

Attaining High Performance Capability

The attainment of high performance capability in the individual, team, or inclusive military organization normally precedes combat operations. Exposure to the latter even for relatively short times provides an intensive learning experience that cannot be duplicated in training. The attainment of a high performance capability in a military organization is not a matter of training only. Several other management options exist, and their judicious combination provides the best management of human resources.

Allocations of Duties to Positions

Allocate duties to positions equitably.

An equitable allocation of duties to positions is an important factor in overall, organizational effectiveness. Suppose for a moment that all duties (tasks to be carried out) were alike in every respect (difficulty, time for completion, importance) and interchangeable. They could, then, be allocated to any duty position or even all could be allocated to one duty position. Put this way, it is self evident that the person to whom all tasks (duties) are assigned will be woefully overloaded, while other individuals will have little or nothing to do. Also, an equitable reallocation in this hypothetical case

TASK REALLOCATION

BEFORE				AFTER			
DUTY POSITION A		DUTY POSITION B		DUTY POSITION A		DUTY POSITION B	
TASK a	b	c	d	TASK a	b	c	d
e	f	g	h	e	f	g	h
DUTY POSITION C		DUTY POSITION D		DUTY POSITION C		DUTY POSITION D	
i	j	k	l	i	j	k	l
m	n	o	p	m	n	o	p
DUTY POSITION C		DUTY POSITION D		DUTY POSITION C		DUTY POSITION D	
DUTY POSITION		E		DUTY POSITION		E	
A		36		A		50	
B		73		B		73	
C		83		C		80	
D		45		D		67	

will be simple: as nearly as arithmetically possible assign an equal number of tasks to each team member.

However, tasks do differ in a great many ways. For example, they differ in their relative importance or criticality to mission success. Mission success will be endangered if all critical tasks are concentrated in one duty position and the person involved is killed. Success will also be endangered if that person's performance capabilities deteriorate--for any reason--to low levels. A low level of effectiveness, it will be recalled, equates with a low reliability of performance or a small likelihood that each critical task will be carried out adequately.

Distribute critical tasks.

From the command/management point of view, tasks or duties or responsibilities differ in:

1. Criticality
2. Difficulty
3. Duration
4. Frequency
5. Vulnerability

The meaning of criticality has been explained already. Difficulty, for present purposes, refers to the amount of preparation or experience required before the task can be performed adequately. Duration is the time elapsing between initiation and completion of a task while it absorbs the full performance capacity of a person. Frequency, of course, means how often the task needs to be performed. Vulnerability refers to the degree to which performance capability may degrade under adverse conditions.

Each of these dimensions of difference present a dimension for management consideration in task assignments to positions. While many assignments are rigidly anchored in positions because of laws, policy, or tradition this should not prevent, at least, the consideration of what might be gained through reallocation of selected responsibilities.

While precise, mathematical solutions to allocation and assignment problems have been developed in the field of operations research, such techniques most likely are beyond the capabilities of a small military organization. Skilled management judgment must substitute for them. For example, expected values of E for many critical combat tasks appear in Appendix A. A high concentration of tasks showing very low values of E within a single duty position is clearly undesirable and cause for considering reallocations. How might these tasks be redistributed? How does their difficulty, duration and frequency restrict the possibilities? What is the likely benefit (if any) resulting from one possible reallocation as opposed to another? These are the most essential questions to be dealt with in exercising management judgment.

Selection for Duty Assignments

Select in accordance with personal characteristics.

Sensory Ability

Given that the responsibilities and personal attributes required for a duty position have been allocated and fixed, the problem now becomes one of fitting a person to the specifications. To a very large extent this selection precedes assignment to an operational organization and goes beyond its discretion. However, some discretion remains and can be used to good management advantage.

Consider sensory ability.

The latitude which remains relates primarily to selection for specific roles the individual will play as part of a team which itself is constituted for specific combat purposes. For example, the visual detection of targets is a necessity in almost all combat situations. While advanced technological aids have been available and may become progressively more available, the eye is still the fundamental means for detection. Vision, in this sense, is not simply a matter of "sharpness" (acuity) as measured by an eye-chart. Because targets are likely to be camouflaged, at a distance, the visual problem is to distinguish the target from its surroundings. This may depend more on the ability to detect discontinuity of colors (hues) than on the ability to distinguish progressively smaller, black and white letter shapes. Brightness and hue are different dimensions of vision, and there are others. Vision at night is quite different from vision during the day. The ability to spot an irregularity in a visual pattern differs from that of seeing the pattern as such; the ability to detect movement differs from the ability to detect stationary patterns, and so forth.

It is impractical to conduct surveys of the diverse visual abilities among members of a military unit. However, there should be an awareness that they exist. The management problem is how these abilities manifest themselves in specific continuous operations situations. It is possible to arrange tests as part of routine exercise. For example, it might be arranged that selected potential targets (e.g., a person, a squad, a vehicle, etc.) attempt concealed approaches to a team or unit generally alerted to

Pinpoint persons processing unusual sensory ability.

detect approaching targets. On repeated occasions, it will become evident which members of the alerted unit are consistently among the first to detect the target. Clearly, they will be best fitted to act as "the eyes" for the group as a whole.

What has been said about vision is paralleled in hearing. Hearing, too, enters into target detection as well as many other situations. It is an important factor in all sorts of verbal communication--face-to-face and over electronic channels of communication. The joint dependence on vision and hearing is not confined to target detection, but exists as well in communication. Existing scientific evidence has demonstrated that vision materially aids comprehension in verbal, face-to-face communication--especially in the presence of noise. Noise, of course, is an ever present condition on the battlefield.

Vision and hearing are the principal distance senses through which human beings gain information about the world beyond their skin. Others (e.g., smell, touch) exist, but are of negligible interest for present purposes. Nor are sensory capabilities the only ones on which people differ.

Consider motor ability.

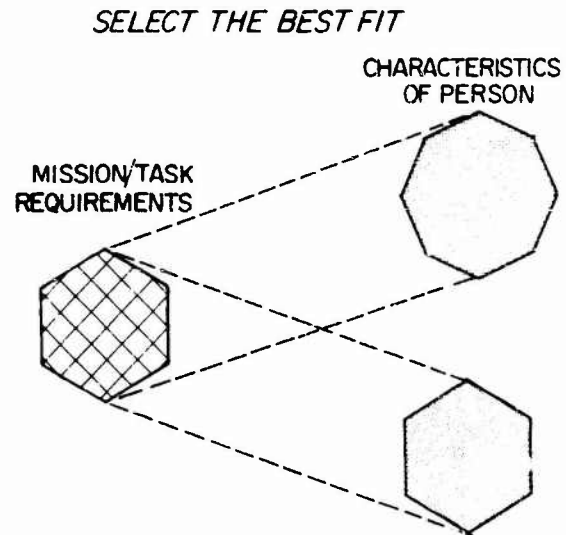
Motor Ability

The other side of this coin is the output from the person in the form of information (e.g., speech) or physical manipulation of the environment. People differ with respect to output capabilities as well as input capabilities.

Muscular strength is only one of many considerations in this connection. It is not entirely equivalent to stamina. Lifting heavy shells into the breech of a gun at rapid rates and for extended duration demands endurance as well as some minimal muscular strength. In many tasks the required muscular strength is negligible, but precise manipulation or eye-hand coordination are the critical issues. Static (stationary) and/or dynamic (with body in motion) balance may be quite important in many circumstances.

Muscles are used in speech, but the muscles do not determine the speech quality. Assessment with respect to speech is a simple matter. There may be speech defects (e.g., stammer, lisp) or there may be a problem with English that is so heavily accented as to impair ready comprehension. When verbal communications are likely to be difficult due to masking noise, distortion in electronic channels, distance, etc. heavily accented speech is likely to become quite incomprehensible. This is a disadvantage that affects--without prejudice--some members of some segments of the population whose habitual language is not a standard form of English. This disadvantage needs to be taken into consideration in assigning communications responsibilities.

Muscles are also a factor in fatigue. For practical purposes, physiological (muscular) fatigue is not a major consideration in most military tasks. Especially under extreme conditions, the stamina will be found to accommodate whatever muscle may be required.



Cognitive Ability

The "fatigue" resulting from prolonged loss of sleep is quite distinct from physiological fatigue. This kind of fatigue does not affect the muscles, but affects cognition (e. g., memory, thinking, problem-solving,

Consider cognition ability.

quickness of thought). If sensory capabilities (vision, hearing) represent the input to the person and motor abilities the output from the person, then cognition represents that which goes on between.

In a revealing study of how sleep loss affects the ability of military personnel to perform various military tasks, volunteers were deprived of sleep over a nine day period. During this time, they performed a variety of tasks, and performance of these tasks on successive days could be compared. Tasks such as, field stripping and inspecting weapons or weapon handling were performed about as well on the last day as on the first. This was also true for their ability to group rifle fire on designated targets. However, the ability to detect and hit targets which emerged at random intervals while volunteers were deployed in a perimeter defense declined drastically. Note that only the vigilance (alertness) declined, and not the ability to aim for and hit a target. Capabilities for logical reasoning, coding and decoding (e. g., map coordinates), recognizing contradictory or confusing indications and acting on them, and similar matters also declined greatly. Memory for details (codes, map coordinates, specifics of orders) also suffers. Squad leaders, after extended sleep loss, were able to read a map but could no longer relate it to terrain and orient themselves.

The ability to resist the effects of sleep loss is an extremely important one in combat. While it may not be practical to test performance degradation due to extreme sleep loss, observation during extended training exercises may prove a workable alternative. This also applies to orientation ability which does not improve with practice when it is not possessed initially.

Summary

The management problem is one of selecting personnel on the basis of manifestations of high levels of ability. Military situations in which these abilities are likely to manifest themselves need to be devised. The manifestations of the abilities either in general (across tasks) or in specific tasks need to be systematically observed and noted. Those who do best within the given organization (i. e., among available personnel) can then be selected as needed. Such selections are a key to survival for all in continuous combat operations.

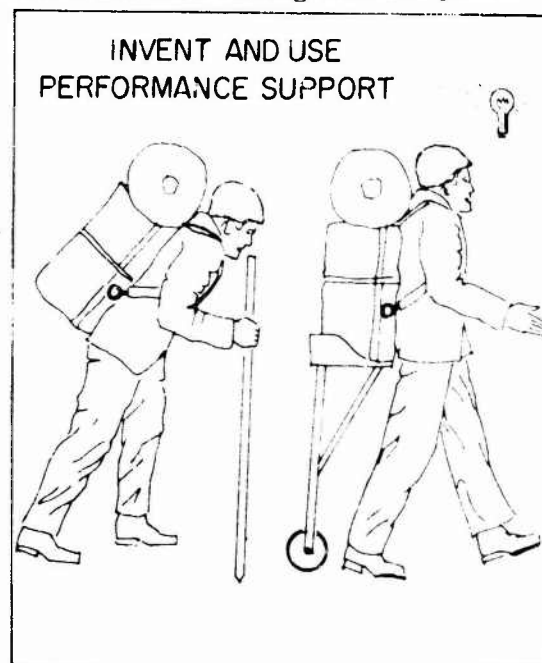
Performance Supports

Performance Aiding

The human resources unit is very often the person, but this is not necessarily always so. An automatic identification of the performing unit with the single, biological person tends to eliminate many potential areas of management solution from consideration. This point is particularly well demonstrated by the concept of performance supports.

Performance supports are any means or methods for amplifying or supporting the performance capabilities of the person. At the output end, this refers, first of all, to any means for increasing muscle power or endurance. A stick used as a lever falls into this category. So does a radio telephone which permits the voice to be heard over any distance. At the input end the most obvious example will be a night vision device (NVD) which immensely extends the visual capabilities of the person in the dark.

When a NVD is used, the characteristics of the performing unit (soldier + NVD) are different from either alone. Now the image produced by the NVD acts as an amplifier for the visual apparatus of the person and the output of the person is augmented. For management purposes, the performing unit of resource is the combination and interaction of person and device.



The performance aid concept is not invariably simple. The parallel to vision in hearing will be easily imagined (amplifiers, filters). Complexity enters when performance supports are considered in relation to cognitive processes. A range card is a familiar example. A more complex example is the TACFIRE system whose capabilities replace a great deal of human observation, calculation, and communication. In both cases the information handling load is shared between the human and the device, relieving the unaided human or expanding his capabilities.

Provide necessary performance supports.

Performance supports can be provided for tasks of any scope. In the practical application within the small, operational, military organization, the useful, practical application will mostly be to tasks of limited scope. What sort of tasks? For example, an extremely common military task is to estimate relative distances between terrain features, or to judge the angle (azimuth) with the observer at the apex, or to judge range to a terrain feature. Sometimes finger or hand widths are used to aid this judgment. This is a kind of performance support. A better one might be a grid and protractor, with scale markings, overlaid on a transparent card. When held--say six inches before the eyes--this provides an excellent visual (spatial) frame of reference for accurate judgment. Practicality would have to be assessed, but seems likely since this performance support could be carried in a shirt pocket.

The effect of continued use is an important consideration with respect to performance supports. With respect to the example, it is quite likely that the visual frame of reference would become "internalized." Dependence on the actual device may disappear, because an internal representation now guides accurate spatial judgment (probably not consciously). In short, some performance supports act as temporary crutches to help the person develop a capability he did not possess before.

For practical purposes, a reliance on the inventiveness of the individual soldier is advised. Especially with some prompting and an explanation of the principle, he is in a good position to decide where and how

Capitalize on the inventiveness of the individual soldier.

performance supports may help him. A campaign in which suggestions are solicited and useful ones are rewarded is likely to be productive of provocative ideas. Most of these ideas will concern means and/or devices that can be supplied or prepared locally.

Other Factors

In addition to the factors discussed so far, the attainment of a high performance capability depends on other subtle, but nevertheless important, considerations. Of necessity, the management guidance that can be given with respect to these factors is far less specific and definite. They call for sensitivity, awareness of their character, reflection, and application of good management judgment.

Leadership

In a comprehensive review of scientific literature and thought as it pertains to leadership in the formal (military) organization, an important distinction emerged--distinguishing between the concepts of leadership,

Don't forget leadership needs.

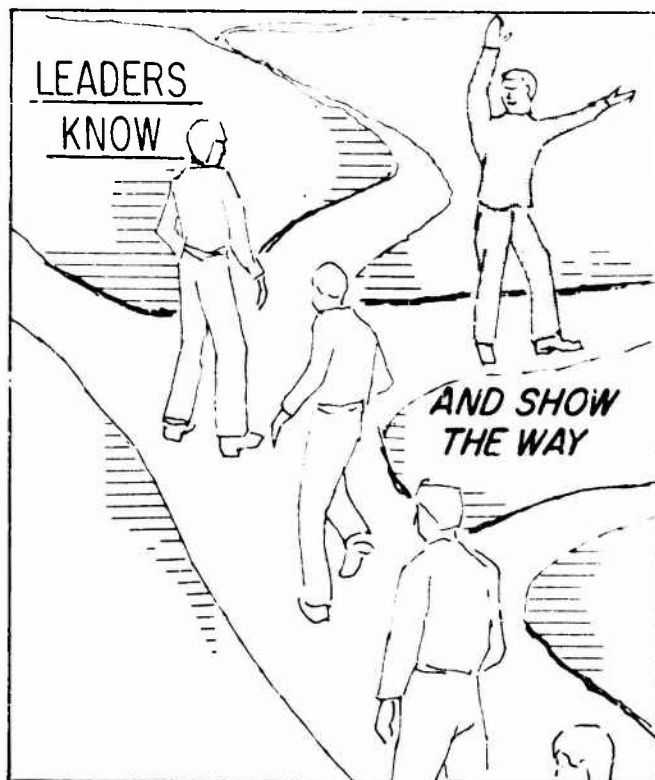
power, and authority, and identifying superordinate role behaviors that constitute each.

First, it must be appreciated that leadership cannot be separated from communication, information exchange, or social interaction. Leadership cannot be exercised in isolation, and, therefore, communication is

Communicate!

integral to leadership. Leadership is exercised because the leader is the best, most proficient problem solver in the group (unit, organization). He leads in the original sense of that word, because the solutions to common problems and the paths toward them are more clearly apparent to the leader than to others in the group. Because he best knows what to do, others follow in the expectation that it will serve them best to do so.

Leaders solve problems.



Leadership in contravention to the previous sense, can be exercised through power. In essence, power implies the threat of coercive reprisal ("or else"), if obedient performance does not follow the power-leader's directions. Power is the basis for the leadership of the bully who asserts himself and is obeyed even when he leads into disaster.

Authority, in the ideal and proper sense, combines power and knowledgeable leadership. Authority can grow out of either power or leadership as an expectation about a person and the acceptance of certain relationships

Integrate power with knowledge.

and roles in the group. In military practice, authority is designated by sources external to the group (i. e., higher Hq). Therefore, the relationship exists to begin with. In the military organization, authority needs to be maintained rather than gained through demonstrations of leadership and judicious exercise of power.

Sustain the leader's authority.

Sustaining the authority already conferred by still higher authority means that subordinates must develop a firm belief that there is real, i. e., knowledgeable, leadership. This belief cannot be developed unless, at least, some of the common goals are understood and the best approach to their attainment is convincingly demonstrated. By no means must the leader/ commander/ manager justify every policy or decision. Rather he must explain (selectively) some dominant objectives for the group as a whole (e. g., survival in combat) and show that his policies generally are best suited to achieve them.

Don't be afraid to use your authority.

Additionally, authority must be sustained by the demonstration of power. An initial judicious display will be with respect to a policy in which a belief of correctness has been built up already. Once a decision has been reached, management must use its authority to assure that everyone works towards the objectives.

Communication

Communication is inseparable from leadership. The flow of communication is by no means only from the top down. Communications present issues relating to their content, structure, and patterns.

Directive communications emanate from the top. Directive communications (orders) need to specify: (1) what is to be achieved, (2) how it is to be achieved, and (3) what characterizes the end of (successful) task execution. Ambiguity (not clear what is meant) or equivocality (two or more

valid interpretations possible) in any of the three aspects defeats the intent of the communication. Even with unquestioned authority, an ambiguous or equivocal order (directive communication) cannot be obeyed because those to whom it is addressed cannot know what to do. Prior to release, directive communications should always be reviewed from this point of view. Directive communications need to be complete and clear.

Communicate clearly and directly.

Clarity is not only a matter of the words used. The structure of the communications can be at least equally important. The structure of a communication should be transparent. What is dependent on what (if... , then clauses) and what is to be considered jointly (a and b and c) and what choices exist (d or e) should be immediately obvious.

