



Simulating 21st Century Dismounted Combatant Operations

Presented by

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Outline



✓ Background

- Where we've been
- Where we need to go

✓ A vision for Modeling & Analysis

✓ Facts of life

✓ It's about analysis, not modeling

✓ The challenges

- What's required, and what constitutes success?

✓ Where we are

✓ Gazing into the crystal ball

✓ The way forward

✓ Summary





Where We've Been



- ✓ During the Vietnam Era, an individual combatant was a “Christmas Tree” on which items were hung
- ✓ Models and analyses were focused on a stove-piped “Eaches” approach, with separate and independent models for
 - Ballistic effects
 - Chemical effects
 - High level, force-on-force battles





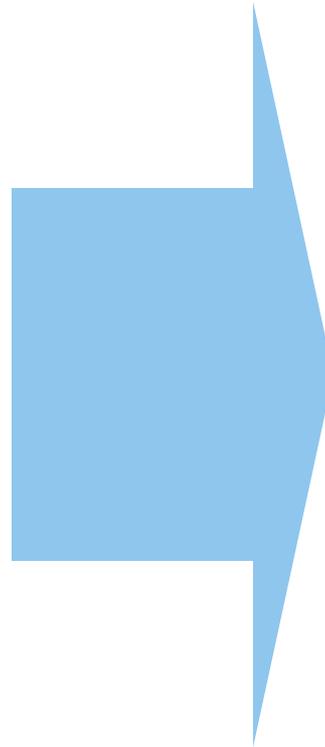
Where We Need To Go



Paradigm Shift



... Christmas Tree 



... Integrated Human-Centric System



Modeling & Analysis



A Vision

Provide the decision maker with what he needs, when he needs it by developing and exercising the models and tools to perform the required critical analyses throughout the acquisition life cycle.

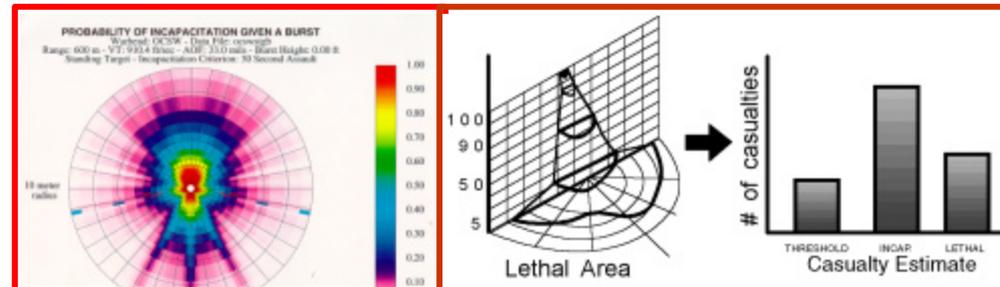
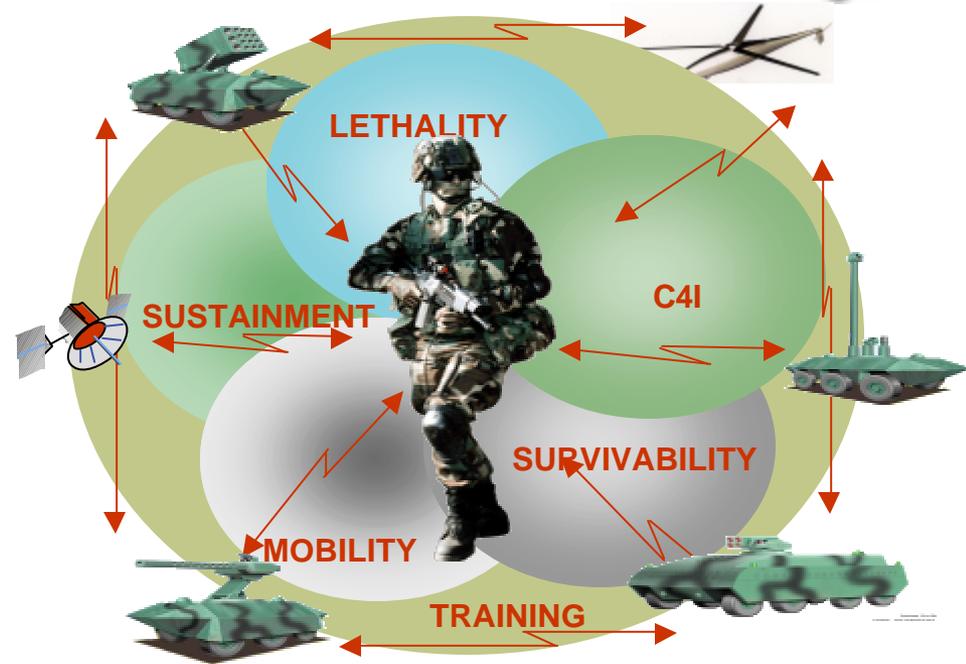




Facts of Life



- ✓ We cannot afford to test everything
- ✓ The best method to assess combat effectiveness requires a hierarchy of models combined and supplemented with live data using real people
- ✓ System effectiveness across all anticipated missions can be assessed only through simulation



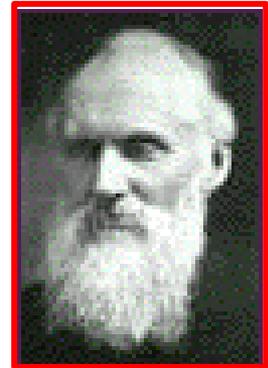


More Facts Of Life



“When you can measure what you are speaking about, when you can express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind . . . scarcely advanced to the stage of science.”

