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REPORT IN BRIEF

Making the Soldier Decisive on Future Battlefields

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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, the United States has used its technical prowess and industrial capability to develop decisive weapons that overmatch those of potential enemies. In its current engagement—what has been identified as an "era of persistent conflict"— the nation's most important weapon is the dismounted soldier operating in small units. Today's soldier must be prepared to contend with both regular and irregular adversaries. Results in Iraq and Afghanistan show that, while the U.S. soldier is a formidable fighter, the contemporary suite of equipment and support does not afford 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. This National Research Council (NRC) report establishes the technical requirements for overmatch capability for dismounted soldiers operating individually or in small units. It prescribes technological and organizational capabilities needed to make the dismounted soldier a decisive weapon in a changing, uncertain, and complex future environment and provides the Army with fifteen recommendations on how to focus its efforts to enable the soldier and tactical small unit (TSU) to achieve overmatch.

Introduction and Background

The NRC committee was tasked 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. 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. The committee found that the necessary elements of overmatch capabilities for the soldier and tactical small unit include situational understanding, military effects, such as lethal and nonlethal effects and stability actions, maneuverability, sustainability, and survivability.

Setting Conditions to Achieve Overmatch

The committee found that four essential actions constitute the technical requirements for the Army to achieve overmatch.

Exploit the Human Dimension

As described in the full NRC report, 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—primarily in the human dimension, including all 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. 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. To determine overmatch options for the TSU, the report recommends that 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.

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, cultural understanding, human-system interfaces, and other areas with potential to contribute to decisive overmatch. Current measures of performance (MOPs) and measures of effectiveness (MOEs) are not adequate to assess these improvements.

The Army should develop, maintain, and evolve an optimal set of MOPs and MOEs for assessing capability improvements for the dismounted soldier and TSU by investing in an analysis architecture and infrastructure, including a comprehensive metrics development methodology that supports objective dialogue among combat and system developers, systems engineers, trainers, and program activities. The MOPs and MOEs, together with the guidance for using them, should be tested and validated for practical application and ease of use, as well as for accuracy as predictors and indicators of desired performance and effectiveness outcomes.

Overhaul Acquisition

The goal of achieving overmatch capabilities cannot be accomplished until small-unit and soldier requirements are accorded the same high levels of attention as major materiel systems requirements. At the same time, the approach of acquiring and fielding every "new" technology is both impractical and unaffordable. Most important, it is unlikely that the solutions to achieve overmatch capabilities can be successfully implemented within the Army's current acquisition framework. A principled groundwork for analyzing the TSU system has not been laid for a natural progression to define and implement overmatch capabilities that integrate the span of human and materiel dimensions and that evolve continuously with changing threats and opportunities.

The Army should establish an executive authority for TSU integration, responsible for option generation and evaluation, requirements currency, and programmatic acquisition for the soldier and TSU within a metrics-driven, system-of-systems engineering environment.

Components of Capability Solutions Most Likely to Achieve Overmatch

As outlined in the full NRC report, there are many opportunities to improve the capability of TSUs in ways that could potentially ensure the decisive overmatch of TSUs across the range of future military operations. Many of these opportunities, or capability options, will have their greatest effect only if both materiel and non-materiel factors from across the DOTMLPF domains (Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities) are integrated in an optimized capability solution—likely within one or more of five solution areas: designing the TSU; focusing on TSU training; integrating the TSU into Army networks; balancing TSU maneuverability, military effects, and survivability; and leveraging advances in portable power.

Designing the Tactical Small Unit

A systems approach that focuses on developing TSU metrics can expand TSU design options, enabling the Army to fully exploit the capabilities of soldiers and equipment. The TSU should not be viewed as just an organization or formation but as a system of systems. A holistic, top-down analysis would then be able to determine design parameters for the optimal size (number of soldiers), organization (number of fire teams, duties), and equipment (communication, lethality systems) of the dismounted TSU of the future. Development and analyses of TSU options will require collaboration among multiple Army activities., including the U.S. Army Training and Doctrine Command (TRADOC) Infantry School at the Maneuver Center of Excellence (MCoE), the TRADOC Analysis Center, the Army Research Laboratory , the Army Research Institute of Environmental Medicine, the Army Research Institute for the Behavioral and Social Sciences, the Army Materiel Systems Analysis Activity, and the Army program executive offices for Simulation, Training, and Instrumentation (PEO STRI) and Soldier (PEO Soldier).