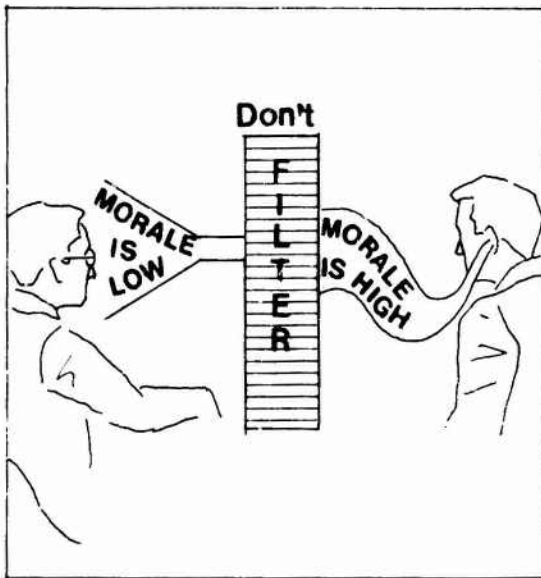
In the formal (military) organization, the issues often discussed and often ignored relate to communications patterns. Within the formal authority structure, clear cut communication channels exist which follow (for the most part) the established lines of authority.

Provide feedback.

The concept of "feedback" is a central one in control (command) theory. Effective and efficient control can be exercised only so long as information about all relevant conditions is complete and accurate. The blind person moving through the physical world is deprived of visual information. He cannot easily tell (or tell at all) whether an obstacle is in his path or how successfully he is avoiding a known one with the curtailed information available to him. Similarly, the commander who is deprived of the full range of significant information cannot know the true state of affairs.

Don't filter.

The "filter" concept is integral to the feedback concept. A filter is anything that acts in such a way as to diminish, restrict, or distort the total information transmitted by the original source. For example, when a given specific message (as written on a piece of paper) is whispered to another person and by that person to another, and so forth, the content and meaning of the original message will be significantly changed by the



time it is passed back to the original source. The information content of the original message has been filtered by each successive person. As the number of such intermediate levels and the ambiguity of the original message (communication) increases, the likelihood increases that the information will become degraded by the time it reaches its destination.

Command/management authority, in the sense previously explained, depends on adequate and reliable information exchange. Adequacy can be achieved by expanding the possibilities for information feedback through direct observa-

tion and open channels for informal communication. Reliability can be obtained by comparing information received over two or more channels.

Motivation and Morale

Most scientific theories distinguish between the potential for performance and actual performance. The latter depends on the existing state of capability (through learning, training, practice) and on the existing level of motivation. Obtained performance is the product of motivation and

$$\text{Performance} = \text{ability} \times \text{motivation.}$$

acquired (learned) capability. No matter how high the level of either factor, if the other is zero (or effectively zero) no performance will be obtained. Individuals or teams perform best when motivation and morale are high.

Morale and motivation are not entirely synonymous. Morale is the condition in a group in which personal needs, desires, and objectives are either aligned with those of the group, or are willingly subordinated. High morale arises, for example, out of well established authority which formulates group objectives. These objectives are accepted and even adopted by each group member, because the authority has become unquestioned and the leadership is trusted.

When morale in a group is high, the achievement of the group's goals provides the incentives. Reinforcement, the essential ingredient for achieving a high performance capability, derives from indications that the goals are being approached--that there is progress toward these goals. A reward (reinforcement) is the information that the individual has contributed to the achievement of the (common) goal.

This information may be inherent in the situation and self-evident. The player who helps a baseball team score a run or a football team to a touchdown is aware of that fact. In other situations, these matters are not so immediately obvious. Reinforcement may depend on expressed recognition of the contribution by an authority figure.

Reproof, of course, is the other side of the coin. Reproof can work in two ways depending on how it is given. A stinging reproof acts as a punishment. An objective reproof which distinguishes between the (inadequate) performance and the person can increase incentive strength. The coach who analyzes what was wrong with a given play, and implies that he believes the player can do far better, is likely to evoke a strong desire in the player to live up to that opinion.

Build a cohesive group.

Morale, as mentioned, amounts to alignment with or willing subordination of personal goals to group goals. A precondition is identification with the group. The greater the feeling of belonging to the group, the stronger will be the operation of the factors outlined here. Therefore, anything that contributes to the cohesiveness of the group and to identification with it should be encouraged. The possibilities are too numerous and diverse for discussion here. A few can be suggested: (1) emphasize membership in the group, i. e., "you're one of us, and we take care of our own," (2) emphasize group prowess, i. e., "we're one helluva bunch, and we can do anything," (3) emphasize uniqueness and superiority of group, i. e., "when things really get tough, they call for us, 'cause nobody else can..." Other themes of this type can be imagined. In any case, fixed slogans and cut-and-dried examples cannot substitute for continuing, sensitive appraisal of the extent to which group identification exists in the organization and for constant efforts to strengthen it.

Morale, motivation, leadership, and communication are interactive.

The factors in the management of morale, motivation, leadership, and communication do not exist in isolation from each other. Quite the contrary, they are largely interdependent and interactive. For example, where an authoritative leadership has been established, communication is good, morale high, and group identification strong it becomes easy to set group achievement goals. Such goals, amounting to high performance standards, then become (self-imposed) standards for each individual member of the cohesive group. A complex of integrated, but multiple incentives establishes a powerful and durable motivational structure.

Summary

At least three coordinated incentives now operate: (1) responding to, complying with, or pleasing the authority of leadership, (2) meeting the self imposed standards of performance, and (3) the peer pressure inherent in the demand to live up to the performance level of others in the group (team, unit).

Setting Group Goals

Set high, but realistic, standards.

Group goals or performance standards need to be set in a carefully calculated pattern which is itself dependent on accurate assessment or appraisal. The principle is to set the achievement goal just slightly ahead of the current level of performance.

Competition

Promote competition.

Competition is another technique for enhancing group identification. Rivalry between comparable organizations at comparable levels of competence automatically establishes performance standards, i. e., we must be good enough to beat the competition. Because the competition will act similarly, the standards need to be constantly raised, if one is to be successful or to remain successful.

Competition enhances group identification.

Competition inherently emphasizes group membership ("our team") and, because the success experience from successful competition is contingent on group identification, competition enhances group identification.

Self Esteem

Motivation and morale were discussed above from the external point of view. That is, the sources of control and manipulation for motivation/morale which were considered are external to the individual.

Play on the individual's self esteem to increase his motivation.

The strongest, most stable and durable motivation, however, arises internally and is based on the individual's own self esteem. No external source of control comes close in effectiveness to the control a person exercises over himself. The ultimate object in leadership and group identification development is to have the individual person adopt the common goals as his very own. Once the source of motivation has been transferred from external (leadership) control to internal control, the self esteem motivation begins to act independently and continuously. It becomes, in the ideal case, an integral part of the individual's personality integration (self-concept, self-esteem). The force of the necessity for protecting the integrity of the individual personality is equalled only by the needs for self preservation in the biological sense.

Maintaining High Performance Capability

Once a high performance capability has been attained, the problem shifts to maintaining performance capability. This is not to imply that on some specific day the concerns change from one to the other. Rather, there will be a progressive shift as the performance capabilities of the military unit begin to reach substantial levels.

Maintain performance capability.

Decline in performance comes about mainly as a consequence of the operation of three major types of factor. First, there is motivation/morale. Maintenance of morale is no different from establishing it. A second factor in the decline of performance is traceable to the process of forgetting by each individual person. The management techniques for coping with these issues have been discussed in connection with training and over training. The third complex of factors in the decline of performance are those which degrade it in circumstances such as, continuous combat operations. Several types of management options exist for coping with these factors.

Cross Training

Cross training does not, in itself, present any technical, training issues. Once again, principles of training and over training apply in general. The operation of critical abilities and of the principal debilitating factors impacting on them were described previously. Accordingly, cross training reduces to three management questions of: (1) who should be cross trained with whom, (2) for precisely which capabilities, and (3) with what order of priority and relative emphasis?

Cross train to maximize performance at minimal costs.

With a purely economic criterion selection for cross training would seek to determine the person(s) whose present, existing capabilities most nearly match those required for the duties in the target job (position). Training and attendant costs would thus be confined to the "additional" capabilities that the selected person does not yet possess.

However, in seeking to decide who is to be cross trained with whom, there are, first of all, basic policies that constrain choice. For example, basic command responsibilities cannot be delegated except to the position next in line. While normally those persons entering consideration for cross training will be of the same MOS and either at the same or at the next lower level when normal cross training needs are considered, this constraint may not hold when the exigencies of the continuous operations situation are considered. In the combat organization, cross training needs to be

Cross train in depth.

of considerable "depth," i.e., if A is disabled, B takes over, and if B is disabled, C does, and so forth. Ideally, if not practically, each member of the organization should be cross trained with every other member.

Establish cross training priorities.

Once the ideal is accepted, the remaining issues reduce to priorities within available time. With respect to "which capabilities," the questions become the order in which they should be acquired and the performance standard, (since ideally everyone is to be cross trained for everything). This, of course, is identical with the third issue--the basis on which priorities and emphasis can be set.

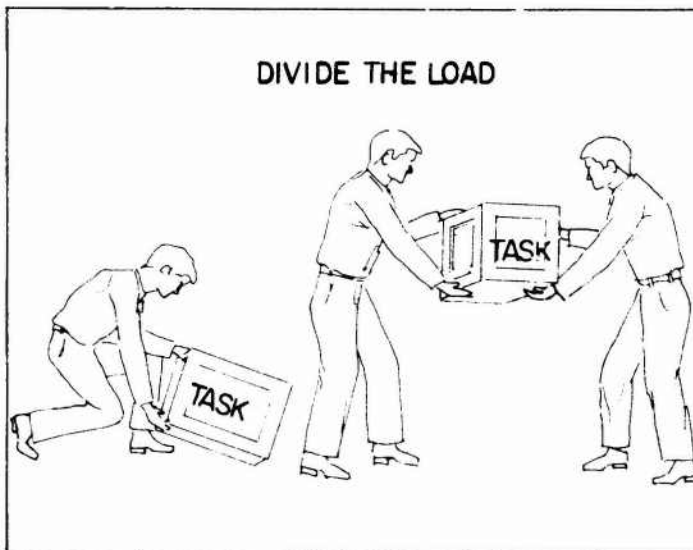
How can effective cross training be managed in the operational military organization? If individuals B, C, etc., are slated for cross training so as to master, at least, certain critical duties of position A, it will rarely be feasible or necessary to send them for formal schooling. This sort of training can be accomplished within the organization and on a somewhat informal basis. During a period when low ability personnel were accepted for Army service, studies were conducted on how to train them effectively. These studies demonstrated that even low ability personnel learned effectively with a system of peer instruction. Individual A, who had mastered some set of tasks, served as the instructor in a tutorial relationship for individual B. The "formal" aspect of instruction was confined to the designation of A as the instructor and to what tasks he was to teach. After B had mastered these tasks, he then assumed the role of instructor with respect to C, and so forth. Both, "instructor" and trainee learn effectively in this arrangement. In general, it has been shown that the teach-back technique is highly effective. In short, a trainee rapidly masters any material (task) if, after having learned it minimally, he is required to teach it back to someone else including his instructor.

Use peer instruction and "teach back."

Task Load Sharing

Lighten the load on heavily loaded persons.

When the task at hand consists of lifting some object which exceeds the strength of all but the very strongest, load sharing is clear and obvious. That task becomes easy and its performance reliable when two or more people share the exertion. Even when the load to be lifted is such that it



presents no serious problem to the fresh, rested person, it may be impossible for the extremely fatigued person.

The principle of task load sharing can be extended to situations in which the load is not literally a physical weight. In a clerical task, for instance, it is often possible to share the component activities of the task between two people and to gain efficiency

as well as longer endurance. In a calculation, especially of a repetitive type, it is often possible to split the activities in an analogous way. In perceptual or sensory tasks (looking, listening), such divisions of task responsibility are often possible.

Also, as discussed before, the sharing need not be between two persons. It can be a sharing with devices (in the broadest sense of that term). A rope and pulley arrangement shares the load of lifting weights. A hand held calculator shares the load of calculations, and so forth.

The issue is not whether task load sharing should be done, but when it should be considered. Progressive deterioration of performance capabilities needs to be foreseen. Tasks that are critical in some sense (mainly to mission accomplishment) should be examined in detail, and provisions for sharing the task load with other persons or with devices preplanned. Remember that the person who can easily complete a task in normal situations may find the task overloads him under the impact of continuous operations.

Redundancy of Performance

Redundancy means deliberate duplication or parallel performance. Redundancy is perhaps the most widely and used technique for assuring adequate performance in adverse circumstances. It is, for example, the standard engineering technique for guaranteeing the performance of complex hardware systems. Simply put, in a vehicle with both hydraulic and mechanical brake linkage, one or the other can fail and yet brakes will be available.

Redundancy serves to assure performance reliability.

Redundancy, as applied to human performance, is similar to task load sharing with this difference: two or more persons perform the same task to assure that it is performed correctly. For example, if two persons perform a calculation independently and arrive at the same result, some confidence can be given to that result. Similarly, if these people independently determine their location on a map and agree, it is more likely that the result will be the correct, actual location than the determination of a single person.

Redundancy is an obvious technique whose price (duplication of effort) must be weighed against benefits. The issue is management analysis to identify critical task situations and times when the technique is warranted.

Distribution of Performance

Distribution of performance is likely to be (with over training) one of the most effective means for preserving human resources in continuous combat operations.

Distribution of performance refers to the pattern in which intervals of rest and sleep are interspersed with active combat performance. Within extended combat operations a nap and rest policy is undoubtedly among the most critical management techniques and it may well be the decisive one that determines overall success or failure.

Fatigue relentlessly increases with mission duration until--at the extreme--it becomes the most dominant source of performance degradation and dwarfs the other factors into minor influences. Fatigue, as this word is popularly used, is made up of two quite independent and different effects. Physiological fatigue (fatigue proper) is the result of the accumulation of chemicals in muscle tissue that act so as to prevent further contraction of the muscles. In practice, as explained earlier, physiological fatigue is of negligible concern so long as a good level of overall physical fitness has been maintained.

Fatigue, in the sense of sleep loss, amounts to the cumulative effects of various factors (including some chemical accumulations) on the nervous system and especially a part of the brain. Sleep loss, then, affects the brain while physiological fatigue affects the muscles. As sleep is denied for a longer and longer period, the need for sleep is asserted more and more strongly by the brain. Eventually, in a literal sense, it snatches sleep. Attention cannot be focused and/or can be focused only for very short periods. Memory, thinking, and problem solving suffers. In general, any task that is cognitive (producing knowledge, decision), or has cognitive components, will suffer.

A recent comprehensive survey summarized sleep loss effects as follows:

Tasks Most Vulnerable to Sleep Loss Effects

- Uninteresting and monotonous tasks
- Tasks that are new or require learning on the job
- Work paced tasks (as opposed to self paced tasks)
- High workload tasks that require time sharing with other primary and secondary tasks
- Tasks that require continuous attention and steady performance
- Tasks in which the worker has little feedback on his performance

Types of Performance Impairment Most Likely from Sleep Loss

- Slower reaction time, increased time to perform known tasks
- Short-term memory decrement, impairment in speed of learning
- Impairment in reasoning and complex decision chain
- Errors of omission, lapses of attention
- Increased feelings of fatigue, irritability, depression
- Erratic performance or increased variability in proficiency

Amount of Sleep Loss Required to Impair Performance

- 24 hours on routine and monotonous tasks or new skills
- 36-48 hours on most tasks involving cognitive and perceptual skills
- 50 percent/24 hours cumulative reduction of normal sleep time over one week

- 4-6 hours if working 0200-0600 watch after day of continuous work
- 24 hours if sleep loss is imposed on one week of "4 on - 2 off" work-rest schedule
- 24 hours if sleep loss is imposed on two weeks of "4 on - 4 off" work-rest schedule

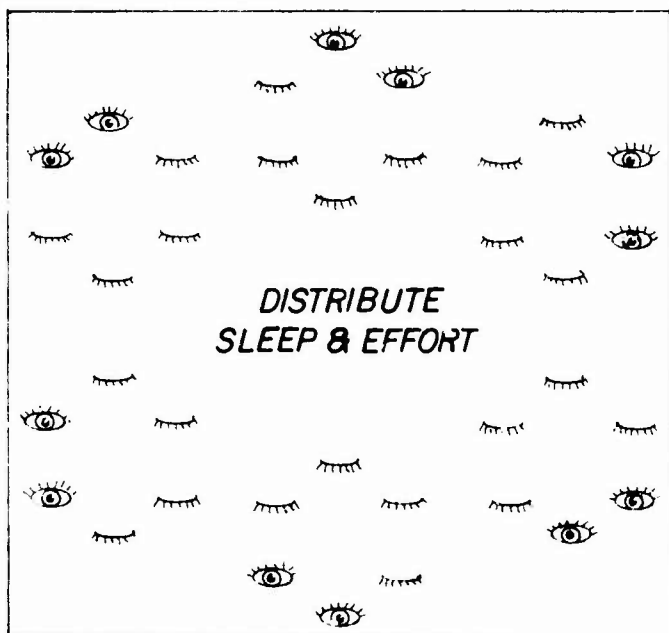
Procedures for Reducing Performance Impairment
Risks in Continuous Operations

- Periodic breaks in task and mild physical exercise or recreation
- 6-8 hours continuous off duty time per 24 hour period
- Task rotation among cross trained crew on relatively routine jobs
- Task rotation among crew on complex tasks only when members are highly trained to shift functions
- Selection of personnel who prefer and are able to adapt to different work schedules
- Training on complex tasks to degree of "over learning"
- System design to compensate for types of errors most likely to occur

While the procedures for reducing performance impairment are interesting and useful, they are not specifically designed for land combat situations, nor can they furnish the backbone of a policy for continuous combat operations. Such a policy must be adapted to the realities of the surrounding conditions.

Allow cat naps and rest periods.

In sleep deprivation, even short snatches of sleep have a profound restorative effect. Interspersion of even very brief periods of sleep in periods of prolonged overall sleep-deprivation can stave off a total collapse for a very long time.



The implications for a general policy under conditions of continuous combat operations would seem to be clear. All personnel should use every available opportunity to sleep, doze, or close the eyes, and to rest generally. The question is what defines the available opportunity. For example, while not actually under attack or on the move, should some or all personnel sleep or should they engage in defensive preparation? No absolute answer to this question is possible. It must be a command/management trade-off decision based on actual conditions in each case. So long as it is desired to conserve human resources for the longest possible time, the sleep choice in this trade-off should have the greatest possible weight.

Assuming that there is some choice possible in the distribution of rest/sleep periods, it might be asked whether it is preferable to have continuous sleep or distributed periods of sleep. Suppose, for example, that three in 24 hours could be devoted to sleep. Should the sleep be continuous for three hours, or should there be a one hour sleep period every eight hours? While conclusive scientific evidence seems to be lacking, it is judged that policy should aim for the longest possible continuous sleep period supplemented by cat nap opportunities. Above all, as choice in these matters nears the vanishing point, the opportunities for cat naps should be preserved and cat napping encouraged.

