

Unit Combat Power (and Beyond)



Briefing for ISMOR

28-31 August 2007

Purpose and Agenda

- **Purpose.** To propose a revised method for:
 - **Assessing unit combat power and capabilities, and**
 - **Informing adjudication of outcomes and decision-making in modern combat simulations and war games.**
- **Agenda**
 - **Definitions.**
 - **Background.**
 - **Applications.**
 - **Problem.**
 - **Research approach.**
 - **Constraints, limitations, and assumptions.**
 - **Literature review**
 - **Consideration of options.**
 - **Recommended method.**
 - **Summary.**

Definitions (1 of 2)

- **“Combat power – The total means of destructive and/or disruptive force which a military unit/formation can apply against the opponent at a given time.”** (*Joint Pub 1-02, Department of Defense Dictionary of Military and Associated Terms, 9 June 2004*).
- **“Joint Functions” – The functions include:**
 - **Command and Control,**
 - **Intelligence,**
 - **Fires,**
 - **Movement and Maneuver,**
 - **Protection, and**
 - **Sustainment.**

(*Joint Pub 3-0, Joint Operations, 17 September 2006*)
- **“Elements of Combat Power” – The elements of combat power are the joint functions tied together by leadership.**
- **“Firepower score” – In models and wargames, typically a measure of the single round lethality of a particular weapon system. In some models, it is a product of lethality and rate of fire.**

Definitions (2 of 2)

- **“Combat Power Value (CPV)”** – In simulations and war games, the value assigned to a weapon system that measures (or estimates) its contribution to combat power relative to other weapon systems. This value may be a whole number or it may be normalized to a specified weapon system.
- **“Unit Combat Power (UCP)”** – In models and war games, the summation of the combat power values of the weapons systems available to the unit. For example, using normalized CPVs:
A combat unit contains 10 systems each with a CPV of 1.0 and 5 systems each with a CPV of 0.4. Thus, Unit combat power = $10 \times 1.0 + 5 \times 0.4 = 12.0$
- **“Unit readiness”** - The ability of a unit to accomplish the wartime missions for which the unit is organized or designed. In the U.S. military, this is measured as a “C” level that measures personnel, equipment on hand, equipment readiness, and training level.
(AR 220-1, Unit Status Reporting, 19 December 2006).
- **“Strength Value”** – Term to designate the unit strength or unit combat power for new or revised methods evaluated in this research.

Background

- **Theories of combat and combat outcomes typically include some estimate of relative combat power or force ratio. These include:**
 - **Scientific theories of combat proposed by Clausewitz, Jomini, Bloch, Fuller, and others.**
 - **Fiske – 1905.**
 - **Lanchester – 1914, and Osipov – 1915.**
- **Relatively recent efforts include:**
 - **Soviet Union correlation of forces and means (COFM).**
 - **U.S. weapons effectiveness indices/weighted unit values (WEI/WUV). *WEI/WUV out of favor in U.S. Army.***
- **Theories and variations of unit combat power are applied in a number of useful war games and simulations to:**
 - **Train commanders and staffs,**
 - **Inform course of action planning, or**
 - **Inform force development and systems acquisition decisions.**

Operations and War Games Applications

Examples

- **Operations.** In Desert Storm, Gen Schwartzkopf wanted airpower to reduce the enemy to a specified strength before committing ground forces.
- **War games.**
 - Force ratios and strength of units used by human-in-the-loop war gamer for decisions regarding maneuver, fires, resupply, etc.
 - Residual unit combat power used to assess outcomes (How well did the force survive?).
 - Force ratio (unit combat power comparison) used in some war games or aggregated force-on-force models to adjudicate victory or defeat in an engagement.