The Army should transform and sustain the design of the TSU, including re-assessing unit organization and size, by the following actions:

- Develop representative MOPs and MOEs for the primary dimensions of TSU performance and ensure these measures incorporate human-dimension criteria.
- Assemble a consortium of stakeholders to implement iterative work-centered analyses of the soldier task workload and the TSU and soldier-system performance required by increasing the scope (range, quality, thresholds) of TSU MOPs and MOEs. The analyses should enable development of predictive analytical models of soldier physical and cognitive task and mobility performance, soldier-to-soldier task and mobility interaction within a TSU network, and TSU task and mobility performance.
- Expand the TSU task and mobility model to predict influences of weapons, intelligence, surveillance, and

reconnaissance (ISR), as well as information technologies on TSU MOPs and MOEs.

The Army should also evaluate soldier performance for the future mission effectiveness of the TSU in the near term by leveraging existing research and development and by considering all DOTMLPF domains.

In addition, to maintain the currency of representative measures for the primary dimensions of soldier and TSU mission performance, the Army—including its doctrine and training, research and development, acquisition, and testing elements—should undertake a recurring program (at least biannual) to re-evaluate soldier performance. This program should consider the analytical foundation for the functional design of the TSU, including numbers of soldiers, grades and specialties, career experience, organization, and external support requirements.

Focusing on TSU Training

Focused training is essential to improving the performance of soldiers and TSUs to levels that can assure overmatch. With the TSU as the centerpiece of future Army operations, small-unit leader training will be more important than ever.

The Army should focus training for the individual soldier and TSU in the near term as follows:

- Define TSU training objectives to produce TSUs that perform acceptably on the TSU MOPs and MOEs.
- Produce nonintrusive physiological status monitors to allow self-awareness and command chain assessments.
- Apply results of research in individual differences to the administration of TSU training.
- Expand sociocultural training capabilities to produce necessary TSU skills within time and resource constraints expected for TSU deployments.
- Expand instructor development to incorporate current theories of learning and feedback.
- Develop a concept for TSU master trainers to be assigned to company or battalion level to ensure continuous effective training of TSUs.
- Develop tools for TSU leaders, and leaders at higher levels, to assess soldier and TSU training readiness against the TSU MOPs and MOEs.
- Ensure that effects of nutrition, hydration, sleep, dietary supplements, tobacco, and alcohol on cognitive and physical performance are incorporated in all modes of training of soldiers and non-commissioned officers, including electronic games as well as live, virtual, and constructive simulations for individual (self) and group training.

In the mid to far terms, the Army should refine its focus on training for the individual Soldier and TSU by increasing the resolution of its suite of assessment tools to allow tracking of soldier and TSU skill acquisition through and during each individual and collective training event, including live, virtual, and constructive simulations and electronic games.

Integrating the TSU into Army Networks

The Army has already recognized the important role of the network in achieving expanded capabilities in combat. Yet, dismounted soldiers and TSUs today have limited organic capability, such as radios, to take advantage of networking in all mission environments. Ensuring full integration of the TSU into the Army network is essential to achieve decisive overmatch. A crucial concept to guide this integration is to ensure that TSU leaders and individual soldiers have sufficient situational understanding.

To achieve decisive overmatch capabilities, the Army should fully integrate the soldier and TSU into existing and planned communications, information, and socio-cognitive networks to ensure that the network enhancements required for this purpose address all DOTMLPF domains.