William Thomsen, Lord Kelvin, 1804-1907



“If I had time ... to study, I think I should concentrate almost entirely on the “actualities of war”, the effect of tiredness, hunger, fear, lack of sleep, weather ... It is the actualities that make war so complicated and so difficult, and are usually neglected by historians.”

Field Marshall Archibald Wavell, 1883-1950

Author of ‘Soldiers and Soldiering’





And Still More

Almost Everything But War Is Simulation

**Virtual
(Apparently Real)**

**Training &
Educational
Community**

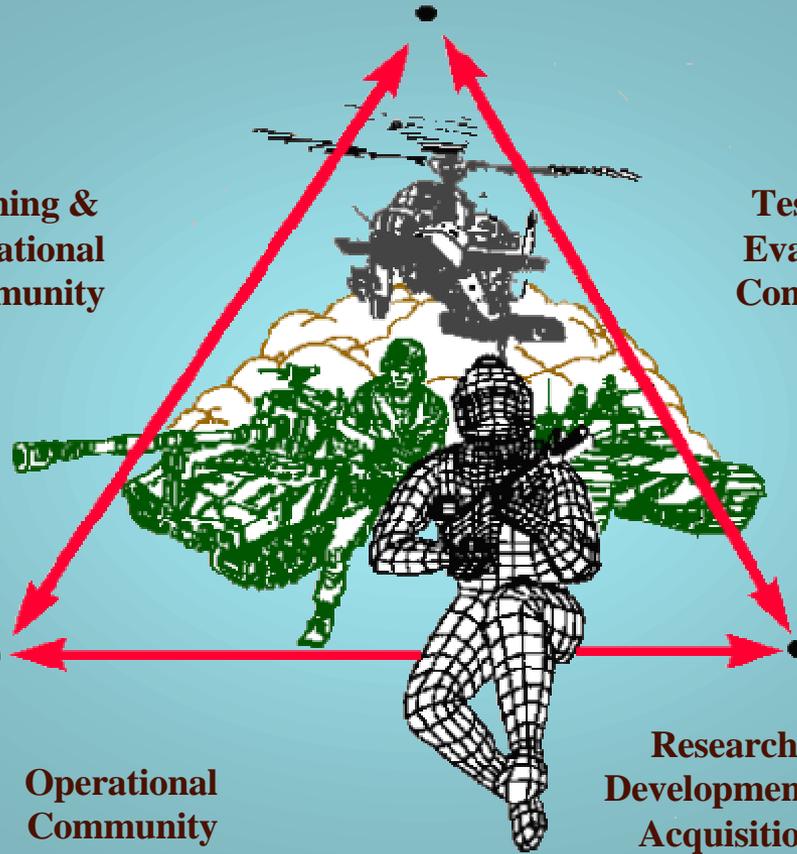
**Testing &
Evaluation
Community**

**Subsistent
(Real, Live)**

**Constructive
(Combat Model)**

**Operational
Community**

**Research,
Development &
Acquisition
Community**





Operations Analysis, Not Modeling, Is The Key

So, what exactly is the problem?

Operations analyses, supported by modeling and simulation (exercises, training, operations, planning) provide the only peacetime capability to develop requirements, explore doctrine, and assess warrior systems' performance -- examining the full range of battlefield operations and hazards.





Across The Domains...



Models Must Be Complementary

- ✓ Advanced Concepts and Requirements (ACR): Includes combat development, doctrine development, experimentation, and requirements generation.
- ✓ Research, Development, and Acquisition (RDA): This domain includes: test and evaluation, training development, materiel development, and research and development technology base.
- ✓ Training, Exercises, and Military Operations (TEMO): Includes most forms of training at all echelons from individual trainers through collective, combined arms, combined and joint exercises. Includes rehearsals for plans and operations and evaluations of completed missions.



