Making the Soldier Decisive On Future Battlefields

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Making the Soldier Decisive on Future Battlefields

Committee on Making the Soldier Decisive on Future Battlefields

Board on Army Science and Technology

Division on Engineering and Physical Sciences

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[1]NAE, National Academy of Engineering; IOM, Institute of Medicine; NAS, National Academy of Sciences

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Preface

This study resulted from recognition by the U.S. Army that a great disparity exists between the decisive overmatch capability, relative to prospective adversaries, of major U.S. weapon systems (such as tanks, fighter aircraft, or nuclear submarines) and the relative vulnerability of dismounted soldiers when they are operating in small, detached units (squads). The increased reliance in recent Army deployments on soldiers operating in these tactical small units (TSUs), as well as the expanding responsibilities of ground forces in the future for missions that go beyond traditional combat, provided the incentive to ask what could be done to give dismounted soldiers and TSUs a credible degree of decisive overmatch in any of the anticipated future operational environments.

I would like to thank the Committee on Making the Soldier Decisive on Future Battlefields for its tenacity and dedication in interviewing numerous experts (including recently deployed Army enlisted soldiers and officers), assessing the pertinent issues, and developing recommendations to address the many demands of its statement of task from the Army sponsor (see Summary of this report). The committee in turn is grateful to the many Army and Department of Defense personnel, both civilian and military, who provided much of the information on which this report is based. We particularly thank the veterans of recent combat deployments who shared with us their hopes for those who will follow them, as well as their insights, frustrations, and triumphs in the trying circumstances of operations in Iraq and Afghanistan.

The committee and I also greatly appreciate the support and assistance of the National Research Council (NRC) staff, which ably assisted the committee in its fact-finding activities and in production of the report. In particular, I thank the staff of the NRC's Board on Army Science and Technology (BAST), who successfully organized the attendance of committee members and guests at major meetings in multiple locations and maintained a secure Internet forum for the members to accumulate study information, collaborate on report inputs, share expertise, and develop the consensus for the report we present here.

The study was conducted under the auspices of the BAST, a unit of the NRC's Division on Engineering and Physical Sciences, established in 1982 at the request of the United States Army. The BAST brings broad military, industrial, and academic scientific, engineering, and management expertise to bear on technical challenges of importance to senior Army leaders. The BAST is not a study committee; rather, it deliberates on study concepts and statements of task for the expert committees that are formed under rigorous NRC procedures to conduct a particular study. The BAST discusses potential study topics and tasks, ensures study project planning and execution in conformance with NRC procedures, and suggests candidate experts to serve as committee members or report reviewers.

Although the Board members are listed in the front pages of the report, with the exception of any members who were nominated and appointed to the study committee, they were not asked to endorse the committee's findings or recommendations or to review final drafts of the report before its release. The findings and recommendations are those reached by unanimous consensus of the Committee on Making the Soldier Decisive on Future Battlefields. The NRC's approval of this report likewise does not indicate a position on the substance of the findings and recommendations but rather certifies that the study was conducted in accordance with its procedures.

Hank Hatch, *Chair*
Committee on Making the Soldier Decisive
on Future Battlefields

Acknowledgments

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

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Judith L. Swain (IOM), National University of Singapore
Michael R. Thompson, Scitor Corporation

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Robert A. Frosch, NAE, Harvard University. Appointed by the National Research Council, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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Acronyms and Abbreviations

AAR	after action review
AIT	advanced individual training
ACEP	Army Center for Enhanced Performance
APFT	Army Physical Fitness Test
APS	active protection systems
AO	area of operation
ARDEC	Armament Research, Development and Engineering Center
ARFORGEN	Army Force Generation
ARI	Army Research Institute for the Behavioral and Social Sciences
ARL	Army Research Laboratory
ARL-HRED	Army Research Laboratory-Human Research and Engineering Directorate
ARTEMIS	All-Terrain Radar for Tactical Exploitation of MTI and Imaging Surveillance
ASA(ALT)	Assistant Secretary of the Army (Acquisition, Logistics and Technology)
ASB	Army Science Board
ASIMO	Advanced Step in Innovative Mobility
ASVAB	Armed Services Vocational Aptitude Battery
BAST	Board on Army Science and Technology
BCT	brigade combat team
BT	basic training
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance
CALL	Center for Army Lessons Learned
CASCOM	U.S. Army Combined Arms Support Command
CBA	cost benefit analysis
CBRN	chemical, biological, radiological, and nuclear
CCD	capabilities development document
CERDEC	Communications-Electronics Research, Development, and Engineering Center
CIED	Counter-improvised explosive device
CIST	company intelligence support team
CONOPS	concept of operations
CRAM	Counterrocket, artillery, and mortar
DA	Department of the Army
DARPA	Defense Advanced Research Projects Agency
DIME	diplomatic, information, military, and economic
DMFC	direct methanol fuel cell
DoD	Department of Defense

DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities
DoS	U.S. Department of State
DSTS	Dismounted Soldier Training System
EEA	essential element of analysis
FCS	future combat systems
FOB	forward operating base
FORESTER	FOliage PENetration Reconnaissance, Surveillance, Tracking and Engagement Radar
FITE	Future Immersive Training Environment
FMV	full motion video
G1	Deputy Chief of Staff for Personnel
GMAV	gas micro air vehicle
GPS	global positioning system
GSM	global system for mobile communication
HAL	Hybrid Assistive Limb
HHC	headquarters and headquarters company
HSI	Human-Systems Integration
HSI/MSI	hyperspectral imaging/multispectral imaging
HULC	human universal load carrier
ICD	initial capabilities document
IED	improvised explosive device
IIT	Infantry Immersion Trainer
IMPRINT	Improved Performance Research Integration Tool
IPE	individual protective equipment
IR	infrared
IRST	infra-red search and track
IRT	independent review team
ISR	intelligence, surveillance, and reconnaissance
JIEDDO	Joint Improvised Explosive Device Defeat Organization
JCIDS	Joint Capabilities Integration and Development System
JCTD	Joint Capabilities Technology Demonstration
JP	jet propellant
LADAR	LAser Detection And Ranging
L-V-C	Live - Virtual - Constructive
MANPRINT	MANpower, PeRsonnel, INTegration
MCoE	Maneuver Center of Excellence
MEPS	Military Entrance Processing Stations

METT-TC	Mission, Enemy, Terrain and weather, Troops and support available—Time available, Civilians
MMOG	massively multiplayer online game
mmw	millimeter wave
MOE	measure of effectiveness
MOP	measures of performance
MOS	military occupational specialty
MOUT	military operations on urban terrain
MRMC	U.S. Army Medical Research and Materiel Command
NCO	non-commissioned officer
NGO	nongovernmental organization
NPC	non-player characters
NRC	National Research Council
NSWC	Naval Surface Warfare Center
OEF	Operation Enduring Freedom
OE/OD	organizational effectiveness/organizational development
OIF	Operation Iraqi Freedom
OPTEMPO	operations tempo
ORSA	operations research and system analyst
OSA	open system architecture
OSUT	one-station unit training
OSHA	Occupational Safety and Health Administration
PEO Soldier	Program Executive Office-Soldier
PEO STRI	Program Executive Office for Simulation, Training and Instrumentation
PETMAN	protection ensemble test mannequin
POI	program of instruction
PMESI	political, military, economic, social, infrastructure
PSM	physiological status monitor
R&D	research and development
RDEC	U.S. Army Research, Development & Engineering Center
RMFC	reformed methanol fuel cell
ROEs	rules of engagement
RoL	Rule-of-Law
SA	situational awareness
SALTI	DARPA Synthetic Aperture Ladar for Tactical Imaging
SAR	search and rescue
SIGINT	signals intelligence
SIPRNet	Secure Internet Protocol Network
SOFC	solid oxide fuel cell
SOS	system-of-systems

SOT	Statement of Task
SSIM	strategic social interaction module
S&T	science and technology
STRICOM	Simulation Training and Instrumentation Command
SWAP	size, weight, and power
SWAP-C	size, weight, power, and cost
TAPAS	Tailored Adaptive Personality Assessment System
TCPED	tasking, collection, processing, exploitation and dissemination
TiGRNET	Tactical Ground Reporting Network
TOPS	Tier One Performance Screen
TRL	technology readiness level
TRADOC	U.S. Army Training and Doctrine Command
TSU	tactical small unit
TTHS	trainees, transients, holdees, and students
TTP	tactics, techniques and procedures
TUS	U.S. Navy Transparent Urban Structures
UAS	unmanned aerial system
UAV	unmanned aerial vehicle
UGV	unmanned ground vehicle
USAREC	United States Army Recruiting Command
USARIEM	U.S. Army Research Institute of Environmental Medicine
VBS2	Virtual Battle Space 2
VHF	very high frequency
WAMI	wide area motion imagery
WAS	wide area security
WLR	weapons location radar

Summary

The focus of this study was achieving decisive overmatch for the dismounted Soldier[1] and tactical small unit (TSU) on future battlefields. In particular, the committee was asked to determine the elements of overmatch capabilities necessary to achieve decisiveness, identify technical requirements for optimizing Soldiers and small units, identify near-, mid-, and far-term technologies for investment, and determine the relative importance of such investments. The complete statement of task is in Box SUM-1.

To examine the desired elements of decisive overmatch, Chapter 2 identifies capabilities needed for decisive overmatch by Soldiers and small units in dismounted infantry squad operations, including situational understanding, military effects (including lethal and nonlethal effects and stability actions), maneuverability, sustainability, and survivability. Chapter 3 then articulates the foundational capabilities needed to identify and implement potential solutions. Finally, Chapter 4 describes how to achieve overmatch by focusing on the five areas most likely to enable improvements in Soldier and TSU decisiveness.

To identify relevant technical requirements, the committee gathered information about ongoing concept and technology development efforts both in and out of the Army with potential to contribute to decisive overmatch within the near (5 years), mid (5-10 years), and far (beyond 10 years) terms. The committee also interviewed Soldiers, both officer and enlisted, with recent combat experience in Iraq and Afghanistan to gain an understanding of known shortcomings.