CHAPTER VI

CASE EXAMPLES

This final section brings together the various concepts and considerations presented earlier. The section attempts to show how the concepts and considerations relate in a realistic continuous operations scenario. Essentially, the case method of presentation is followed. Specifically, after an initial description of the overall scenario, a set of specific problems is presented. After each problem, typical human resources management questions, which can be answered through the methods described earlier or with the help of the data presented in the accompanying Guidebook, are presented. The compendium of human resources questions is not complete relative to any of the problems. Nor is the problem list complete. Nonetheless, it is believed that the problems and the associated questions will serve to focus the attention of the reader on the utility and applicability of the previous materials.

General Scenario

The action takes place at coordinates and locations which can be identified by reference to the following map: Germany, 1:25,000, C-2 (Coburg) overprinted.

U.S. Forces. The 54th Inf Div (Mech), part of the I U.S. Corps, has advanced to the south and southeast through Germany and has reached a line generally along the northern side of the highway which runs from PA350665 to PA490650. At 081000 July, the division was informed that elements of the I Corps to their east had reached the Main River and were preparing for a river crossing operation which would take place in three days. I Corps elements to the northwest of the 54th Inf Div (Mech) have met increasing opposition and have been ordered to continue the attack until on line with the 54th Inf Div (Mech). The 54th Inf Div (Mech) has been ordered to defend in its present location and to be prepared to continue the attack on order.

Enemy. Aggressor resistance increased steadily as he was driven south toward the Main River. Elements of the Aggressor 121 Fusilier Motorized Rifle Division of the 19th Combined Arms Army have been identified opposite the 54th Inf Div (Mech). Aggressor morale is good and his forces are at 90 percent authorized strength. There are no known supply deficiencies.

Air. Both friendly and enemy forces have the capability of achieving local air superiority for limited periods of time.

Nuclear Weapons. Both friendly and enemy forces have a nuclear capability. Neither force has used this capability to date.

Weather. The weather forecast for the next four days is: rainy during the period 8-13 July with scattered cloud cover. Severe thunderstorms possible daily between 1300 and 1700. Ceiling during thunderstorms will be 500 feet. Visibility extremely limited in early morning until 0700 due to ground fog. Excellent at other times except during heavy showers. The wind is out of the northwest at five to eight knots. Temperature ranges between 25 degrees F and 45 degrees F.

Terrain. The terrain in the brigade area is characterized by rolling, forested hills with steep slopes in some areas. The forests are generally cleared of underbrush; however, the size and spacing of the trees will pose some restrictions on vehicular movement. The soil in the lower areas is composed of clay and silt alluvium deposited by the streams. At higher elevations, black loam is prevalent while the plateaus are a mixture of clay, loam, and gravel. Man made terrain features include villages, road cuts and embankments, rock walls, and roads. All of the streams in the area are fordable. The Itz River is fordable with difficulty and will require some engineering work to facilitate crossing.

Specific Situation

Defensive Order

At 081015 July, the 1st BDE, 54th Inf Div (Mech), receives an order to defend along the northern side of the railroad, PA408664 to PA475665, for approximately three to five days.

Task Force Organization, 1st BDE

The 1st BDE is constituted as follows:

- TF 4-78 Mech heavy
- TF 4-79 Mech heavy
- TF 4-80 Mech heavy
- TF 2-4 Armor heavy
- TF 2-50 FA (155, SP)
- A Btry (-) (3-454) (V) (AD) (DS)
- A/54 Engr (CBT) DS
- Commex. Team 54th ASACO.

Initial Sequence of Events

The enemy attacked with one division in two echelons of two regiments each. On the west he used one tank regiment of about 100 tanks followed and overwatched by another. On the east, because of closer terrain and the rain, he attacked with one tank regiment followed by a motorized rifle regiment.

On the west, the long range fire of the HAWs and tanks from all three positions have destroyed 40 to 50 tanks of the lead regiment near Roth a Forst and the BDE CO reorients that portion of his defense.

TF 4-78 is defending the western section of the 1st BDE area and is organized as follows:

<u>TM ACE</u>	<u>TM BLUE</u>	<u>TM GREEN</u>	<u>TM TANK</u>	<u>TM CON</u>
A/4-78(-)	C/4-78(-)	B/2-4 Armor(-)	C/1-70th Armor(-)	1/A/54
3/C/2-4 Armor	2/C/2-4 Armor	2/C/4-78 Armor	1/A/4-78	Eng (DS)
1 AT Section	2 AT Section	1 GSR Team	1 AT Sections	
1 GSR Team				

The following notes further expand TF 4-78's situation:

(1) Since TM BLUE has the largest fields of fire and controls the most likely tank approach into the area, the team has at least three tanks plus HAWs.

(2) TM ACE has a forrested area to its front and is therefore subject to a mechanized infantry attack.

(3) TM GREEN is in reserve; but if the situation warrants, it can be moved forward. Foremost, the team must be able to deliver supporting fire from its location.

Types of Examples

Within this overall and general context, three types of platoon actions (PAs) are described:

1. Repelling an attack from a battle position.
2. Creating and defending a strong point.
3. Disengaging and occupying a new battle position (BP).

All elements of TF 4-78 participate directly or indirectly in each of these three types of actions: (1) Mech. Infantry Platoon, (2) Tank Platoon, (3) FIST, and (4) Artillery Battery (155, SP). The problems and human resources management issues for consideration presented below are indicative rather than exhaustive.

Platoon Action 1

Repelling An Attack From A Battle Position

General Situation

It is 0430 and 68 hours after threat forces launched a breakthrough attack. All U.S. forces have been in continuous combat during this time. TM ACE (A/4-78(-)(M), 3/C/2-4 Armor, 1 AT Section, 1 GSR Team) is occupying BP 41 in a heavily wooded area. Threat forces consisting of tanks and motorized rifle elements of two regiments are known to be approaching BP 41. The Task Force Commander ordered the TM ACE Commander to defend BP 41 and to expect a predawn attack.

Case 1--Mechanized Platoon

It is dark and moonless. The Mech PL needs to detect the enemy approach and engage threat targets at maximum effective range. Scattered remnants of the covering force continue to fall back and pass through the fields of fire of his platoon.

Problem Detect all elements as early as possible, but also distinguish between friendly elements withdrawing and enemy elements approaching BP 41.

Typical Human Resources Issues for Consideration

- Have the "sharpest eyes and ears" in the platoon been previously identified?
- Can a single sentry be relied on to stay alert?
- Should action be taken immediately on the first report of enemy movement?
- At what distance can a sentry possibly detect an approach under the circumstances? At what distance can he discriminate?
- How much practice have (potential) sentries had in night identification of U.S. motorized equipment by sound? For enemy motorized equipment? What were past success rates?
- Are NVDs available? Can auditory aids be provided?

- Will the PLs reasoning be equal to making optimal decisions on specific action after confirmed enemy contact? Should he rely only on his own reasoning?
- To what extent can the GSR be helpful in locating and distinguishing between enemy and friendly elements?

Problem Detect threat infantry approaching dismounted.

Typical Human Resources Issues for Consideration

- How alert can the defenders be expected to be?
- Should a revised sleep cycle have been implemented?
- How will the time of day affect the performance of the U.S. troops?
- On contact, will ability to fire accurately be adequate?
- Are sentries likely to be exposed to bright flashes?
- Will sentries have NVDs?
- How should GSR be used?

Problem When engagement begins track and destroy enemy armor and infantry targets.

Typical Human Resources Issues for Consideration

- With existing light levels and target/background contrast, at what distances can targets be acquired? How well tracked?
- Given the existing sleep loss and stress, what reliance can be given to the SLs ability to keep track of rapid changes in the situation and to adjust firing properly?
- How reliable will be verbal communications with existing light and noise levels?
- What will be the likely state of morale at the expected time of attack?
- How much training practice has there been with this sort of situation? For what proportion of present personnel? What were the success or failure rates?

Problem Accurately estimate the size and composition of any attacking force.

Typical Human Resources Issues for Consideration

- How much reliance can be given to the quantitative estimate in any one person's report? Has the ability to make such judgment been affected by the stress of the battle?
- Can "mental arithmetic" be trusted in combining individual reports into an overall estimate?
- How reliable will be any one person's (e.g., the PLs) evaluation of incoming reports and their combination into an overall estimate?

Problem Maintain light and noise discipline prior to attack.

Typical Human Resources Issues for Consideration

- Were SOPs in this respect established and practiced beforehand?
- What alternate means for (silent) communication exist? What ambiguities will they introduce?
- Will the light level allow the alternative means?
- Is the situation such as to forecast discipline deterioration?

Case 2--Tank Platoon

The Tank PL has ordered the heavy section to engage targets and the light section to illuminate on order. Dismounted security elements report suspected threat armor approaching the vicinity and request illumination.

Problem Tank illumination may reveal the presence of tanks and their approximate position too early.

Typical Human Resources Issues for Consideration

- Without illumination, at what range can threat armor be detected visually? Identified?
- Can identification of tanks by security elements be trusted absolutely?
- How would illumination (artillery flare or tank spotlight) affect subsequent visual capabilities of security elements?
- What visual supports might eliminate the need for illumination?
- How will illumination affect the dark adaptation of friendly forces?

- Is the moonlight sufficient for making an identification?
- What is the position of the moon and the anticipated contrast?

Problem Armor approaching may be a lost friendly element withdrawing from covering force area.

Typical Human Resources Issues for Consideration

- At what ranges (under the circumstances) can friendly/enemy armor be reliably discriminated?
- Will the fatigue level affect the ability to make the judgment?
- How much practice and how much success have the security elements had in identifying friendly armor by sound alone? Enemy armor? Should personnel with special ability/training be assigned?
- What performance aids (including NVDs) can be provided?
- Have prior ARTEPs indicated any problems relative to this situation?

Problem If and when several enemy armor targets are illuminated, how will they be engaged by the heavy section.

Typical Human Resources Issues for Consideration

- Given the prevailing fatigue level and disrupted diurnal rhythms, can rapid decisions be made, or is deliberate preplanning necessary? By the PL? By Tank Commanders?
- Must the PL positively identify enemy targets before commencing the engagement, or should the first TK CDR to identify the enemy initiate firing?
- Should relevant procedures be formulated and reviewed prior to issuance?
- How has the time sharing ability of our forces deteriorated?
- What SOPs have been established for this type of situation? Were they previously practiced?
- Will the response of friendly troops be timely and accurate? How will sleep loss affect their performance?

Case 3--FIST

It is 0430. Heavy enemy artillery suppressive fires force the Artillery FO accompanying the 1st PLT to abandon his primary OP. While moving to his alternate OP, he finds it, too, is being shelled. He has not had time to select a third OP and must do so now.

Problem The FO must move under fire and in darkness across unfamiliar terrain to an adequate vantage point selected as the basis of a map recon.

Typical Human Resources Issues for Consideration

- Given the darkness and fatigue level can the map recon be trusted?
- Can the FO orient himself and navigate correctly to his destination without the use of a compass or other aids?
- How good is the FO's orientation ability? How much has it degraded from normal?
- Can he trust his memory for landmarks on the way to his new OP?
- Can he judge (on the move) the best route (not the most direct route) and maximally use concealment, cover, and protection?
- Will the FO's esprit carry him through?
- Has he been overtrained in this regard? How did he perform in field exercises?

Problem The FO must orient himself to the terrain and report his position accurately to the FDC.

Typical Human Resources Issues for Consideration

- Should the FO's reported position be double checked?
- Can the FO perform resection and maintain light discipline?
- Can the FO orient his map to terrain in darkness accurately enough to determine his position?
- Who should select terrain features in verifying the FO's position and directions?
- How long is it since the FO has rested?

Problem The FO must identify established TRPs if possible, or select and report new planned target locations.

Typical Human Resources Issues for Consideration

- Should either the FO or his RTO catnap during this period?
- During periods of limited visibility can the FO identify established TRPs from different vantage points?
- During such periods can the FO select new TRPs and acquire targets?
- Can he verify TRPs using map and compass?
- Should FO and RTC carry out these tasks jointly? Independently?
- Might a total breakdown of morale develop, if new difficulties are encountered?

Problem The FO must adjust fires on targets of opportunity.

Typical Human Resources Issues for Consideration

- How much reliance can be placed on the FOs (and RTOs) vigilance to detect targets of opportunity?
- Is reported target-of-opportunity information likely to be accurate? How reliable?
- How clearly or coherently can he communicate non-standard target information?
- Is illumination necessary?

Case 4--Artillery Battery

The DS battery has received a CFF to engage a suspected enemy OP and has been adjusting fire on this target of opportunity. It is ready to FFE. The FIST Chief sends an order to the battery FDC to fire a priority immediate suppression mission and to redirect the adjustment mission on the suspected OP. The FDC advises the FIST Chief that because of ammunition shortage the prepared fuzes and charges will have to be changed and adapted to fire the new mission.

Problem Fuzes and charges will have to be changed or adjusted.

Typical Human Resources Issues for Consideration

- Without meticulous reference to data sheets (or interim written records), can gun crew members correctly remember fuze settings and charges prepared for the interrupted mission? The new mission?
- Can fuze resettings be relied on to be correct?

- Is there a need for additional cross checks?
- How will the temperature affect the fuze change operation?

Problem Guns will have to be reoriented and elevations changed.

Typical Human Resources Issues for Consideration

- Considering sustained sleep loss and disrupted diurnal rhythms, might digits in Az and/or QE be reversed? Changed?
- Can any crew member be relied upon to read, e.g., mil-scales, accurately?
- Can a verbal report of a scale reading be relied on to correspond to the real scale value?

Problem A new firing sequence will have to be accomplished to achieve desired results.

Typical Human Resources Issues for Consideration

- Can any one crew member be relied on to: (1) correctly recall changed elements of the new fire order, and (2) not to confuse elements of the prior with the new order?
- Which crew member can be relied on best?

Problem The immediate suppression mission might be redirected.

Typical Human Resources Issues for Consideration

- Will a further redirection intensify all previously listed issues?
- Is there a likelihood that decision making (e.g., reallocation of resources) will become faulty?
- Can troops respond to a redirected activity now? What is their physical shape? Should some sleep/catnaps be directed?

Platoon Action 2

Creating and Defending a Strongpoint

General Situation

It is 0830, 40 hours after threat forces launched the breakthrough attack. All U.S. forces have been in continuous combat during this time.

TM ACE (A/4-78(-)(M), 3/C/2-4 Armor, 1 AT Section, 1 GSR Team) is ordered to prepare and occupy BP 41 before dark. BP 41 is located in a heavily wooded area. The main thrust of the threat attack is expected to come in the vicinity of BP 41 in about 12 to 18 hours.

Case 5--Mechanized Platoon

The Mech PL is told that no engineer assistance will be available to prepare the BP. During his recon the PL discovers the BP is covered by dense woods and will require extensive preparation to yield acceptable fields of fire. The terrain is very rocky and difficult to dig by hand. Defensive positions will require overhead protection from artillery and tree splintering effects.

Problem Security must be maintained throughout the defensive preparation of the BP.

Typical Human Resources Issues for Consideration

- How should defensive preparation and security duties be rotated among squads or squad members?
- Should rest/sleep discipline be integrated with security responsibilities? For whom and on what priority?

Problem Defense will be organized around key crew served weapons and oriented toward the primary threat--a dismounted infantry attack.

Typical Human Resources Issues for Consideration

- What priority should be given to weapon emplacement, clearing fields of fire, maintenance, ammo logistics, etc., versus rest/sleep for crews?
- Should the time frame change priorities?
- Which abilities should be conserved maximally and by whom, and which responsibilities should be delegated?

Problem Defensive positions will be extremely difficult to prepare and fields of fire will require lengthy, heavy work to clear them.

Typical Human Resources Issues for Consideration

- Assuming that at least 12 hours will be available, during which period should the maximum physical effort take place?

- Will a high degree of physical exertion jeopardize soldiers' ability to function during the attack?
- What provisions should be included in the defensive preparation in view of expected light levels at the time of attack?
- What constitutes a proper trade off between the degree of preparation of the defensive position and rest/sleep?
- What type of work/rest cycle should be instituted?
- When should persons with leadership responsibilities be awake and when should they be asleep?
- In what tasks can maximum degradation be anticipated? Minimum degradation?

Case 6--Tank Platoon

The Tank PL is located where he has good natural cover. He has relatively clear fields of fire into the suspected armor avenue of approach to the southwest of BP 41. One Tank Commander reports that a breech mechanism malfunction will take his crew one or two hours to repair and the PSG has requested permission to redistribute ammunition within the platoon to balance loads. The TM CDR has ordered the Tank PL to complete preliminary fire planning by 1130.

Problem The tank crew involved with the breech repair will not be able to prepare a fire plan in the allotted time or take part in the action, if an attack occurs before repair is accomplished.

Typical Human Resources Issues for Consideration

- Can crew members, exclusive of TK CDR, be trusted to accomplish breech repair? How much past practice have they had?
- Can the fire planning task for the breech disabled tank be shared by adjacent tank commanders?

Problem Tanks will have to be moved out of firing positions to accomplish ammo redistribution. This will reduce the time available for target planning.

Typical Human Resources Issues for Consideration

- Have tank crews received sufficient cross training to accomplish ammo redistribution without supervision by the TK CDRs?
- Can they reposition tanks into proper primary positions?

- How much time can any one tank crew be permitted for reloading, when fire planning must be accomplished by all? Will it be sufficient?
- Which men should be assigned to the redistribution task?

Problem Firing positions will require concealment preparation.

Typical Human Resources Issues for Consideration

- At the expected time of attack, what visual problems will confront threat forces seeking to locate tank firing positions?
- In what way might flash blindness effects be used to support concealment?
- How might background contrast be used to decrease detection probability?
- How much time and effort should be devoted to concealment in lieu of other requirements? What constitutes minimal sufficiency?

Case 7--FIST

The FIST has joined TM ACE and is now in the process of consolidating fire plans and target lists. Individual FO target lists have been received and several duplications exist. The FIST Chief and FS NCO process the lists, assign target designations, and confirm target location data.

Problem The FIST Chief must consolidate lists supplied by his FOs with his own, eliminating multiple designations for duplicated targets. Also, unnecessary target selections must be eliminated.

Typical Human Resources Issues for Consideration

- Considering all circumstances, will the FOs target lists and associated information have a more or less than normal reliability?
- Is the FIST Chief likely to make a significantly greater number of mistakes than normally?
- Will a greater or lesser than normal number of target selections be labeled unnecessary?

Problem The FIST Chief and FS NCO must coordinate to determine the weapon system to be used for each target and assign appropriate designation.

Typical Human Resources Issues for Consideration

- Under the circumstances, will there likely be a coordination/communication difficulty between FIST Chief and FS NCO?
- What type of errors are likely?
- Are target related decisions likely to be inappropriate or far less than optimal?

Problem Reported data must be confirmed or recomputed for each target.

Typical Human Resources Issues for Consideration

- Will unusual computational difficulties be experienced, and can substantial computational mistakes be expected?
- Should increased cross checking be instituted?

Case 8--Artillery Battery

The artillery battery commander receives orders placing him in direct support of TM ACE and dispatches his FIST to join the TM ACE CDR. He orders the battery to displace by section and sends the XO to recon and select a firing position from which BP 41 can be adequately supported.

Problem Battery section chiefs must navigate from their present location to selected coordinates using covered and concealed routes.