Combat Simulation Applications

Examples

- **Closed-form simulation heuristics (decision rules).**

- **Decision based on remaining percent of initial unit strength:**

- **Discontinue attack if strength less than 60%.**

- **Merge unit with another when strength falls below 30%.**

$$\text{Percent Strength} = \frac{\sum (\text{current \# systems}_i * \text{system value}_i)}{\sum (\text{initial \# systems}_i * \text{system value}_i)}$$

- **Decision based on force ratio:**

- **Use joint effects to achieve a force ratio of at least 3:1 before attacking.**

$$\text{Force Ratio} = \frac{\sum (\text{friendly \# systems}_i * \text{system value}_i)}{\sum (\text{enemy \# systems}_j * \text{system value}_j)}$$

Where:

i is the *i*th system of *n* systems in the unit,

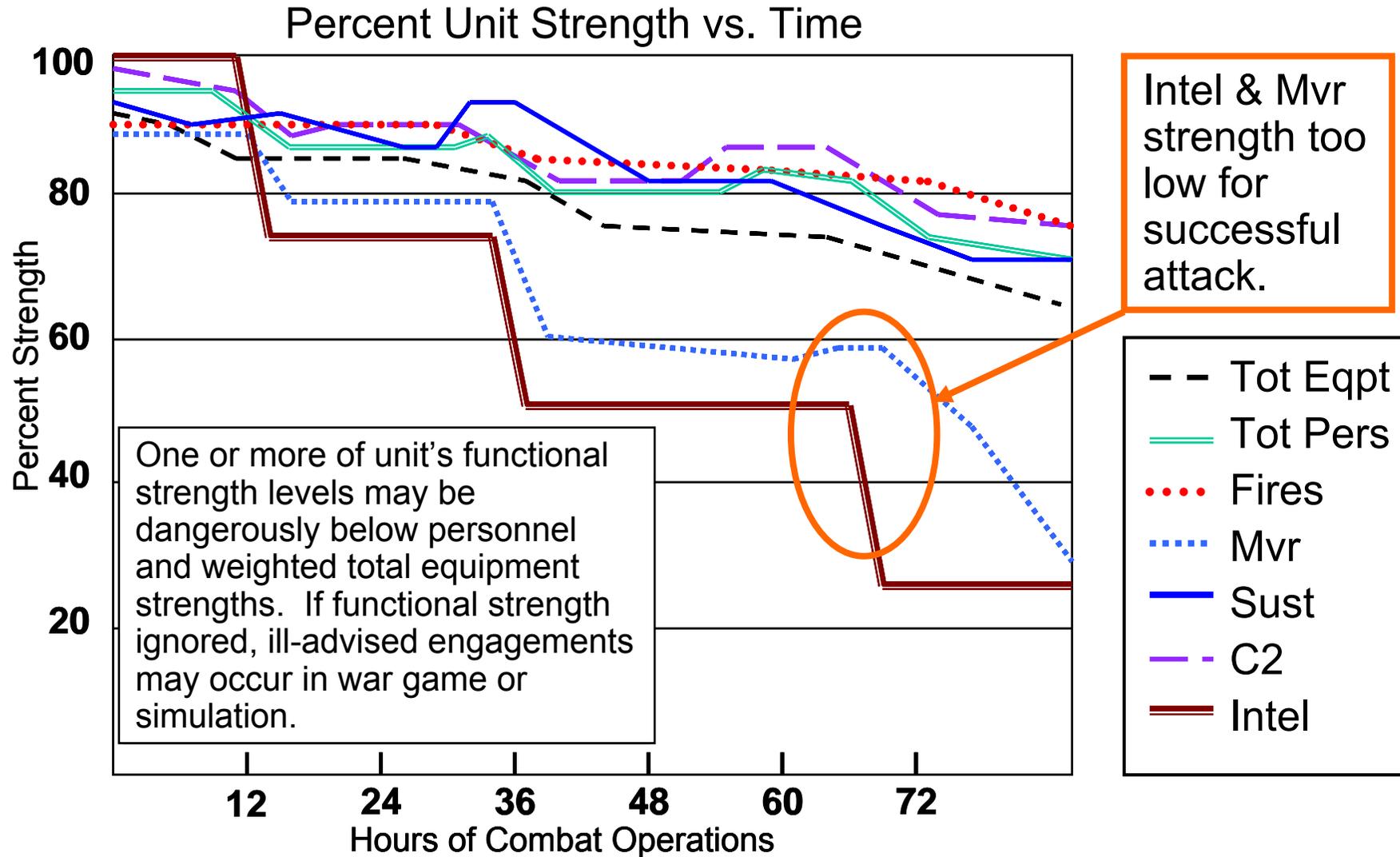
system value = combat power value (or firepower score).