MOPs and MOEs—the measures for assessing levels of situational understanding—would have utility for materiel development and evaluation, analytical modeling and simulation, and human factors research, as well as TSU training. It is possible that physiological correlates to such measures could be confirmed, and limited instrumentation could be operational, for validation of materiel development trials conducted in the mid term. By the far term, it should be possible to assess the range, resolution, and reliability of soldier and TSU situational understanding in relevant operational environments in real time.

The report recommends an immediate Army initiative to engage the science and technology community from both human and materiel perspectives, as well as users, trainers, and other stakeholders in Army networks, to produce measures for assessing levels of situational understanding needed by the TSU.

Balancing TSU Maneuverability, Military Effects, and Survivability

For dismounted operations, the fulcrum on which maneuver, survival, and effective action must be balanced is the soldier's combat load.Excessive soldier loads degrade not only maneuverability of both individual soldiers and TSUs but also their resilience, survivability, and effectiveness. With such heavy burdens, traversing rough terrain and making rapid changes in direction, speed, and orientation greatly increase soldiers' susceptibility to injuries.

The Army should initiate and maintain a program of experimental trials to inform improved models for assessing the effectiveness of dismounted soldiers and TSUs as a function of soldier load and measures/indicators of mobility and agility. The program should include an iterative process to explore innovative concepts for balancing TSU maneuverability, military effects,

and survivability, as well as continuing exploration of more traditional approaches such as lightening individual carried items and offloading soldier load robotic carriers.

Flexibility with respect to effective action becomes even more demanding when TSU mission objectives require a dismounted unit to be prepared to shift rapidly among traditional lethal combat, nonlethal means of projecting force, and stability objectives where effectiveness is measured in terms of communication with the local population, building capacity for civil operations, or humanitarian objectives. Little is known about the effects of nonlethal weapons on adversaries or about their impact on engagement decision complexity for the soldier. The effectiveness of nonlethal actions used as an alternative to lethal means will depend to a great extent on the perceptions of those being confronted. In the mid-term, the Army should undertake research to identify a range of unambiguous signals of nonlethal intent. The research should extend to the exploration of cultural differences in intent interpretation.

Given the range of missions and tasks that dismounted TSUs may be called upon to perform in the future, even experienced leaders at the TSU level and higher echelons cannot be expected to know immediately the best combination of available options, extending across all DOTMLPF domains, for the optimal balance of maneuverability, military effects, and survivability in every environment and engagement. An easy-to-use mission planning aid could incorporate the relationships among options learned from prior operational experience (lessons learned), as well as the relationships among metrics, indicators, and DOTMLPF options found and validated through experimental trials and incorporated in assessment models used by the development community. The Army should develop a mission planning aid to assist in balancing maneuverability, military effects, and survivability for use in training and operations by TSU leaders and leaders at higher echelons.

Leveraging Advances in Portable Power

As long as electronics are used to enable the key equipments on which soldiers and TSUs depend, advances in portable power will continue to provide decisive-edge potential to U.S. soldiers. Power issues have doctrinal implications because of their impact on TSU tactics, techniques, and procedures. The last decade has seen major advances in portable power materiel technologies, which could have outsize influence on overmatch. However, this can occur only if the Army can leverage the advances to their full effect, which requires considering the full range of DOTMLPF implications for alternative portable-power solutions.

There is no doctrinal philosophy for the TSU to recharge the battery; there is no organizational equipment to support recharging; there is no hint of the training required; there is no parallel materiel development of a recharger or fuel reformer to exploit new rechargeable battery or fuel-cell technologies. The Army needs to complete development of JP-reforming technology over a wide range of sizes in order to exploit either rechargeable battery technology or fuel-cell technology.

Advances in portable power will contribute to the decisiveness of TSUs by giving future soldiers high confidence that their equipment ensemble will have sufficient energy to carry out the mission. Achieving this goal will help to reduce fatigue, eliminate the anxiety associated with resupply, increase confidence in situational awareness from powered sensors, and assure communications links with higher levels in the command structure. The Army should develop and maintain a robust program in advanced energy sources based on full analysis of DOTMLPF elements with the goal of eliminating power and energy as limiting factors in tactical small unit operations.

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