Typical Human Resources Issues for Consideration

- How might the relocation be planned to minimize performance degradation?
- In orders, what discretion should be left to recipients?
- What performance level might be anticipated as compared with a typical ARTEP? What should be done to improve the anticipated level?

Problem Ammo section must load and prepare ammo for transport to new firing position.

Typical Human Resources Issues for Consideration

- How should sleep discipline be applied in this case?
- Will the physical effort involved in loading-unloading affect the performance of later tasks which require precision of performance?

Problem The XO must lay the battery at the new location and also maintain local security.

Typical Human Resources Issues for Consideration

- Should the XO personally supervise all aspects of laying the battery and security arrangements?
- How can rest/sleep discipline be integrated with security provisions?

Platoon Action 3

Disengaging and Occupying a New Battle Position

It is now 1030 and 74 hours after threat forces launched the breakthrough attack. At 0500, TM ACE was attacked by a combined arms force estimated to be at least two regiments. TM ACE successfully repelled the initial tank and infantry attacks launched against the BP from different directions. This action bought enough time for another team to occupy a blocking position to the rear of TM ACE. Now the Task Force Commander has ordered TM ACE to disengage and withdraw to another BP before becoming overrun.

Case 9--Mechanized Platoon

The Mech PL orders his platoon to disengage and remount carriers at a designated assembly area. Shortly after the squads begin withdrawing, the PSG reports one APC has been immobilized and cannot be used. The second squad leader reports that an artillery barrage has wounded three of his men, one seriously. He will be delayed 20 minutes in reaching the assembly area.

Problem Men, supplies, and equipment must be reloaded on the operable APCs or lost.

Typical Human Resources Issues for Consideration

- Can the available personnel muster the necessary strength and speed to reload rapidly at this stage?
- How reliable is the report of the second squad leader?

Problem Transporting the wounded might endanger the entire platoon or cause failure of a timely withdrawal.

Typical Human Resources Issues for Consideration

- Should the decision be left to the SL on the spot?
- In what way can the PL support the SLs decision making?

Problem FPF must be provided by all elements to keep dis-mounted threat infantry from damaging the APCs which are reloading and withdrawing.

Typical Human Resources Issues for Consideration

- Will the accuracy of overwatching elements be adequate?
- Will jammings, etc. be cleared rapidly enough to maintain a high rate of fire?
- Is assignment redundancy indicated?

Case 10--Tank Platoon

The TM ACE CDR has ordered the Tank PLT to remain in contact and cover the withdrawal of the rest of the team. The heavy section has been forced to abandon its primary and its secondary firing positions. It is withdrawing to the vicinity of the light section positions. The light section is alternating its fires to cover the withdrawal of the heavy section and of the Mech PLTs. The PSG reports that the light section is receiving effective antitank fire and can no longer support the withdrawal from the present firing position.

Problem Heavy section is already minimally effective in supporting the withdrawal as it maneuvers to new firing positions.

Typical Human Resources Issues for Considerations

- How much reliance can be placed on the TK PL to solve heavy section's dilemma and to direct it to an adequate new firing position?
- How likely is it that his directions to the heavy section will be complete, clear, and adequate? How likely is it that they will be fully understood?
- How much reliance can be placed on TK CDRs in the heavy section to navigate properly and to select routes offering optimal cover and concealment?

- How might prior training have affected performance in this situation? What prior training should have been given?
- How might a knowledge of the skills and abilities of specific individuals affect the course of action in this set of conditions?

Problem Light section must move, interrupt, overwatch, and support TM withdrawal.

Typical Human Resources Issues for Consideration

- Can light section be expected to perform the requisite maneuvering precisely and efficiently?
- If not, what corrective human resources action can be instituted? What steps should have been taken prior to the engagement so that his situation would be best met?
- Will selection and occupation of successive overwatch firing positions benefit from supervision and direction?
- What degree of vigilance can be expected from TK CDRs during overwatch?

Problem New positions must be selected and occupied.

Typical Human Resources Issues for Consideration

- If any single individual makes the choice of new positions, are these choices likely to be uniformly optimal?
- Can TK CDRs be relied on to find their designated new positions?
- What are the performance objectives and is it realistic to expect that they will be met?

Case 11--FIST

The company mortar platoon has been ordered to displace and is enroute. The DS battery is receiving counter battery fires and must displace also. The heavy mortar platoon is available only sporadically, because TM BLUE has Task Force priority for fires. FIST FOs are mounted and withdrawing with the rest of the team and are unable to adjust fires on targets of opportunity. TM ACE has called for FPFs.

Problem FPFs must be redirected to GS batteries through the FSO.

Typical Human Resources Issues for Consideration

- Without prompting, will the FIST Chief furnish all pertinent information to the FSO?
- Has the team been overtrained sufficiently to meet this situation?

Problem The FIST Chief must redirect any other team fire missions to the FSO, since mortars are unavailable.

Typical Human Resources Issues for Consideration

- Can the FSO fully rely on the FIST Chief's evaluations and recommendations?
- What types of error may be anticipated?
- Must target data be double checked?

Problem Effective CLGP and smoke missions cannot be maintained by organic FOs.

Typical Human Resources Issues for Consideration

- Under the circumstances, what is the advisability of using inexperienced observers and guiding them through CFF?

Case 12--Artillery Battery

Effective counter battery fire forces a displacement from the battery firing position. Calls for FPFs and immediate suppression fires to cover TM ACEs withdrawal continue to be directed to the battery FDC.

Problem Fire missions must be accomplished using hip shot techniques enroute to new position.

Typical Human Resources Issues for Consideration

- Under the circumstances, are hasty surveys likely to contain mistakes?
- What sort of safety measures should be imposed?

Problem Communication between FDC and battery must be maintained.

Typical Human Resources Issues for Consideration

- Does this present a human resources issue, or is it a purely military management problem?

Problem Section chiefs must navigate to new positions using covered and concealed routes.

Typical Human Resources Issues for Consideration

- Can navigation and route selection safely be left to one (e.g., lead) section chief?
- Can the section chief navigate with a map, though mounted in a buttoned up vehicle?

APPENDIX A

1. Critical task lists for: (1) mechanized infantry, (2) armor, (3) field artillery, and (4) support teams (FIST).
2. Tables of performance effectiveness over five days of continuous operations by tasks and platoon actions under the worst conditions. See the companion Guide-book for description of platoon actions.
3. Graphs and tables of performance effectiveness over five days of continuous operations by duty positions and for units under conditions ranging from best to worst.

CRITICAL TASK LIST

1. Mechanized Infantry

Gunner/Carrier Team Leader

1. Fire from bounding vehicle
2. Overwatch bounding vehicle
3. Fire to protect bounding vehicle
4. Overwatch dismount
5. Fire .50 Cal at areas
6. Coordinate firing with other vehicles and dismounted elements
7. Maintain knowledge of the squad's location
8. Communicate with PL
9. Detect enemy movement
10. Determine need to relocate
11. Establish revised TRPs plus range cards
12. Direct relocation or repositioning
13. Reposition to allow other SWs to fire as needed
14. Cover disengaging squads
15. Maintain concealed disengagement
16. Fire to protect regrouping
17. Report vehicle readiness to SL

Maneuver Team Member

18. Check condition of weapons
19. Detect targets in exposed position from bounding vehicle
20. Fire weapons from bounding vehicle
21. Plan fire effective positions
22. Coordinate weapons locations
23. Mark routes between possible positions
24. Identify TRPs
25. Plan fire cover for possible relocations
26. Fire on targets
27. Fire at areas
28. Fire with NVDs
29. Move rapidly to new positions via marked routes
30. Fire while relocating
31. Move to assembly area
32. Fire to cover move to assembly area

Squad Leader

33. Observe terrain for enemy presence
34. Establish communication network
35. Identify TRPs
36. Prepare range cards
37. Establish routes to subsequent position
38. Supervise obstacle and camouflage construction
39. Adjust firing as necessary
40. Coordinate squad relocation if necessary
41. Direct relocation fire
42. Make new range cards as needed
43. Direct movement to assembly area
44. Direct cover fire while moving to assembly area
45. Assign exposed fire team as needed when mounted
46. Coordinate fire needs per PL instructions while mounted
47. Direct squad movement during disengagement
48. Communicate with PL during disengagement
49. Direct proper movement to regrouping

Platoon Leader

50. Conduct reconnaissance
51. Check accuracy of terrain maps
52. Check on support fire availability
53. Decide to engage unexpected fire or not
54. Direct mounted defense
55. Communicate with OPs
56. Request possible support fire requirements
57. Select positions for cover, concealment, observation
58. Establish inter-squad communication network
59. Assign locations to SLs
60. Establish TRPs
61. Assign fire zones and targets
62. Communicate with company and/or artillery
63. Direct vehicle firing locations
64. Direct vehicle movement patterns
65. Communicate with OPs and company as necessary
66. Decide when (or if) to relocate
67. Order relocation
68. Direct relocation cover
69. Coordinate changes in TRPs, etc., after relocation
70. Order move to assembly area
71. Direct protective fire for move to assembly
72. Direct squad fire zones while mounted
73. Direct squad fire requirements while mounted
74. Direct disengagement
75. Call indirect fire required for disengagement
76. Coordinate regrouping

2. Armor

Tank Platoon Leader

1. Coordinate with 81mm FO (Fire Planning)
2. Coordinate with ARTY FO (Fire Planning)
3. Select firing positions for tanks
4. Select observation posts
5. Select routes
6. Select alternate positions
7. Select supplementary positions
8. Communicate positioning of tanks to the tank CDRS
9. Operate intercom/radio
10. Supervise defensive preparations
11. Inspect for readiness
12. Approve tank commanders' firing data
13. Approve FOs fire plan
14. Prepare PLT fire plan
15. Acquire targets
16. Determine when to commence engagement
17. Order FOs to adjust fires
18. Control employment of coordinated PLT tank fires
19. Operate laser range finder
20. Override gunner's traverse
21. Fire 50 CAL MG
22. Decide when to (if) relocate
23. Control formations on the move
24. Adjust indirect fires
25. Issue fragmentary orders
26. Issue spot reports

Tank Commander

27. Coordinate with gunner
28. Coordinate with driver
29. Occupy firing position
30. Plan fire control measures
31. Escort PL or TM CDR during inspection
32. Report enemy sightings
33. Acquire targets
34. Engage targets on order
35. Adjust indirect fires
36. Operate laser range finder
37. Issue crew fire commands
38. Fire 50 CAL MG
39. Decide when to (or if) relocate
40. Control driver actions when moving
41. Transmit spot reports to tank PL LDR

Tank Gunner

42. Acquire targets
43. Track targets
44. Receive fire commands from TK CDR
45. Fire main gun
46. Fire COAX MG

Tank Loader

47. Load COAX MG
48. Load 50 CAL MG
49. Handle main gun rounds
50. Load selected rounds
51. Conduct WPN safety checks
52. Conduct commo operation checks
53. Set head space and timing on 50
54. Operate breech mechanism
55. Operate fire/safety switch
56. Advise gunner when COAX and main gun can fire
57. Conduct immediate action to correct COAX malfunction
58. Unload unoperational main gun rounds

3. FIST

FIST Chief

1. Receive orders and plans from TM CDR
2. Coordinate with TM CDR
3. Coordinate with PLs
4. Coordinate with FSO
5. Select observation posts
6. Plan WPN SYS, round, FUZE, MOE, & MOC for each target
7. Operate laser locator-designator
8. Orient for direction
9. Determine exact position on the ground
10. Adjust corrective fires
11. Engage targets of opportunity
12. Adjust CLGP (laser)
13. Determine when to request end of mission
14. Adjust ICM mission
15. Adjust counterfire mission
16. Adjust immediate suppression
17. Approve FO calls for fire
18. Redirect FO calls for fire

19. Request FSO provide GS artillery support
20. Adjust TACAIR
21. Adjust high burst
22. Adjust attack helicopters
23. Adjust mortars
24. Adjust illumination
25. Adjust danger close
26. Adjust multiple missions
27. Report target engagement results
28. Order relocation of FIST
29. Relay calls for fire

Forward Observer

30. Receive plans and orders from FIST Chief
31. Receive plans and orders from PL
32. Coordinate with FIST Chief
33. Coordinate with PL
34. Coordinate with FDC
35. Select observation posts
36. Operate laser locator-designator
37. Orient for direction
38. Determine exact location on the ground
39. Acquire targets
40. Determine range of target
41. Determine direction of target
42. Engage targets of opportunity
43. Adjust CLGP
44. Determine when to request end of mission
45. Adjust ICM missions
46. Adjust counterfire missions
47. Adjust immediate suppressive fires
48. Adjust TACAIR
49. Adjust high burst missions
50. Adjust attack helicopters
51. Adjust mortars
52. Adjust illumination
53. Adjust danger close
54. Adjust multiple mission
55. Report target engagement results
56. Relay calls for fire

Fire Support NCO

57. Receive plans and orders from FIST Chief
58. Redirect FO calls for fire

Radio Telephone Operator

59. Operate field telephone

4. Artillery

Battery Executive Officer

1. Supervise battery when it occupies a firing position
2. Lay the battery when it occupies a firing position
3. Measure and report directions
4. Control fires of the battery
5. Insure sections store, segregate and protect ammo
6. Insure ammo is distributed IAW anticipated needs of FDC

Howitzer Section Chief

7. Insure that weapon is properly emplaced
8. Insure weapon is ready for action
9. Lay the weapon
10. Select aiming points for gunner
11. Sight to the crest
12. Order when to boresight
13. Order azimuths marked
14. Order the prefire checks performed
15. Measure and report site to the crest
16. Determine piece to crest range
17. Supervise section during firing

155mm Gunner

18. Lay cannon on initial direction of fire with aiming circle
19. Lay cannon on initial direction of fire with compass
20. Lay cannon on initial direction of fire with distant aiming point
21. Lay cannon on initial direction of fire by reciprocal lay of another cannon
22. Verify direction of fire with reciprocal check as control piece
23. Verify direction of fire with reciprocal check as adjacent piece
24. Verify direction of fire with reciprocal check using lighting device
25. Boresight the panoramic telescope with the MAO alignment device
26. Boresight the panoramic telescope with a distant aiming point
27. Boresight the panoramic telescope with the collimator
28. Boresight the panoramic telescope using the testing target
29. Set/lay cannon for deflection
30. Refer the piece
31. Orient a map with a compass
32. Orient a map by terrain association
33. Determine present location by terrain association
34. Locate a point on a map using the military grid-ref system

155mm Crew Member

35. Lay commo wire to FDC
36. Connect wire to telepost terminal on vehicle
37. Emplace/recover collimator
38. Emplace/recover aiming posts
39. Store ammo at a cannon position
40. Monitor and relay fire commands
41. Prepare ammo for firing
42. Recognize ammo types by color coding
43. Identify fuzes and fuze wrenches by type
44. Fuze the projectile
45. Set the fuze using the proper fuze setter
46. Prepare propellant charge
47. Set/lay cannon for quadrant with the range quadrant
48. Operate M109A1 Howitzer under unusual conditions

Projected Effectiveness (E) for Critical Combat Tasks

- a. Tables by units, tasks, days and platoon actions
- b. Summary graphs
- c. Summary tables by duty positions, units, days and platoon actions

Mechanized Infantry: Gunner/Carrier Team Leader

		Task No.																
Day		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Platoon Action ₁	1	61	62	67	73	100	57	78	92	73	71	36	51	57	41	100	100	92
	2	37	39	46	61	100	32	61	84	53	51	13	27	32	17	100	100	87
	3	23	24	31	48	100	18	48	78	38	36	05	14	18	07	100	100	78
	4	14	15	21	37	100	10	37	71	28	26	02	07	10	03	100	100	71
	5	08	09	14	29	100	06	29	65	20	18	01	04	06	01	100	100	65
Platoon Action ₂	1	61	67	100	100	100	92	84	92	73	85	46	78	85	57	73	55	100
	2	37	46	100	100	100	84	71	84	53	73	21	61	73	32	53	30	100
	3	23	31	100	100	100	78	59	78	38	62	10	48	62	18	38	17	100
	4	14	21	100	100	100	71	50	71	28	53	04	37	53	10	28	09	100
	5	08	14	100	100	100	65	42	65	20	45	02	29	45	06	20	05	100
Platoon Action ₃	1	100	100	100	100	100	57	78	92	73	100	100	100	100	100	100	100	100
	2	100	100	100	100	100	32	61	84	53	100	100	100	100	100	100	100	100
	3	100	100	100	100	100	18	48	78	38	100	100	100	100	100	100	100	100
	4	100	100	100	100	100	10	37	71	28	100	100	100	100	100	100	100	100
	5	100	100	100	100	100	06	29	65	20	100	100	100	100	100	100	100	100
Platoon Actions 1, 2, 3	1	72	75	87	92	100	67	80	92	73	85	55	74	79	61	90	82	97
	2	52	56	76	85	100	45	64	84	53	72	30	55	62	38	81	67	95
	3	37	42	67	78	100	30	51	78	38	61	17	40	49	23	73	55	92
	4	27	32	58	72	100	20	41	71	28	52	09	30	38	14	65	45	89
	5	19	24	51	66	100	13	33	65	20	44	05	22	30	09	59	37	87

NOTE: A value of 100 after the second day implies that only NOMINAL DEGRADATION will occur after that day.

A value of 00 is to be interpreted as E < 1 (i.e., very low).