The Success Story

- **Analysis that used combat power values and unit combat power assessments successfully informed decisions regarding concepts, organizations, and equipment needed to win on a traditional battlefield.**
 - **Concepts:**
 - Airland Battle.
 - Deep attack and “Deep Fires”.
 - Multiple, simultaneous engagements using combined arms.
 - **Organizations:**
 - Division Restructure.
 - Force XXI.
 - Modular Force.
 - **Equipment:**
 - Army “Big Five”.
 - Deep attack rockets and missiles (Multiple Launch Rocket System and Army Tactical Missile System).
 - Stryker Combat Vehicles.

The Challenge of Ignoring Functional Capability

Example



Problem

- **Problem:** With the challenges of irregular warfare, stability operations, and weapons of mass destruction, and the advent of new military systems that are multi-functional and network-enabled, what is an appropriate approach to determining unit strength value?

Is unit combat power still the best way to examine capability to accomplish a given military mission?

Research Approach

- **Conduct literature review to determine basis for, and strengths and limitations of, previous and current strength value methods.**
- **Modify methods or create new options that address or transcend limitations of previous methods.**
- **Compare advantages and disadvantages of the methods.**
- **Recommend a method.**

Goals:

- **Reduce subjectivity of input data**
- **Help war gamer (or the simulation) make more realistic decisions.**

Constraints and Limitations

- **Constraints.**
 - **Values for unit strength and functional capability must :**
 - Be on a common scale for both friendly and enemy forces.
 - Be understood by the war fighter and war gamer and perceived as “reasonable and realistic”.
 - Account for differences in training or readiness (“regulars”, militias, home guard).
 - **Method must allow both “perceived” and “ground truth” assessments.**
 - **Method must account for more than just kinetic capability.**
- **Limitations.**
 - **Research did not address intangibles such as:**
 - Variances in human leadership, courage, and skills application.
 - Luck or divine intervention.
 - **Strength value is a static measure for a given situation, may not appropriately indicate a unit’s capability in a radically different situation (drastic changes in rules of engagement or disruptive technological breakthroughs).**
 - **Strength value may not be appropriate for use in aggregated force-on-force models that use a force ratio to determine victory or defeat.**

Assumptions

- **Assumptions.**
 - **Current and future war games and combat simulations will continue to use some strength value to inform gamer decisions, assist automated decision-making processes, and/or adjudicate outcomes.**
 - **Military systems/units can be properly associated with one or more specific joint functions.**

Literature Review

- **Variety of methods, each with strengths and limitations.**
 - **Strength based on percent remaining of “pacing items”.**
 - Supports good unit decisions, difficult to aggregate to higher units.
 - **Unit readiness based on Unit Status Report or Global Status of Resources and Training System (GSORTS) methodology.**
 - Measures troop strength and training, equipment availability and maintenance, but not effectiveness relative to opposing force.
 - **Red-Amber-Green**
 - Subjective evaluation but still based on some strength value.
 - **“School house” unclassified unit and system combat power weights.**
 - Adequate for teaching/training but not for combat development.
 - **COFM and WEI/WUV, and TASCFORM variations.**
 - Measure lethality, survivability, and mobility with subjective input.
 - Were appropriate for “Cold War” and “Arms Race” assessments.
 - **Anti-potential Potential and related formulations.**
 - Relies on assessment of system vs. system attrition rate but is very situation dependent.
- **Each method has some utility in “real world” to inform:**
 - **Force allocation and operational course of action decisions.**
 - **Force structure and acquisition decisions.**

Options Proposed for Consideration

- **Option 1 - Improve method for developing firepower scores and strength values.**
 - **Use dynamic calculation based on simulation results.**
 - and/or**
 - **Introduce additional factors for assessing functionally- specialized systems or multi-function systems.**
- **Option 2 – Use a new combination method.**
 - **Use a unit readiness approach, combined with**
 - **Joint function capability assessment with designation of “pacing” items. ***

* Pacing” items:

- Key to unit’s overall combat strength.
- Central to unit’s ability to perform its doctrinal mission.
- May vary as function of unit type.
- Typically no more than 4 “pacing” items for a unit.