SETTING CONDITIONS TO ACHIEVE OVERMATCH

If decisive overmatch is to be achieved and sustained in the future, it is essential that the Army identify the favorable asymmetries that can be exploited and the unfavorable asymmetries that must be mitigated. Without the artifacts of a holistic systems engineering process applied to

[1]For this report, the committee has chosen to follow the Army's policy since 2003 of capitalizing the word "soldier" when it refers to a soldier in the U.S. Army.

BOX SUM-1 Statement of Task

The U.S. military does not believe its soldiers, sailors, airmen, and marines should be engaged in combat with adversaries on a “level playing field”. Our combat individuals enter engagements to win. To that end, this country has used its technical prowess and industrial capability to develop decisive weapons, weapons that over-match those of potential enemies, such as the M1A2 tank, the F-22 fighter, and the Seawolf attack submarine. The country is now engaged in what has been identified as an “era of persistent conflict” in which the most important weapon is the dismounted soldier operating in small units. More than for soldiers in Vietnam, Korea, and WWII, today’s soldier must be prepared to contend with both regular and irregular adversaries. Results in Iraq and Afghanistan show that while the US soldier is a formidable fighter, his contemporary suite of equipment and support does not enjoy the same high degree of overmatch capability exhibited by large weapons platforms—yet it is the soldier who ultimately will play the decisive role in restoring stability.

A study is needed to establish the technical requirements for overmatch capability for dismounted soldiers operating individually or in small units. What technological and organizational capabilities are needed to make the dismounted soldier a decisive weapon? How can technology help those soldiers remain decisive on a changing, uncertain and complex future environment? The study will examine the applicability of systems engineering to soldiers and small units, as well as specific technology areas that are relevant to making soldiers decisive, particularly in conditions where we still take casualties today (movement to contact and chance encounters). Technology areas to be considered should include (but not be limited to) situational awareness, weapons, mobility, and protection, adaptation to battlefield environments (e.g., clothing, cooling), communications and networking, human dynamics (e.g., physical, cognitive, behavioral), and logistical support (e.g., medical aid, food, water, energy).

The NRC will establish an ad hoc study committee to examine these requirements. The committee will:

1. Determine the elements of overmatch capabilities necessary for a dismounted soldier to be a decisive weapon on the battlefield, Consider both the individual soldier as well as the soldier as part of a small (squad-size or smaller) unit.
2. Identify technical requirements for optimizing soldiers and small units to achieve overmatch capabilities on the battlefield. Consider technology and societal trends that may affect the balance between U.S. forces & adversaries both now and in future years.
3. Identify near-term, mid-term and far-term technologies in which new or enhanced S&T investments would facilitate the development of decisive soldier capabilities.
4. Determine the relative importance of such investments in making the soldier decisive on future battlefields.

the Soldier and TSU, a final assessment of overmatch opportunities is not possible.

As it came to understand the non-materiel side of TSU and Soldier capabilities, the committee decided that the greatest returns on Army investments for improvements in the near, mid, and far terms would be achieved by balancing the materiel aspects of technology developments with non-materiel aspects, found primarily in the human dimension. The Committee defined the human dimension to include all the attributes of the individual Soldier and of the collected Soldiers forming the TSU that impact performance of mission tasks. This differs from the Army's current perspective on the human dimension, which does not adequately include the complexities of individual Soldier tasks and human interactions within teams.

Knowledge in fields such as cognitive psychology, sociology, and neuro-economics, can provide many of the answers to questions surrounding the adequacy and potential of the individual Soldier and TSU. Applying such knowledge will require an expansion of resources devoted to human dimension research and technology development, as well as to small-unit organization and doctrine.

The study concluded that an essential principle for achieving overmatch capabilities is to recognize that integrating the human dimension with materiel advances is at the core of all TSU improvements. However, Army research and development has always been insufficiently resourced to provide the range of human-dimension opportunities and solutions that might provide overmatching performance.

Recommendation 1: To determine overmatch options for the TSU, the Army should provide sufficient resources for the full range of human-dimension opportunities and solutions that might provide overmatching performance.

Get Serious About Systems Engineering

A systems engineering methodology is essential to develop the relevant measures of performance and effectiveness, as well as supporting indicators, for the TSU. Such measures can be used to develop an integrated assessment methodology (and associated tools) that can evaluate both materiel and non-materiel impacts of prospective TSU enhancements.

Recommendation 2: The Army should establish a Systems Engineering executive authority to support a system-of-systems engineering environment that will be responsible for developing methodologies and analytical tools to evaluate and acquire total system solutions for the dismounted Soldier and TSU. This executive authority must have sufficient seniority, influence, and budget control to operate effectively across the entire Army acquisition community (including research and development, test, and evaluation) in executing its systems engineering mission.

Establish Metrics

Improvement is needed in many human-dimension areas at the Soldier and TSU levels, including leader development, situational understanding, cognitive performance and overload, physical performance, mental and physical resiliency,