Mechanized Infantry: Maneuver Team Member

		<u>Task No.</u>																
		Day	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
Platoon Action ₁	1	78	100	78	100	100	100	100	100	78	100	100	100	100	57	100	100	
	2	61	100	61	100	100	100	100	100	61	100	100	100	100	32	100	100	
	3	48	100	48	100	100	100	100	100	48	100	100	100	100	18	100	100	
	4	37	100	37	100	100	100	100	100	37	100	100	100	100	10	100	100	
	5	29	100	29	100	100	100	100	100	29	100	100	100	100	36	100	100	
Platoon Action ₂	1	85	73	78	85	67	100	100	100	86	62	100	74	100	100	100	100	
	2	73	53	61	73	46	100	100	100	74	39	100	54	100	100	100	100	
	3	62	38	48	62	31	100	100	100	63	24	100	40	100	100	100	100	
	4	53	28	37	53	21	100	100	100	54	15	100	29	100	100	100	100	
	5	45	20	29	45	14	100	100	100	47	09	100	22	100	100	100	100	
Platoon Action ₃	1	100	56	78	65	100	85	67	60	100	100	100	100	73	100	85	62	
	2	100	32	61	43	100	73	46	37	100	100	100	100	53	100	73	38	
	3	100	18	48	28	100	62	31	22	100	100	100	100	38	100	62	23	
	4	100	10	37	18	100	53	21	13	100	100	100	100	28	100	53	14	
	5	100	06	29	12	100	45	14	08	100	100	100	100	20	100	45	09	
Platoon Actions 1, 2, 3	1	88	74	78	83	88	95	88	74	85	100	100	90	90	83	95	85	
	2	77	55	61	68	77	90	77	55	73	100	100	82	81	69	90	72	
	3	67	41	48	56	67	86	67	41	62	100	100	74	73	57	86	62	
	4	59	30	37	47	59	82	59	30	53	100	100	67	65	47	82	52	
	5	52	23	29	38	52	78	52	22	46	100	100	60	59	39	78	45	

Mechanized Infantry: Squad Leader

		Task No.																	
		Day	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Platoon Action1	1	100	100	100	100	100	100	100	26	61	31	51	62	26	71	100	100	100	100
	2	100	100	100	100	100	100	100	07	37	10	26	39	07	51	100	100	100	100
	3	100	100	100	100	100	100	100	02	23	03	13	24	02	36	100	100	100	100
	4	100	100	100	100	100	100	100	00	14	01	07	15	00	26	100	100	100	100
	5	100	100	100	100	100	100	100	00	08	00	03	09	00	18	100	100	100	100
Platoon Action2	1	100	100	100	100	67	73	85	67	61	46	67	78	31	78	66	100	100	100
	2	100	100	100	44	53	53	73	46	37	22	46	61	10	61	44	100	100	100
	3	100	100	100	29	38	38	62	31	23	10	31	48	03	48	29	100	100	100
	4	100	100	100	20	28	28	53	21	14	05	21	37	01	37	19	100	100	100
	5	100	100	100	13	29	29	45	14	08	02	14	29	00	29	13	100	100	100
Platoon Action3	1	61	78	67	45	46	46	100	26	46	41	92	52	26	71	100	41	73	51
	2	37	61	45	21	22	21	100	07	21	17	84	27	07	51	100	17	53	26
	3	23	48	30	09	10	10	100	02	10	07	78	14	02	36	100	07	38	13
	4	14	37	20	04	05	04	100	00	04	03	71	07	00	26	100	03	28	07
	5	08	29	13	02	02	02	100	00	02	01	65	04	00	18	100	01	20	03
Platoon Actions 1, 2, 3	1	85	92	87	67	70	70	95	36	55	39	68	63	28	74	87	74	90	89
	2	72	85	76	45	49	49	90	13	31	15	46	40	08	54	76	55	81	64
	3	61	78	67	30	34	34	85	05	17	06	32	25	02	40	66	41	73	51
	4	52	72	58	20	24	24	81	02	09	02	21	16	01	29	57	31	65	41
	5	44	66	51	14	16	16	77	01	05	01	15	10	00	22	50	23	59	32

Mechanized Infantry: Platoon Leader

		Task No.																
Day		50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
Platoon Action ₁	1	100	100	100	100	100	100	56	67	100	84	100	67	92	100	100	100	84
	2	100	100	100	100	100	100	32	46	100	71	100	45	84	100	100	100	71
	3	100	100	100	100	100	100	18	31	100	59	100	30	78	100	100	100	59
	4	100	100	100	100	100	100	10	21	100	50	100	20	71	100	100	100	50
	5	100	100	100	100	100	100	06	14	100	42	100	13	65	100	100	100	42
Platoon Action ₂	1	67	85	100	78	47	100	61	78	100	92	78	100	100	100	78	100	100
	2	46	73	100	61	22	100	37	61	100	84	61	100	100	100	61	100	100
	3	31	62	100	48	10	100	23	48	100	78	48	100	100	100	48	100	100
	4	21	53	100	37	05	100	14	37	100	71	37	100	100	100	37	100	100
	5	14	43	100	29	02	100	08	29	100	65	29	100	100	100	29	100	100
Platoon Action ₃	1	67	73	92	71	32	92	49	56	71	78	36	56	92	42	56	91	77
	2	46	53	84	51	10	84	25	32	51	61	13	31	84	18	31	82	59
	3	31	38	78	36	03	78	12	18	36	48	05	17	78	07	17	75	45
	4	21	28	71	26	01	71	06	10	26	37	02	10	71	03	10	68	35
	5	14	20	65	18	00	65	03	06	18	29	01	05	65	01	05	61	27
Platoon Actions 1, 2, 3	1	77	85	97	82	53	97	56	67	89	85	66	72	94	75	76	97	86
	2	59	73	95	68	28	95	31	45	80	72	43	52	89	56	57	94	75
	3	46	62	92	56	15	92	17	30	71	60	28	37	84	42	43	91	65
	4	35	53	89	46	08	89	10	20	64	51	19	27	80	31	33	88	56
	5	27	45	87	38	04	87	05	13	57	43	12	19	75	23	25	85	48

Mechanized Infantry: Platoon Leader (cont.)

	Day	Task No.														
		67	68	69	70	71	72	73	74	75	76					
Platoon	1	100	52	42	100	100	100	100	100	100	100					
	2	100	27	18	100	100	100	100	100	100	100					
	3	100	14	07	100	100	100	100	100	100	100					
	4	100	07	03	100	100	100	100	100	100	100					
	5	100	04	01	100	100	100	100	100	100	100					
Platoon Action2	1	100	100	67	100	100	100	100	100	100	100					
	2	100	100	46	100	100	100	100	100	100	100					
	3	100	100	31	100	100	100	100	100	100	100					
	4	100	100	21	100	100	100	100	100	100	100					
	5	100	100	14	100	100	100	100	100	100	100					
Platoon Action3	1	92	47	36	92	57	61	41	60	73	56					
	2	84	47	13	84	32	37	17	37	61	31					
	3	78	57	15	78	18	23	07	22	48	17					
	4	71	07	02	71	10	14	03	13	37	10					
	5	65	07	01	65	06	08	01	08	29	05					
Platoon Actions 1, 2, 3	1	97	60	47	97	83	85	74	85	92	74					
	2	95	36	22	95	69	72	55	72	85	54					
	3	92	22	10	92	57	61	41	60	78	40					
	4	89	13	05	89	47	52	31	51	72	29					
	5	87	08	02	87	39	44	23	43	66	22					

Armor: Tank Platoon Leader

		<u>Task No.</u>																
<u>Day</u>		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Platoon Action 1	1	100	100	71	65	71	71	71	92	100	100	100	71	71	56	67	66	78
	2	100	100	51	43	51	51	51	84	100	100	100	51	51	31	45	44	61
	3	100	100	36	28	36	36	36	78	100	100	100	36	36	17	30	29	48
	4	100	100	26	18	26	26	26	71	100	100	100	26	26	10	20	19	37
	5	100	100	18	12	18	18	18	65	100	100	100	18	18	05	13	13	29
Platoon Action 2	1	100	100	84	100	100	84	100	100	100	92	100	100	100	56	92	100	84
	2	100	100	71	100	100	71	100	100	100	84	100	100	100	31	84	100	71
	3	100	100	59	100	100	59	100	100	100	78	100	100	100	17	78	100	59
	4	100	100	50	100	100	50	100	100	100	71	100	100	100	10	71	100	50
	5	100	100	42	100	100	42	100	100	100	65	100	100	100	05	65	100	42
Platoon Action 3	1	78	73	78	78	78	78	78	100	100	100	100	100	100	100	100	100	100
	2	61	53	61	61	61	61	61	100	100	100	100	100	100	100	100	100	100
	3	43	38	48	48	48	48	48	100	100	100	100	100	100	100	100	100	100
	4	37	28	37	37	37	37	37	100	100	100	100	100	100	100	100	100	100
	5	29	20	29	29	29	29	29	100	100	100	100	100	100	100	100	100	100
Platoon Actions 1, 2, 3	1	92	90	78	80	82	78	82	97	100	97	100	89	89	68	85	87	87
	2	85	81	60	64	68	60	68	95	100	95	100	80	80	46	72	76	76
	3	78	73	47	51	56	47	56	92	100	92	100	71	71	31	61	66	66
	4	72	65	36	41	46	36	46	89	100	89	100	64	64	21	52	57	57
	5	66	59	28	33	38	28	38	87	100	87	100	57	57	14	44	50	50

Armor: Tank Platoon Leader (cont.)

	Day	Task No.										
		18	19	20	21	22	23	24	25	26		
Platoon Action ₁	1	61	92	100	84	66	84	51	71	85		
	2	37	34	100	71	44	71	27	51	73		
	3	23	78	100	59	29	59	14	36	62		
	4	14	71	100	50	19	50	07	26	53		
	5	08	65	100	42	13	42	04	18	45		
Platoon Action ₂	1	92	100	100	100	100	100	84	100	100		
	2	84	100	100	100	100	100	71	100	100		
	3	78	100	100	100	100	100	59	100	100		
	4	71	100	100	100	100	100	50	100	100		
	5	65	100	100	100	100	100	42	100	100		
Platoon Action ₃	1	100	100	100	100	66	73	51	71	100		
	2	100	100	100	100	44	53	27	51	100		
	3	100	100	100	100	29	38	14	36	100		
	4	100	100	100	100	19	28	07	26	100		
	5	100	100	100	100	13	20	04	18	100		
Platoon Actions 1, 2, 3	1	82	97	100	94	76	85	61	80	95		
	2	68	95	100	89	58	72	37	64	90		
	3	56	92	100	84	44	61	22	51	85		
	4	46	89	100	79	33	52	14	41	81		
	5	38	87	100	75	25	44	08	32	77		

Armor: Tank Commander

		<u>Task No.</u>																
Day		27	28	29	30	31	32	33	34	35	36	37	38	39	40	41		
Platoon Action1	1	92	92	84	77	100	78	72	85	56	92	92	84	66	73	92		
	2	84	84	71	59	100	61	52	73	32	34	84	71	44	53	84		
	3	78	78	59	45	100	48	37	62	18	78	78	59	29	38	78		
	4	71	71	50	35	100	37	27	53	10	71	71	50	19	28	71		
	5	65	65	42	27	100	29	19	45	06	65	65	42	13	20	65		
Platoon Action2	1	100	100	92	100	100	84	100	100	84	100	100	100	100	100	100		
	2	100	100	84	100	100	71	100	100	71	100	100	100	100	100	100		
	3	100	100	78	100	100	59	100	100	59	100	100	100	100	100	100		
	4	100	100	71	100	100	50	100	100	50	100	100	100	100	100	100		
	5	100	100	65	100	100	42	100	100	42	100	100	100	100	100	100		
Platoon Action3	1	100	92	100	100	100	100	100	100	100	100	100	100	66	73	100		
	2	100	84	100	100	100	100	100	100	100	100	100	100	44	53	100		
	3	100	78	100	100	100	100	100	100	100	100	100	100	29	38	100		
	4	100	71	100	100	100	100	100	100	100	100	100	100	19	28	100		
	5	100	65	100	100	100	100	100	100	100	100	100	100	13	20	100		
Platoon Actions 1, 2, 3	1	97	94	92	92	100	87	90	95	78	97	97	94	76	81	97		
	2	95	89	84	84	100	76	80	90	61	95	95	89	58	65	95		
	3	92	84	77	77	100	66	72	85	47	92	92	84	44	53	92		
	4	89	80	71	70	100	57	64	81	37	89	89	79	33	43	89		
	5	87	75	65	64	100	50	58	77	29	87	87	75	25	35	87		

Armor: Tank Gunner

		<u>Task No.</u>					
		Day	42	43	44	45	46
Platoon Action ₁	1		100	100	100	100	100
	2		100	100	100	100	100
	3		100	100	100	100	100
	4		100	100	100	100	100
	5		100	100	100	100	100
Platoon Action ₂	1		100	100	100	100	100
	2		100	100	100	100	100
	3		100	100	100	100	100
	4		100	100	100	100	100
	5		100	100	100	100	100
Platoon Action ₃	1		84	84	100	100	84
	2		71	71	100	100	71
	3		59	59	100	100	59
	4		50	50	100	100	50
	5		42	42	100	100	42
Platoon Actions 1, 2, 3	1		94	94	100	100	94
	2		89	89	100	100	89
	3		84	84	100	100	84
	4		79	79	100	100	79
	5		75	75	100	100	75

Armor: Tank Loader

Task No.

	Day	47	48	49	50	51	52	53	54	55	56	57	58
Platoon Action ₁	1	100	100	100	100	100	100	100	100	100	92	92	100
	2	100	100	100	100	100	100	100	100	100	84	84	100
	3	100	100	100	100	100	100	100	100	100	78	78	100
	4	100	100	100	100	100	100	100	100	100	71	71	100
	5	100	100	100	100	100	100	100	100	100	65	65	100
Platoon Action ₂	1	100	100	100	100	100	100	100	100	100	100	100	100
	2	100	100	100	100	100	100	100	100	100	100	100	100
	3	100	100	100	100	100	100	100	100	100	100	100	100
	4	100	100	100	100	100	100	100	100	100	100	100	100
	5	100	100	100	100	100	100	100	100	100	100	100	100
Platoon Action ₃	1	100	100	100	100	100	100	100	100	100	100	100	100
	2	100	100	100	100	100	100	100	100	100	100	100	100
	3	100	100	100	100	100	100	100	100	100	100	100	100
	4	100	100	100	100	100	100	100	100	100	100	100	100
	5	100	100	100	100	100	100	100	100	100	100	100	100
Platoon Actions 1, 2, 3	1	100	100	100	100	100	100	100	100	100	97	97	100
	2	100	100	100	100	100	100	100	100	100	95	95	100
	3	100	100	100	100	100	100	100	100	100	92	92	100
	4	100	100	100	100	100	100	100	100	100	89	89	100
	5	100	100	100	100	100	100	100	100	100	87	87	100

FIST: Chief

		Task No.																
Day		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Platoon Action ₁	1	92	85	85	85	100	100	100	78	84	47	56	85	71	47	57	51	100
	2	84	73	73	73	100	100	100	61	71	22	31	73	51	22	32	27	100
	3	78	62	62	62	100	100	100	48	59	10	17	62	36	10	18	14	100
	4	71	53	53	53	100	100	100	37	50	05	10	53	26	05	10	07	100
	5	65	45	45	45	100	100	100	29	42	02	05	45	18	02	06	04	100
Platoon Action ₂	1	100	100	100	100	92	84	78	85	92	56	74	85	92	56	100	100	100
	2	100	100	100	100	84	71	61	73	84	32	54	73	84	32	100	100	100
	3	100	100	100	100	78	59	48	62	78	18	40	62	78	18	100	100	100
	4	100	100	100	100	71	50	37	53	71	10	29	53	71	10	100	100	100
	5	100	100	100	100	65	42	29	45	65	06	22	45	65	06	100	100	100
Platoon Action ₃	1	92	85	100	100	65	100	78	78	84	47	56	85	100	47	57	51	85
	2	84	73	100	100	43	100	61	61	71	22	31	73	100	22	32	27	73
	3	78	62	100	100	28	100	48	48	59	10	17	62	100	10	18	14	62
	4	71	53	100	100	18	100	37	37	50	05	10	53	100	05	10	07	53
	5	65	45	100	100	12	100	29	29	42	02	05	45	100	02	06	04	45
Platoon Actions 1, 2, 3	1	94	90	95	95	84	94	85	80	87	50	61	85	87	50	69	64	95
	2	89	81	90	90	71	89	72	65	75	25	37	73	75	25	47	41	90
	3	84	73	85	85	60	84	61	52	65	12	23	62	65	12	32	27	85
	4	80	65	81	81	51	79	52	42	56	06	14	53	57	06	22	17	81
	5	75	59	77	77	43	75	44	34	49	03	08	45	49	03	15	11	77

FIST: Chief (cont.)

	Day	Task No.											
		18	19	20	21	22	23	24	25	26	27	28	29
Platoon Action ₁	1	100	100	47	57	57	100	100	60	32	74	100	92
	2	100	100	22	32	32	100	100	37	10	54	100	84
	3	100	100	10	18	18	100	100	22	03	40	100	78
	4	100	100	05	10	10	100	100	13	01	29	100	71
	5	100	100	02	06	06	100	100	08	00	22	100	65
Platoon Action ₂	1	100	100	51	100	57	100	67	60	32	100	100	92
	2	100	100	27	100	32	100	45	37	10	100	100	84
	3	100	100	14	100	18	100	30	22	03	100	100	78
	4	100	100	07	100	10	100	20	13	01	100	100	71
	5	100	100	04	100	06	100	13	08	00	100	100	65
Platoon Action ₃	1	92	71	47	100	52	47	100	60	32	100	100	92
	2	84	51	22	100	27	22	100	37	10	100	100	84
	3	78	36	10	100	14	10	100	22	03	100	100	78
	4	71	26	05	100	07	05	100	13	01	100	100	71
	5	65	18	02	100	04	02	100	08	00	100	100	65
Platoon Actions 1, 2, 3	1	97	39	48	83	55	73	87	60	32	90	100	92
	2	95	80	23	69	31	60	76	37	10	82	100	84
	3	92	71	11	57	17	47	67	22	03	74	100	78
	4	89	64	05	47	09	36	58	13	01	67	100	71
	5	87	57	03	39	05	28	51	08	00	60	100	65

FIST: Forward Observer

Task No.

	Day	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Platoon Action 1	1	92	92	85	85	100	65	100	78	72	61	78	78	56	85	100	7	100
	2	84	84	73	73	100	43	100	61	52	37	61	61	31	73	100	22	100
	3	78	78	62	62	100	28	100	48	57	23	48	43	17	62	100	10	100
	4	71	71	53	53	100	18	100	37	27	14	37	37	10	53	100	05	100
	5	65	65	45	45	100	12	100	29	19	08	29	29	05	45	100	02	100
Platoon Action 2	1	100	92	100	85	100	78	78	85	85	78	78	78	74	85	71	56	100
	2	100	84	100	73	100	61	61	73	73	61	61	61	54	73	51	32	100
	3	100	78	100	62	100	48	48	62	62	48	48	48	40	62	36	18	100
	4	100	71	100	53	100	37	37	53	53	37	37	37	29	53	26	10	100
	5	100	65	100	45	100	29	29	45	45	29	29	29	22	45	18	06	100
Platoon Action 3	1	92	92	100	85	100	65	78	78	72	61	78	78	56	85	71	47	57
	2	84	84	100	73	100	43	61	61	52	37	61	61	31	73	51	22	32
	3	78	78	100	62	100	28	48	48	37	23	48	48	17	62	36	10	18
	4	71	71	100	53	100	18	37	37	27	14	37	37	10	53	26	05	10
	5	65	65	100	45	100	12	29	29	19	08	29	29	05	45	18	02	06
Platoon Actions 1, 2, 3	1	94	92	95	85	100	69	85	80	76	66	78	78	61	85	80	50	83
	2	39	84	90	73	100	48	72	65	58	44	61	61	37	73	64	25	69
	3	84	78	85	62	100	34	61	52	44	29	48	48	23	62	51	12	57
	4	80	71	81	53	100	23	52	42	34	19	37	37	14	53	41	06	47
	5	75	65	77	45	100	16	44	34	26	13	29	29	08	45	32	03	39

FIST: Forward Observer (cont.)