Consideration of Option 1

- **Option 1 - Improve method for developing firepower scores and strength values.**

- **Dynamic calculation**

- **Pro:** Accounts for multiple factors and complexity of combat.
- **Con:**
 - Requires many simulation runs (time and resources),
 - Difficult to access run library for appropriate value, and
 - Emphasizes kinetic over non-kinetic effects.

and/or

- **Add factors for calculation for each joint function and recalculate a new score or value for each system.**

- **Pro:** Accounts for functional capability.
- **Con:**
 - Increased requirement for judgment regarding functional capability.
 - Difficulty of determining appropriate metric for comparable functional value across different systems supporting a function.

Consideration of Option 2 (1 of 2)

- **Option 2 – Combination method “Unit Readiness” component.**
 - **Pro:**
 - Used and understood by warfighters.
 - Accounts for personnel status.
 - Accounts for differences in training levels of friendly and threat “regulars”, militia, and insurgents.
 - Determines unit’s strength based on lowest value among personnel, equipment, or training.
 - Reduces subjectivity of system weighting and firepower scores.
 - **Con:**
 - Requires assessing unit training level (judged to be somewhat subjective).
 - Requires more comprehensive “decision rules”.
 - Does not directly measure unit effectiveness relative to opposing force.

Consideration of Option 2 (2 of 2)

- **Option 2 – Combination method “Joint function” component.**

- **Pro:**

- Army already uses “pacing” items in Unit Readiness.
 - Can be linked easily to Unit Readiness approach.
 - Can apply perception or ambiguity to strengths.
 - Outcome is a function of dependency of mission accomplishment on functional capability versus comparison of metrics.

- **Con:**

- Requires classification of system by contribution to joint function.
 - Requires designation of “pacing” item(s) for one or more joint functions.
 - Requires more thoughtful “decision rules” (leadership).

Recommended Method

- **New combined method – Unit readiness combined with assessment of joint functions using “pacing” items.**

- **Unit readiness accounts for:**

- Personnel strength as percent of authorized strength.
- System strength as percent of authorized system strength.
- System availability (accounts for maintenance and combat damage).
- Training level (accounts for differences in application of systems and unit tactics).
- The lowest value drives the overall unit strength.

- **Joint function assessment with “pacing” items enables:**

- Consideration of combat enablers,
- Application in areas of stability operations, irregular warfare, and weapons of mass destruction scenarios.

The Proposed Formula

General formulation of new method for decision-making:

Given blue unit of type T_{Blue} in mission status M and environment S , decision whether or not to execute the k^{th} set of n_k actions $A_k = \{a_1, \dots, a_{n_k}\}$, where $k \in [1, p]$ and where m red units are within a specified distance D from blue unit is based on criteria expressed as:

If $Min\{P_{Blue}, E_{Blue}\} \geq X_1(T_{Blue}, a_1, \dots, a_{n_k})$ and $w_i(T_{Blue}) \geq W_i(T_{Blue}, a_1, \dots, a_{n_k}), \forall i \in [1, 6]$ and $Min\{P_{j Red}, E_{j Red}\} \leq X_{2j}(T_{j Red}), \forall j \in [1, \dots, m]$

Then execute actions A_k . Else if $k \neq p$, check decision criteria for A_{k+1} .

Where P = Percent personnel remaining,

E = Percent equipment remaining,

X_1 = Threshold variable,

w_i = Level of the i^{th} Function for blue unit type T_{Blue} based on count of pacing items,

W_i = Threshold variable for the i^{th} Function,

X_2 = Threshold variable,

$T_{j Red}$ = Type of the j^{th} red unit.

Summary

- **New method reduces subjectivity of system weighting and firepower factors.**
- **It uses commonly understood Unit Readiness and “pacing” item techniques.**
- **Considers importance of joint functions.**
- **Enables improved representation of unit’s capabilities for stability operations, irregular warfare, and weapons of mass destruction situations.**
- **Moves toward fulfilling potential of new models and simulations that are communications-enabled, perception-driven, and commander-focused, such as Advanced Warfighting Simulation.**

This method enables models, simulations and war games to more faithfully represent a commander’s multi-dimensional decision-making process.

Questions?

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