		<u>Task No.</u>										
		Day	47	48	49	50	51	52	53	54	55	56
Platoon Action ₁	1	47	47	62	52	100	100	60	32	74	92	
	2	22	22	38	27	100	100	37	10	54	84	
	3	10	10	23	14	100	100	22	03	40	78	
	4	05	05	14	07	100	100	13	01	29	71	
	5	02	02	09	04	100	100	08	00	22	65	
Platoon Action ₂	1	100	51	100	57	100	67	60	32	100	92	
	2	100	27	100	32	100	45	37	10	100	84	
	3	100	14	100	18	100	30	22	03	100	78	
	4	100	07	100	10	100	29	13	01	100	71	
	5	100	04	100	06	100	13	08	00	100	65	
Platoon Action ₃	1	47	47	62	52	47	100	60	32	100	92	
	2	22	22	38	27	22	100	37	10	100	84	
	3	10	10	23	14	10	100	22	03	100	78	
	4	05	05	14	07	05	100	13	01	100	71	
	5	02	02	09	04	02	100	08	00	100	65	
Platoon Actions 1, 2, 3	1	60	48	72	54	78	87	60	32	90	92	
	2	36	23	53	29	60	76	37	10	82	84	
	3	22	11	38	15	47	67	22	03	74	78	
	4	13	05	28	08	36	58	13	01	67	71	
	5	08	03	20	04	28	51	08	00	60	65	

2. Radio Telephone Operator

FIST: 1. Fire Support NCO

Task No.

59

100 100 100 100 100 100 92 84 78 71 65 92 84 78 71 65 94 89 84 80 75

Task No.

Day 57 58

Platoon Action1	1	100	100
	2	100	100
	3	100	100
	4	100	100
	5	100	100
Platoon Action2	1	100	100
	2	100	100
	3	100	100
	4	100	100
	5	100	100
Platoon Action3	1	92	92
	2	84	84
	3	78	78
	4	71	71
	5	65	65
Platoon Actions 1, 2, 3	1	97	97
	2	95	95
	3	92	92
	4	89	89
	5	87	87

Artillery: Battery Executive Officer

		Task No.					
		1	2	3	4	5	6
Low	Day	1	2	3	4	5	6
	1	92	92	100	92	100	100
	2	84	84	100	84	100	100
	3	78	78	100	78	100	100
	4	71	71	100	71	100	100
	5	65	65	100	65	100	100
Medium	1	92	72	84	41	92	92
	2	84	52	71	17	84	84
	3	78	37	59	07	78	78
	4	71	27	50	03	71	71
	5	65	19	42	01	65	65
Heavy	1	85	72	78	37	87	73
	2	73	52	61	14	76	53
	3	62	37	48	05	66	38
	4	53	27	37	02	57	28
	5	45	19	29	01	50	20
Average	1	90	78	87	52	92	87
	2	80	61	76	27	85	76
	3	72	48	66	14	78	67
	4	64	37	57	07	72	58
	5	58	29	50	04	67	51

NOTE: For artillery, differentiation is not in Platoon Actions (PAs) but by degree of demand. Low implies no pressure on firing units; medium implies support of line units under pressure; heavy implies firing unit as well as line unit are under pressure.

Artillery: Howitzer Section Chief

	Day	<u>Task No.</u>														
		7	8	9	10	11	12	13	14	15	16	17				
Low	1	100	100	92	85	92	100	100	100	78	84	100				
	2	100	100	84	73	84	100	100	100	61	71	100				
	3	100	100	78	62	78	100	100	100	48	59	100				
	4	100	100	71	53	71	100	100	100	37	50	100				
	5	100	100	65	45	65	100	100	100	29	42	100				
Medium	1	100	85	61	73	84	100	100	100	73	67	73				
	2	100	73	37	53	71	100	100	100	53	45	53				
	3	100	62	23	38	59	100	100	100	38	30	38				
	4	100	53	14	28	50	100	100	100	28	20	28				
	5	100	45	08	20	42	100	100	100	20	13	20				
Heavy	1	92	85	61	67	78	92	92	92	73	67	67				
	2	84	73	37	45	61	84	84	84	53	45	46				
	3	78	62	23	30	48	78	78	78	38	30	31				
	4	71	53	14	20	37	71	71	71	28	20	21				
	5	65	45	08	13	29	65	65	65	20	13	14				
Average	1	97	90	70	74	85	97	97	97	74	72	79				
	2	95	81	49	56	72	95	95	95	56	52	62				
	3	92	73	34	41	60	92	92	92	41	37	49				
	4	89	65	24	31	51	89	89	89	31	27	39				
	5	87	59	17	23	43	87	87	87	23	19	31				

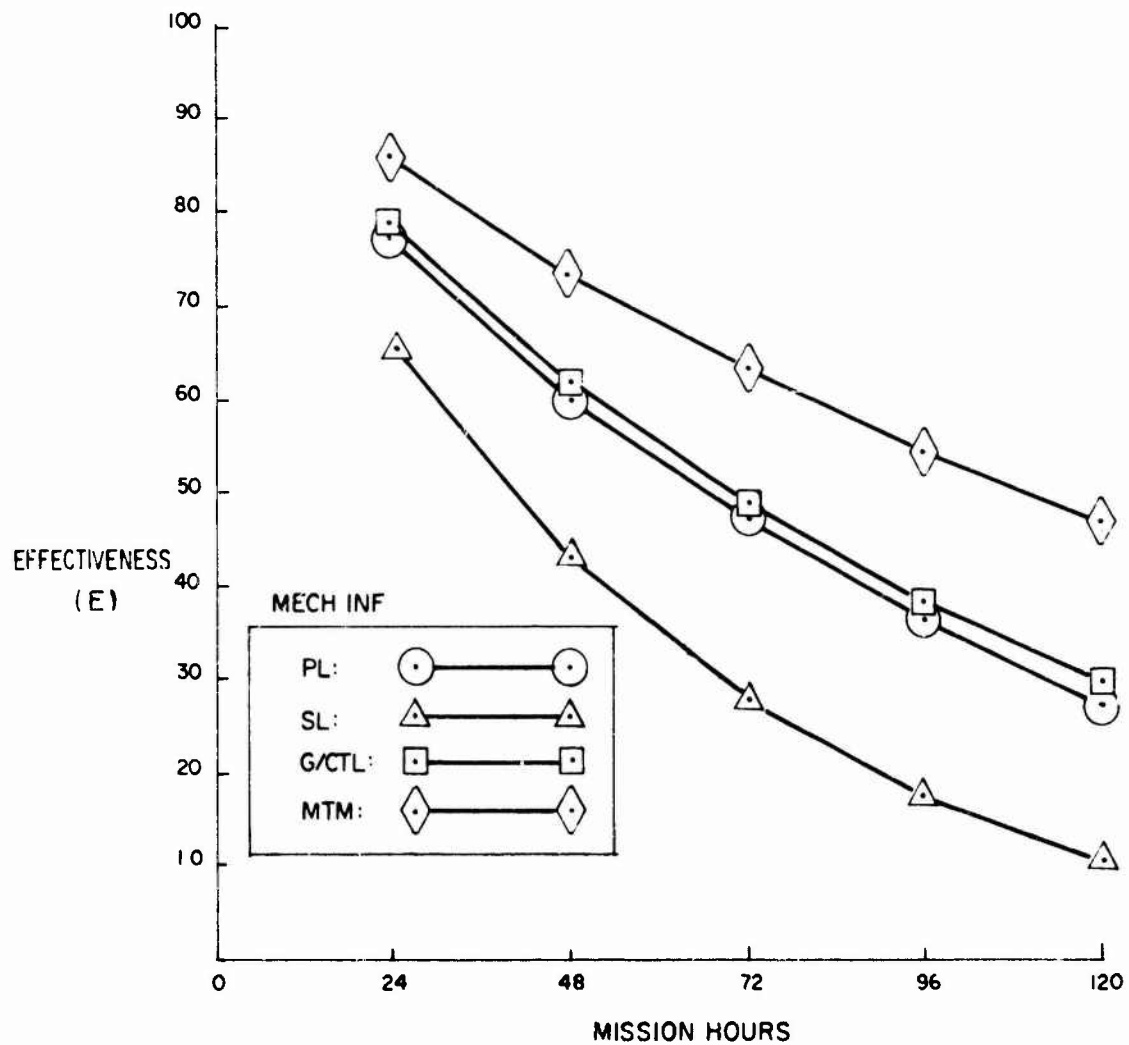
Artillery: 155 mm Gunner

Task No.

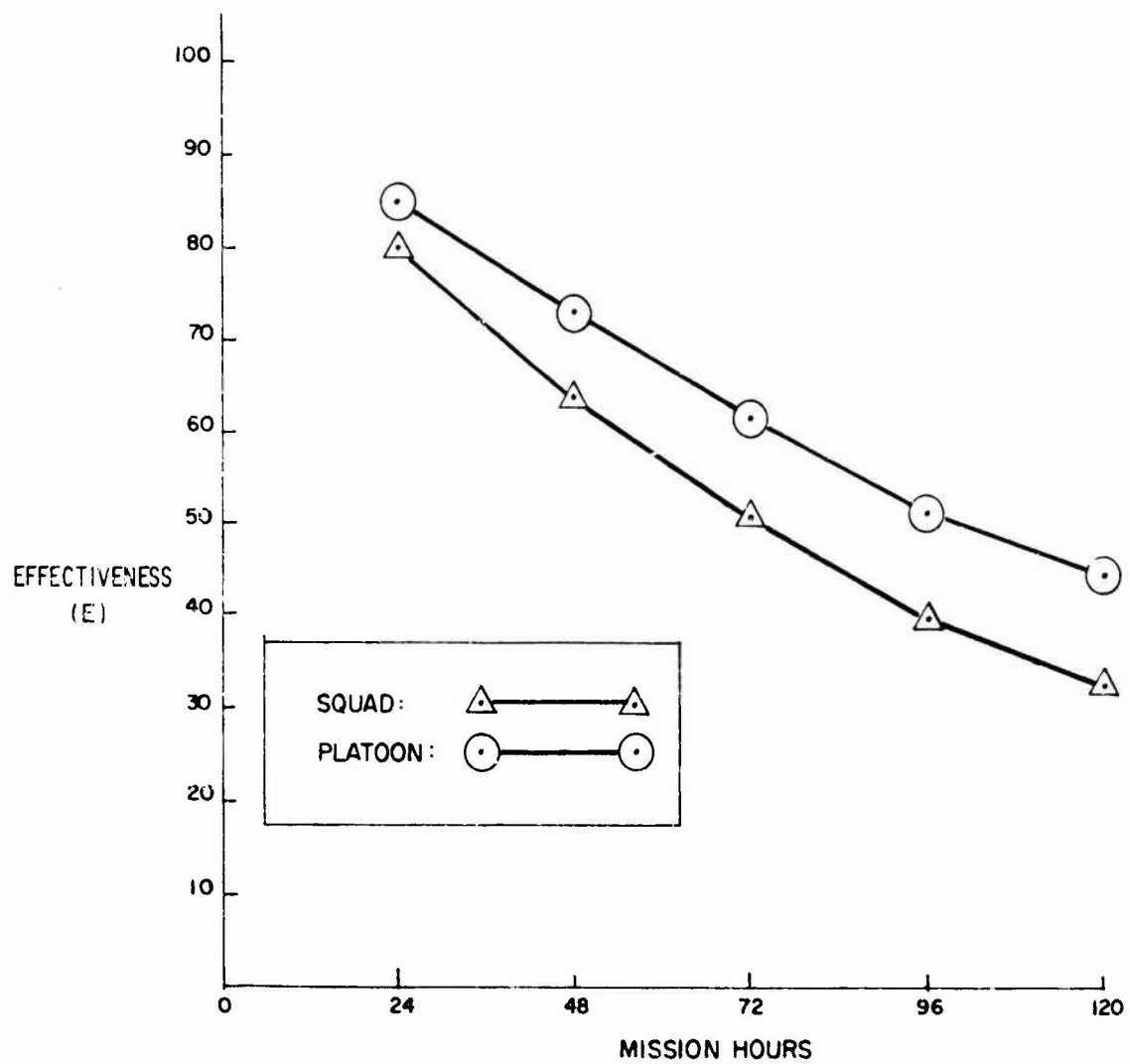
	Day	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Low	1	92	100	92	100	92	92	92	92	100	100	92	100	85	84	85	85	92
	2	84	100	84	100	84	84	84	84	100	100	84	100	73	71	73	73	84
	3	78	100	78	100	78	78	78	78	100	100	78	100	62	59	62	62	78
	4	71	100	71	100	71	71	71	71	100	100	71	100	53	50	53	53	71
	5	65	100	65	100	65	65	65	65	100	100	65	100	45	42	45	45	65
Medium	1	72	85	67	85	78	78	84	78	78	84	78	92	72	84	73	73	67
	2	52	73	45	73	61	61	71	61	61	71	61	84	52	71	53	53	45
	3	37	62	30	62	48	48	59	48	48	59	48	78	37	59	38	38	30
	4	27	53	20	53	37	37	50	37	37	50	37	71	27	50	28	28	20
	5	19	45	13	45	29	29	42	29	29	42	29	65	19	42	20	20	13
Heavy	1	72	85	67	85	78	78	84	78	78	84	78	84	72	84	73	73	67
	2	52	73	45	73	61	61	71	61	61	71	61	71	52	71	53	53	45
	3	37	62	30	62	48	48	59	48	48	59	48	59	37	59	38	38	30
	4	27	53	20	53	37	37	50	37	37	50	37	50	27	50	28	28	20
	5	19	45	13	45	29	29	42	29	29	42	29	42	19	42	20	20	13
Average	1	78	90	74	90	83	83	87	83	85	89	83	92	76	84	77	77	74
	2	61	81	55	81	68	68	75	68	72	79	68	84	58	71	59	59	55
	3	48	73	41	73	56	56	65	56	61	71	56	77	44	59	45	45	41
	4	37	65	30	65	46	46	56	46	52	63	46	71	34	50	35	35	30
	5	29	59	23	59	38	38	49	38	44	56	38	65	26	42	27	27	23

Artillery: 155 mm Crew Member

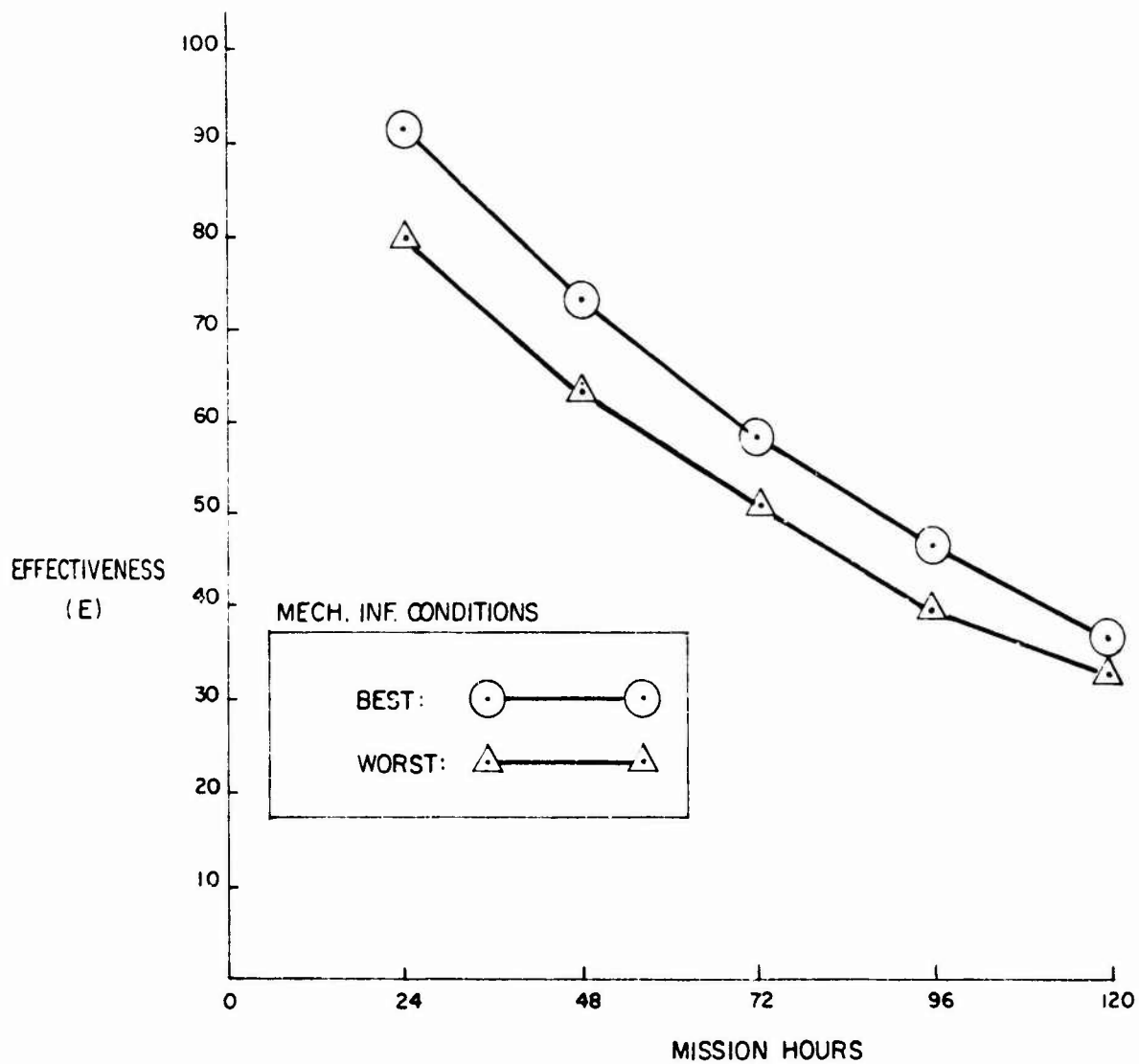
		<u>Task No.</u>														
		Day	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Low	1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	2	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	3	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	4	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	5	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Medium	1	100	100	100	100	100	100	85	100	92	85	100	100	100	92	78
	2	100	100	100	100	100	100	73	100	84	73	100	100	100	84	61
	3	100	100	100	100	100	100	62	100	78	62	100	100	100	78	48
	4	100	100	100	100	100	100	53	100	71	53	100	100	100	71	37
	5	100	100	100	100	100	100	45	100	65	45	100	100	100	65	29
Heavy	1	100	100	100	100	100	100	85	92	92	85	100	92	100	92	78
	2	100	100	100	100	100	100	73	84	84	73	100	84	100	84	61
	3	100	100	100	100	100	100	62	78	78	62	100	78	100	78	48
	4	100	100	100	100	100	100	53	71	71	53	100	71	100	71	37
	5	100	100	100	100	100	100	45	65	65	45	100	65	100	65	29
Average	1	100	100	100	100	100	100	90	97	94	90	100	97	100	94	85
	2	100	100	100	100	100	100	81	95	89	81	100	95	100	89	72
	3	100	100	100	100	100	100	73	92	84	73	100	92	100	84	61
	4	100	100	100	100	100	100	65	89	80	65	100	89	100	80	52
	5	100	100	100	100	100	100	59	87	75	59	100	87	100	75	44



Mechanized Infantry: Progressive degradation of effectiveness -- duty positions



Mechanized Infantry: Progressive degradation of effectiveness – squads and platoons

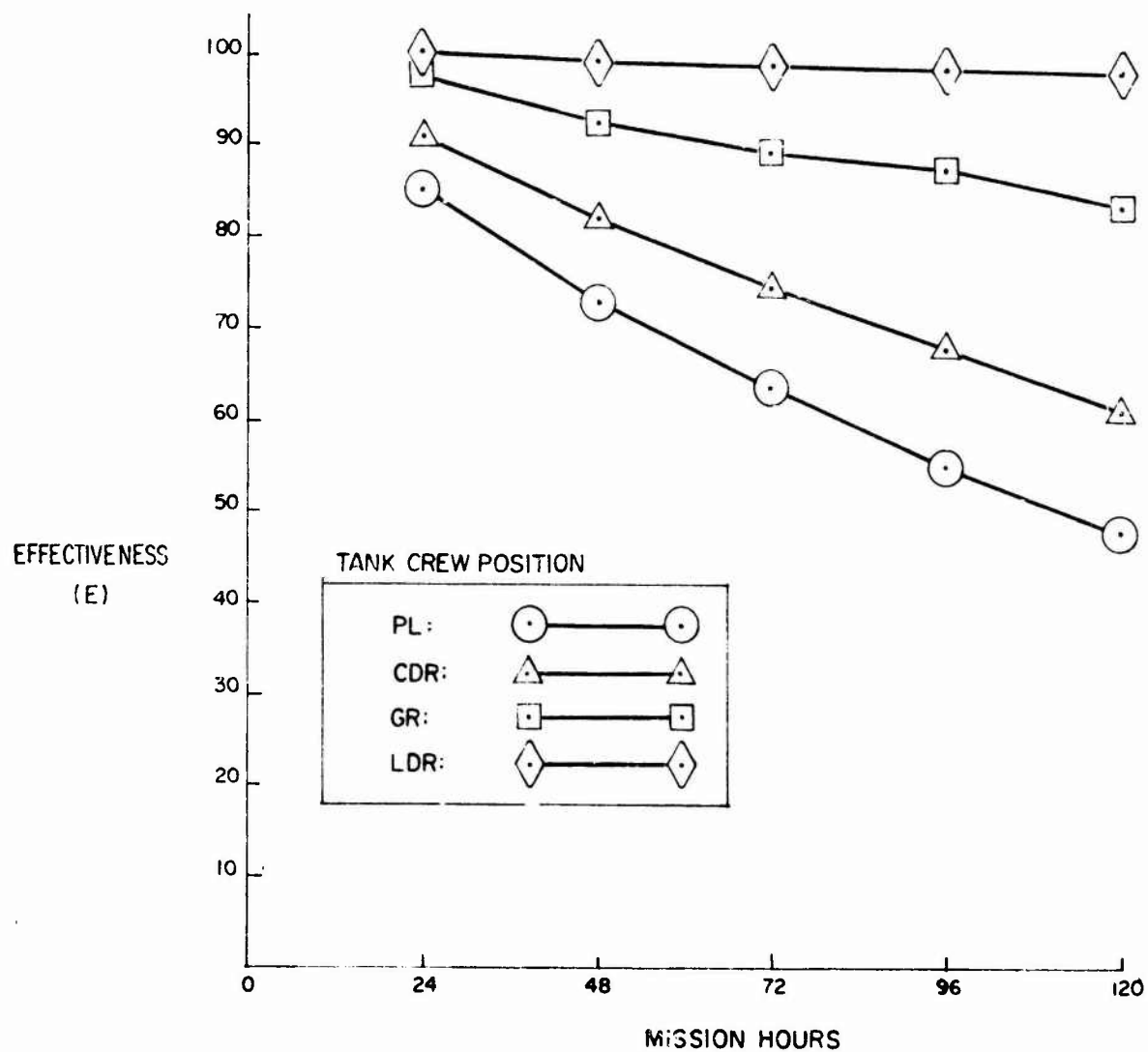


Mechanized Infantry: Effectiveness of squads under best and worst conditions

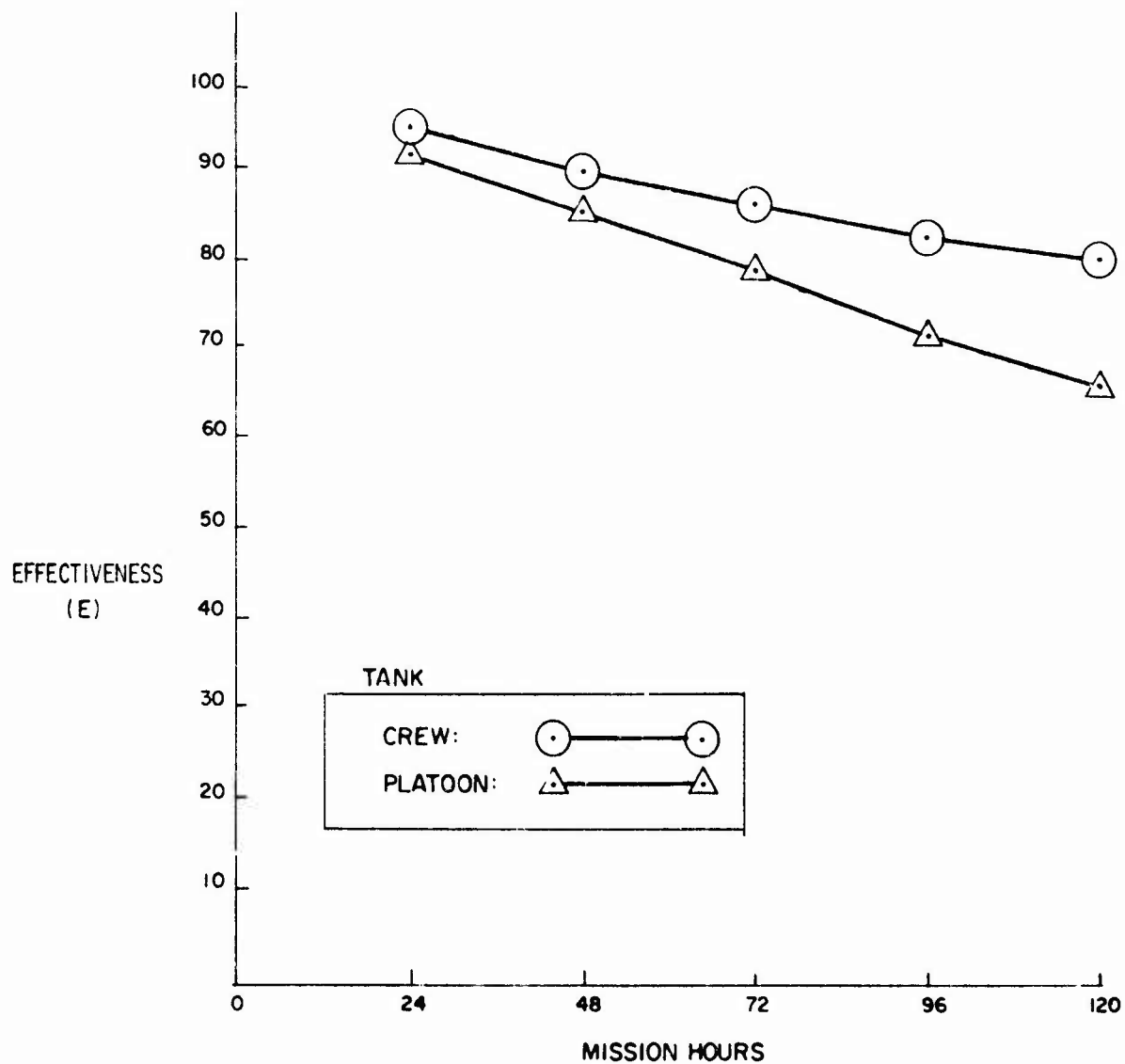
MECHANIZED INFANTRY

Effectiveness (E) for Platoon Actions and Mission Days

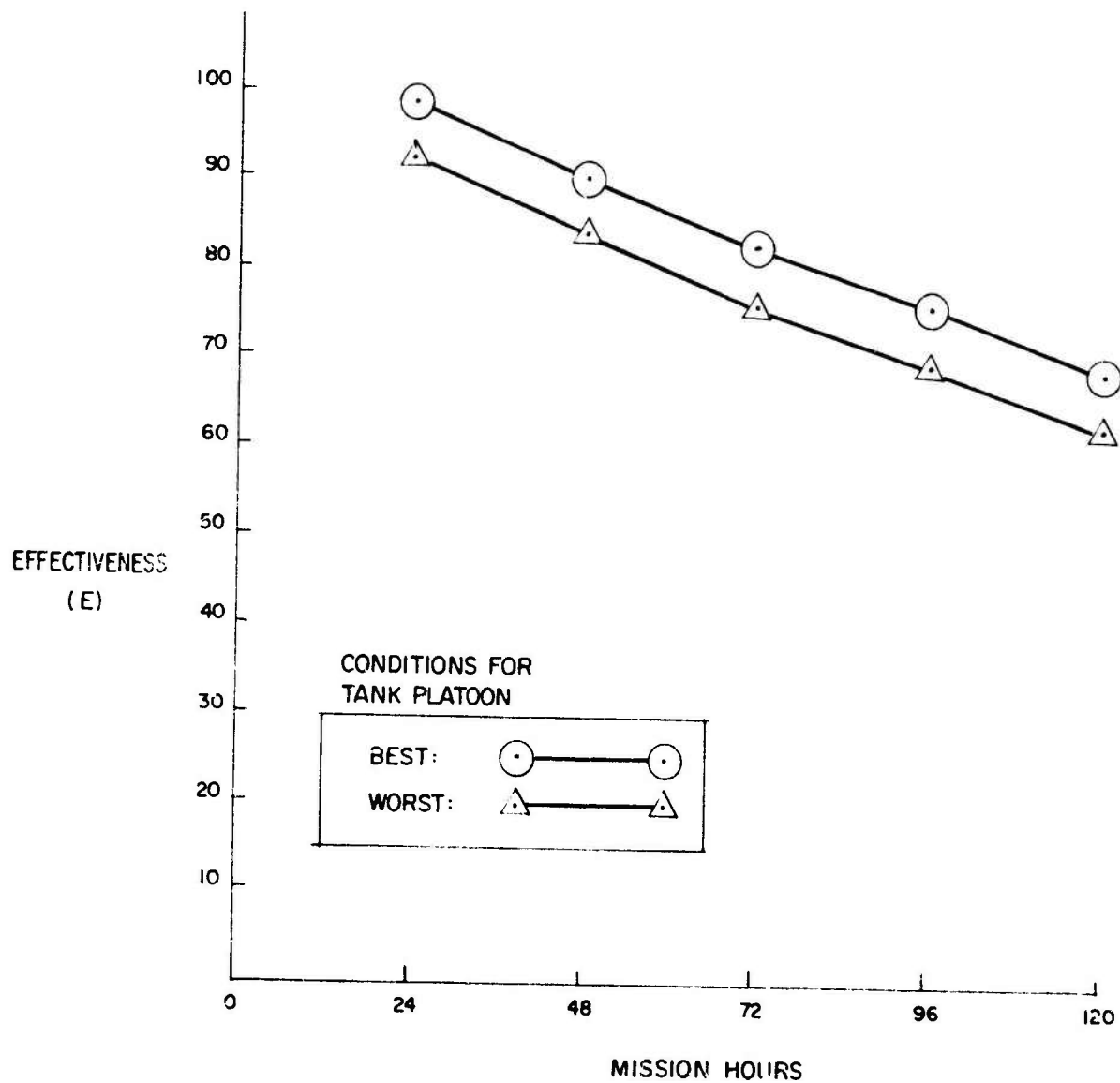
PLATOON ACTION	DAYS	Position				Infantry	
		PL	SL	MTM	G/CTL	Squad	Platoon
PLATOON ACTION ₁	1	88	55	92	69	72	89
	3	69	17	77	32	38	71
	5	54	5	65	15	20	56
PLATOON ACTION ₂	1	88	74	86	77	83	91
	3	67	41	65	46	56	74
	5	51	23	48	28	38	61
PLATOON ACTION ₃	1	62	71	81	93	86	76
	3	23	36	52	81	63	45
	5	9	18	34	70	45	26
PLATOON ACTION _{1,2,3}	1	78	66	86	79	80	85
	3	48	29	64	49	51	62
	5	29	13	47	31	32	45



Armor: Progressive degradation of effectiveness –
duty positions



Armor: Progressive degradation of effectiveness —
tank crews and platoons

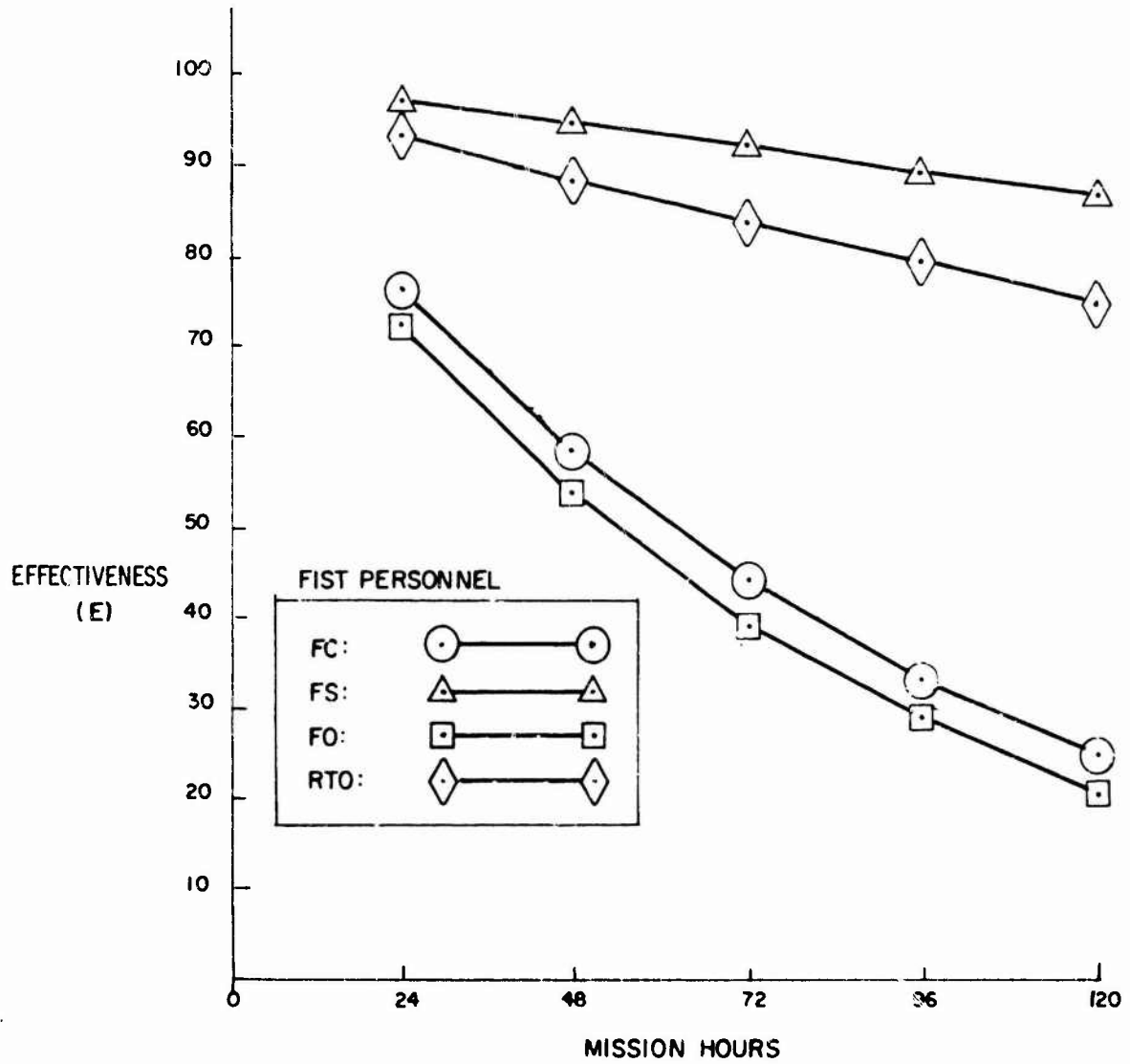


Armor: Effectiveness of tank platoons under best and worst conditions

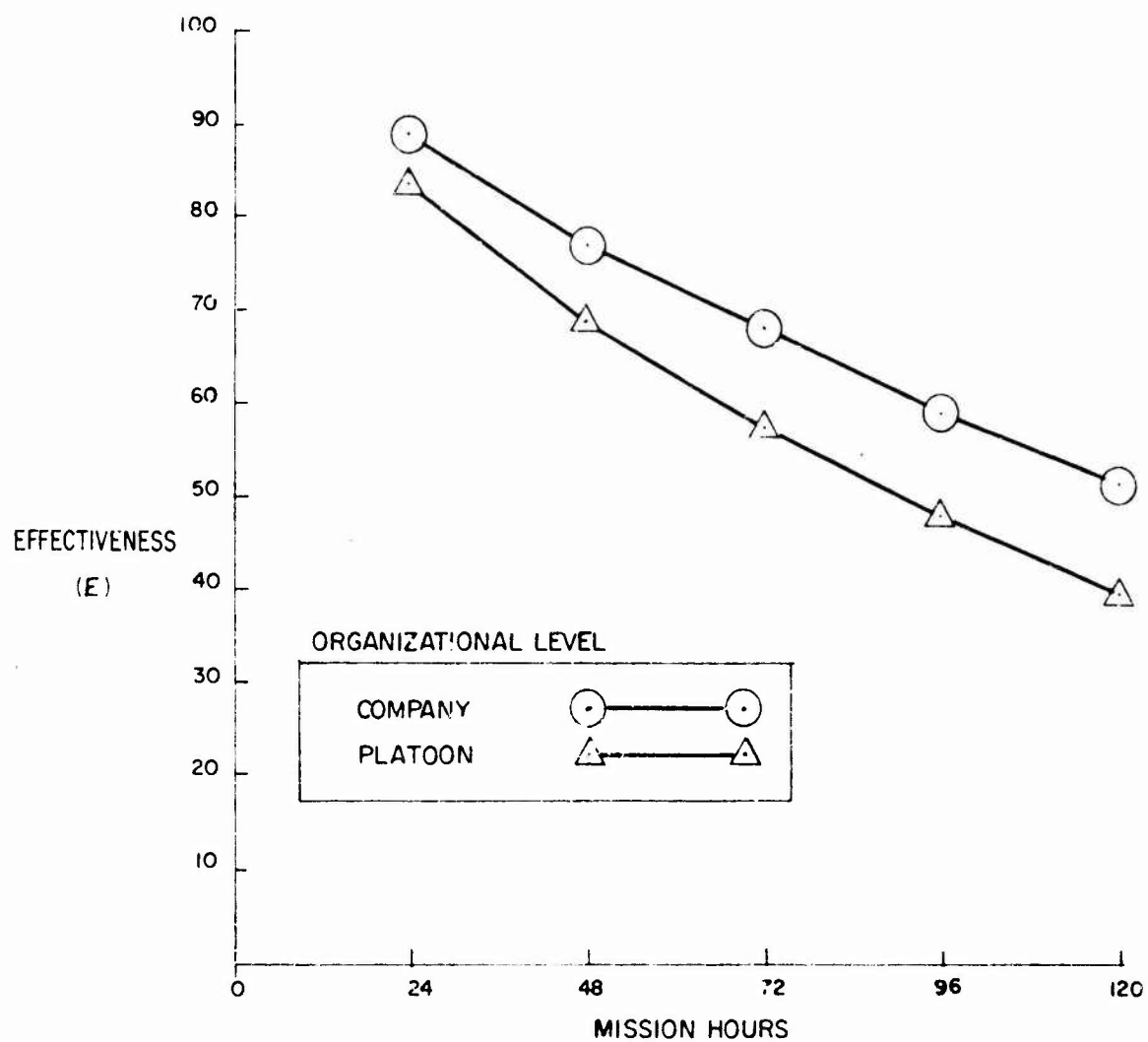
ARMOR

Effectiveness (E) for Platoon Actions and Mission Days

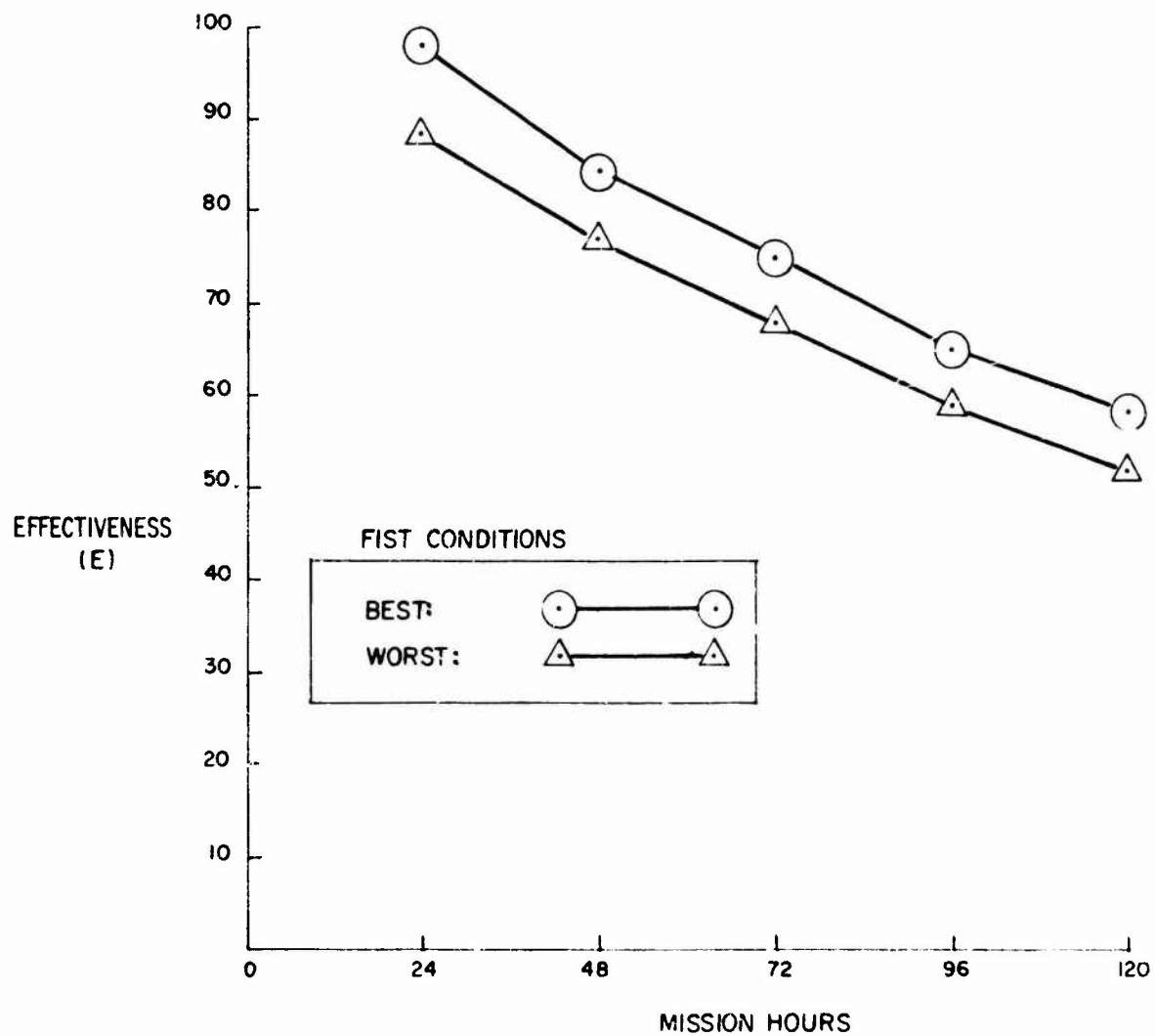
PLATOON ACTION	DY	Position				Tank	
		PL	CDR	LDR	GR	Crew	Platoon
PLATOON ACTION ₁	1	77	81	99	100	93	87
	3	46	54	96	100	80	65
	5	28	36	93	100	70	50
PLATOON ACTION ₂	1	94	97	100	100	99	97
	3	84	92	100	100	97	91
	5	75	87	100	100	95	86
PLATOON ACTION ₃	1	87	95	100	90	95	92
	3	67	85	100	74	86	80
	5	51	76	100	59	77	68
PLATOON ACTION _{1,2,3}	1	86	91	99	97	95	92
	3	64	75	99	90	87	78
	5	47	62	98	84	80	66



FIST: Progressive degradation of effectiveness —
duty positions



FIST: Progressive degradation of effectiveness --
platoon and company levels

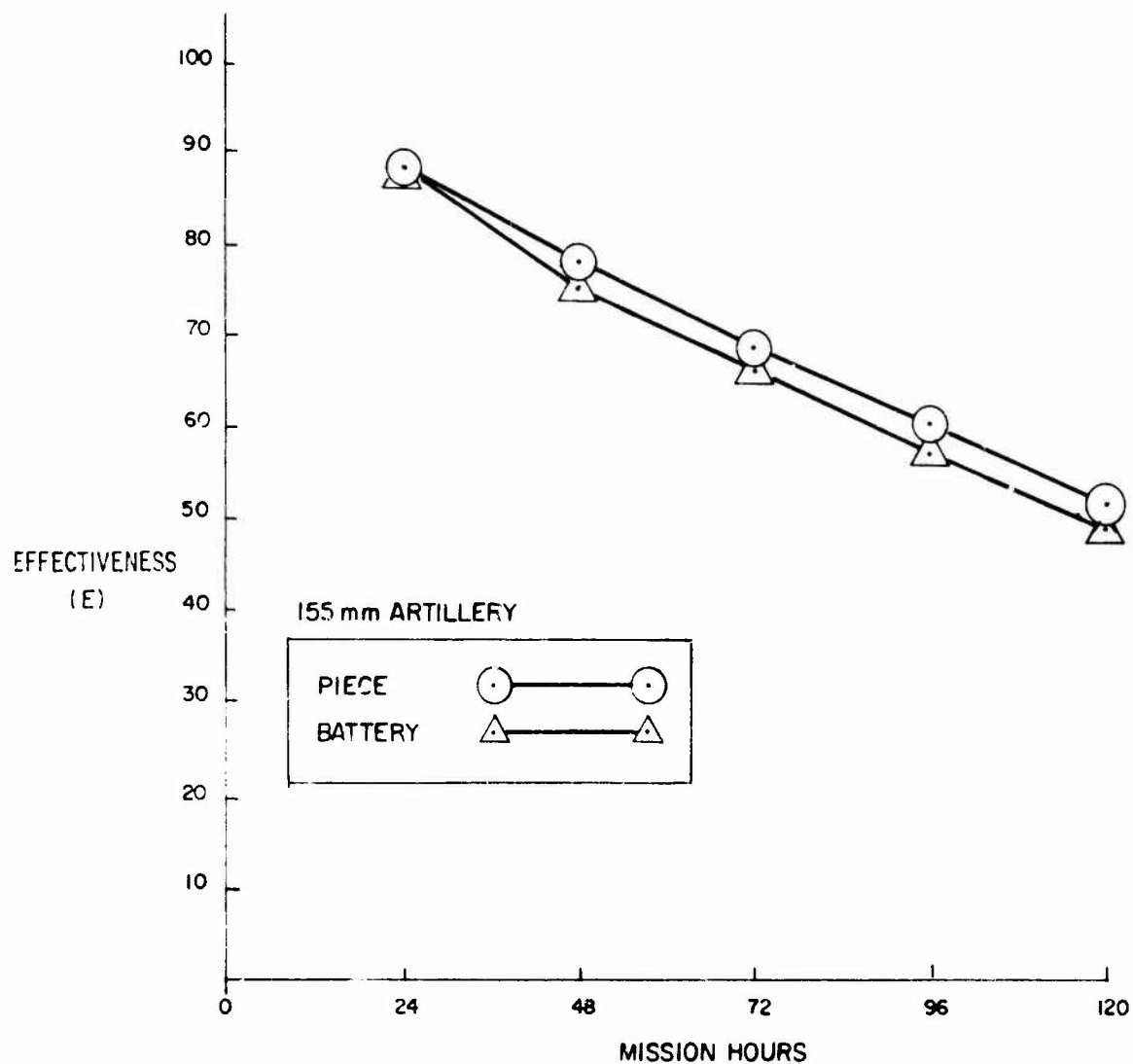


FIST: Effectiveness of teams under best and worst conditions

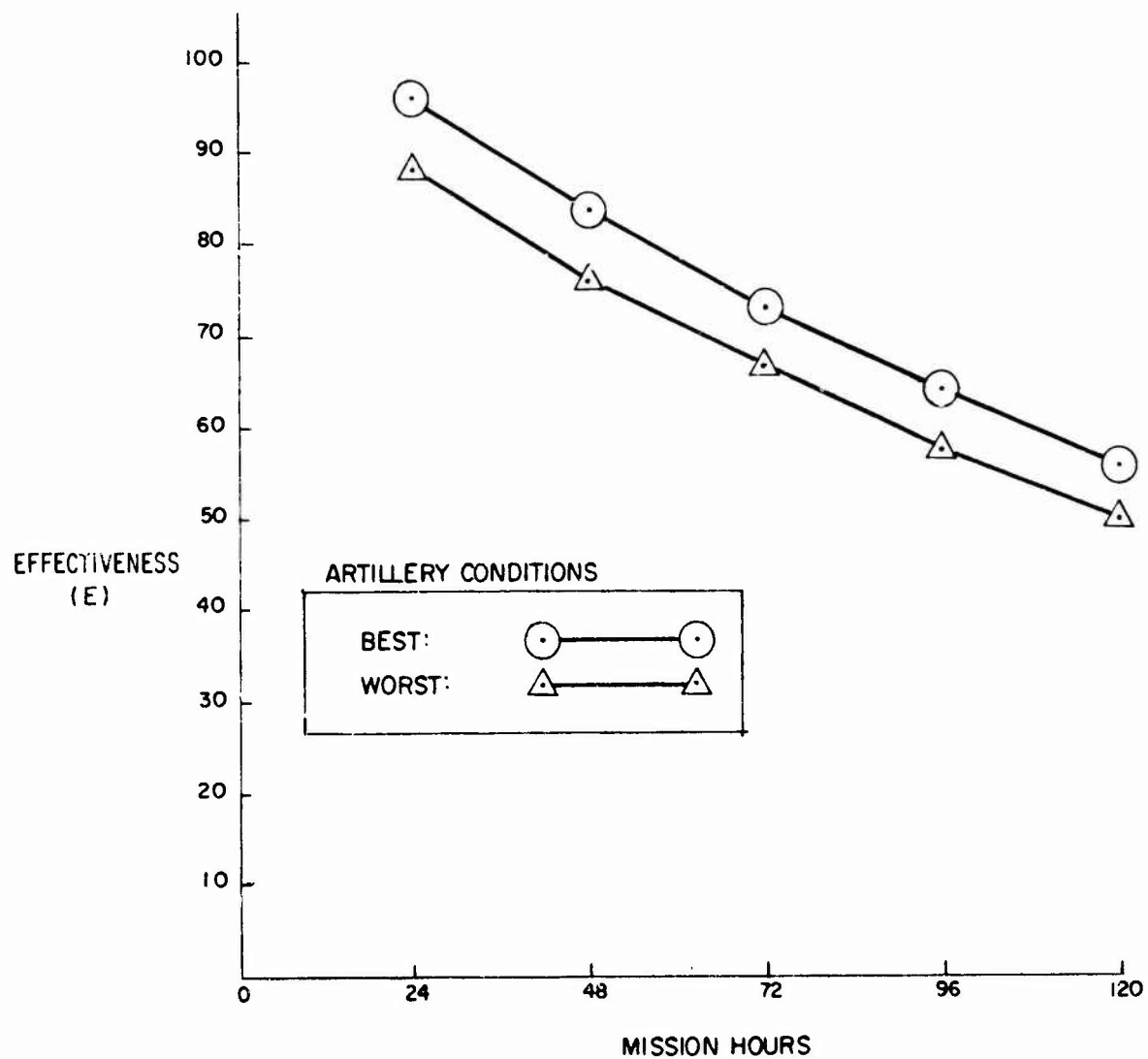
FIST

Effectiveness (F) for Platoon Actions and Mission Days

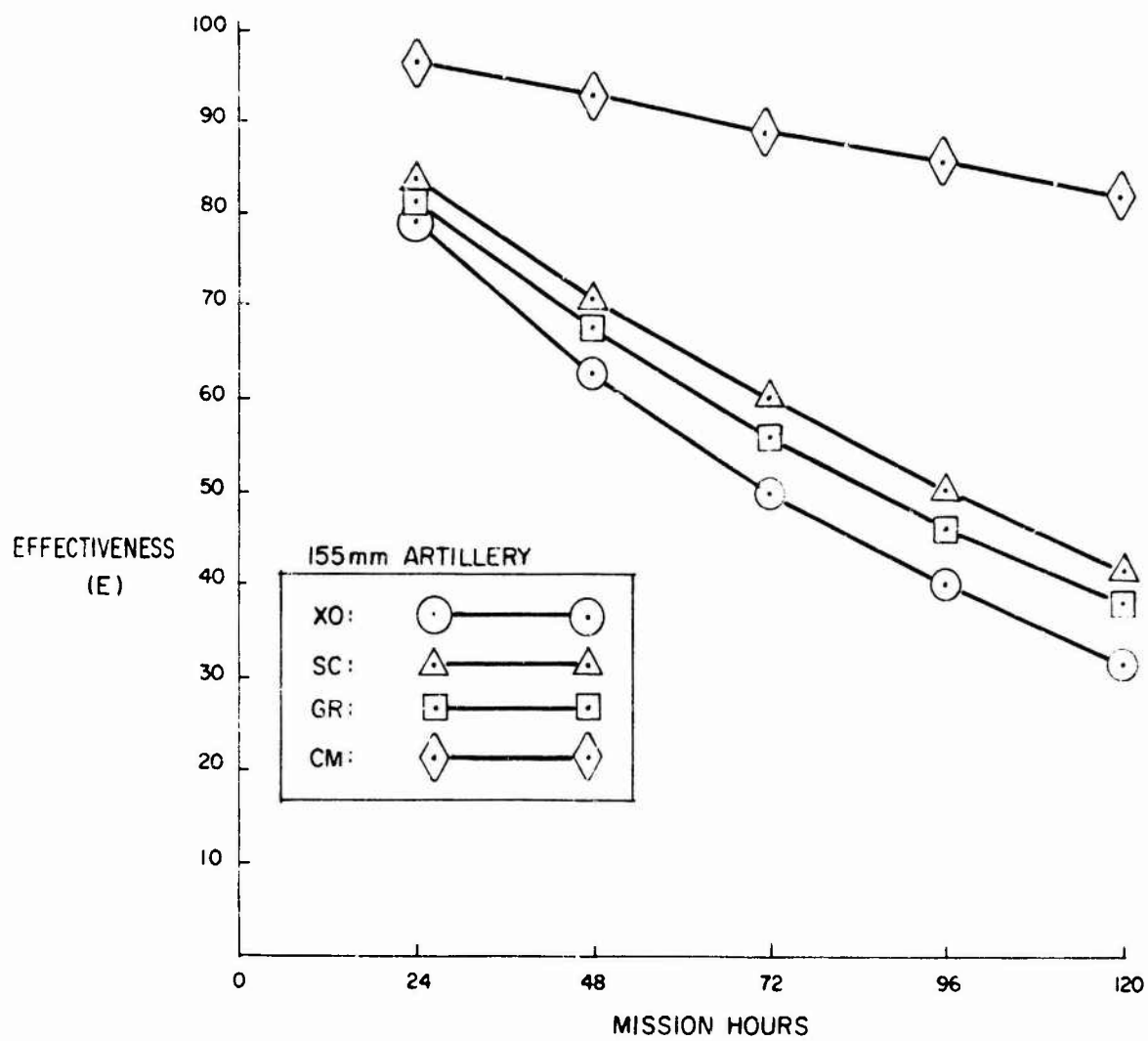
PLATOON ACTION	DAYS	Position				Team	
		FC	FO	FS	RTO	Platoon	Company
PLATOON ACTION ₁	1	74	73	100	100	85	88
	3	41	38	100	100	62	69
	5	22	20	100	100	45	53
PLATOON ACTION ₂	1	82	78	100	92	85	91
	3	55	48	100	78	61	76
	5	37	30	100	65	44	63
PLATOON ACTION ₃	1	73	69	92	92	80	85
	3	38	33	78	78	51	60
	5	20	15	65	65	31	42
PLATOON ACTION _{1,2,3}	1	76	73	97	94	83	88
	3	44	39	92	84	57	68
	5	25	21	87	75	40	52



Artillery: Progressive degradation of effectiveness —
pieces and batteries



Artillery: Effectiveness of batteries under best and worst conditions



Artillery: Progressive degradation of effectiveness — duty positions

ARTILLERY

Effectiveness (E) for Demand Levels and Mission Days

DEMAND	DAYS	Position				Artillery	
		XO	SC	GR	CM	Piece	Battery
LO	1	96	93	92	100	95	97
	3	88	82	79	100	87	92
	5	81	71	68	100	79	87
MED	1	76	82	78	95	86	85
	3	44	55	47	86	63	61
	5	25	37	29	77	47	44
HI	1	69	78	77	94	84	81
	3	33	47	46	82	59	53
	5	16	28	28	72	42	35
AVERAGE L, M, H	1	80	84	82	96	88	88
	3	50	60	56	89	69	67
	5	32	42	38	82	53	51