Guiding Principles



Customers' decision-making requirements must drive all planned efforts

CUSTOMERS' NEEDS

REQUIRED ANALYSES

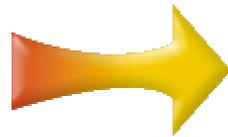
Responsive to Customer Needs

**METHODOLOGY INFRASTRUCTURE:
TOOLS AND DATA**

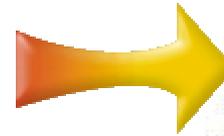
Critical core capability



Simulation Based Acquisition Challenges



-VS- Reality



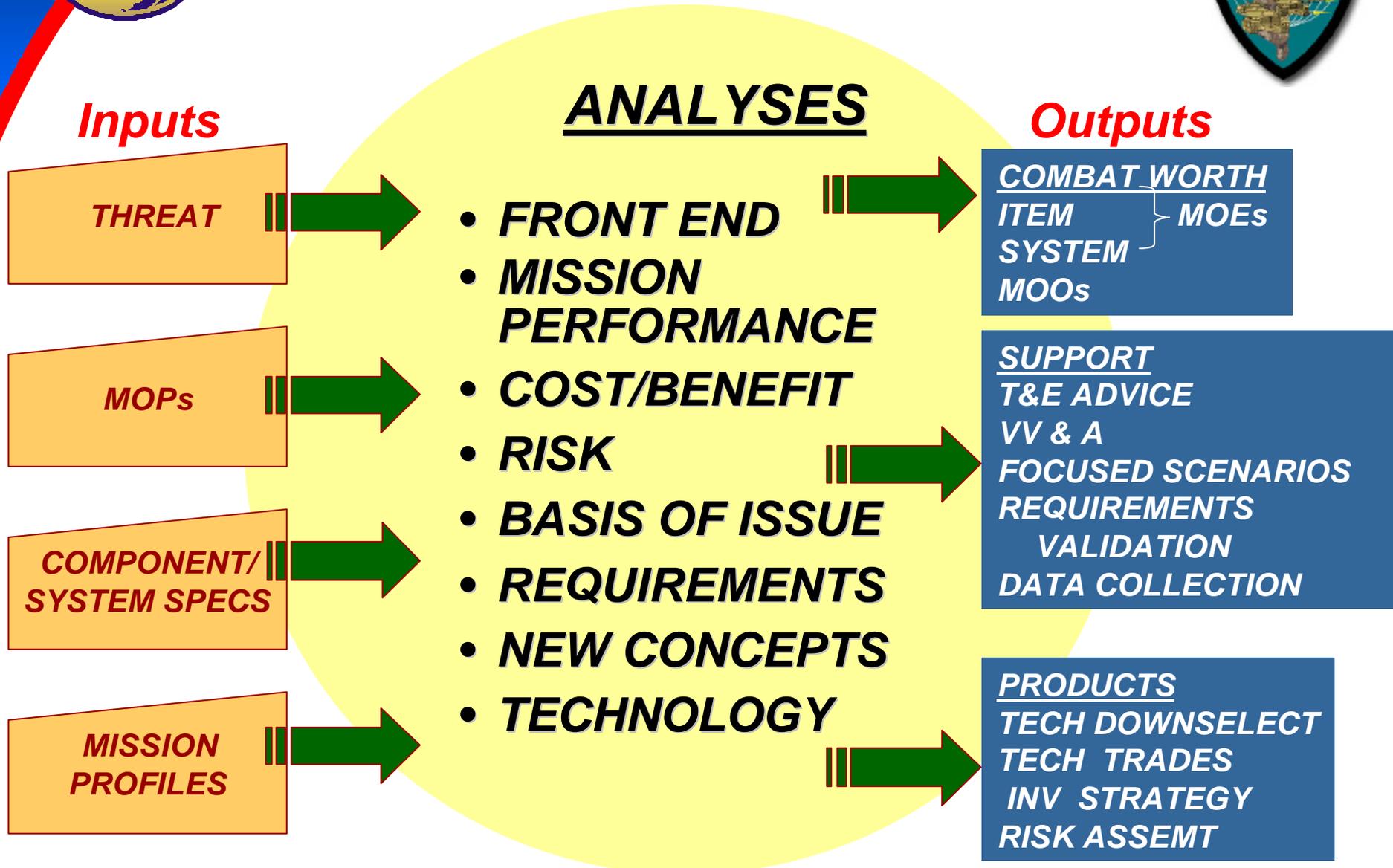
Customer's Taste

Analyst's Budget

- ✓ **Recognize that the complete M&S solution will not be accomplished**
- ✓ **Prioritize and work critical parts to provide answers**
- ✓ **Maintain validated data repository for future upgrades/soldier systems**



What's Required





How Do We Define Success?

✓ Measure Of Outcome (MOO)

- Define How Operational Requirements Contribute To End Results At Higher Levels
- A Binary Measure, Was the Mission A Success - Yes Or No
- Modeling Should Correctly Predict Mission Outcome

✓ Measure Of Effectiveness (MOE)

- Compares Effectiveness Of Alternatives In Meeting An Operational Objective Or Need (DA PAM 5-11)

✓ Measure Of Performance (MOP)

- Defined Metric Of A Component Which Contributes To Basic System Effectiveness As Described By An MOE (DA PAM 5-11)
- Quantifiable Measures Of How Well Mission Tasks Are Accomplished
- Examples Include Detection Range, Number Of Rounds Expended

RESOLUTION

FUNCTIONS SUPPORTED

MODELS & SIMULATIONS

T&E MEASURES

FORCE OR SYSTEM LEVEL

Increasing Aggregation

Comparative Results

$$\frac{dx}{dt} = -ay$$

$$\frac{dy}{dt} = -bxy$$



Actual Performance

Increasing Resolution

Operational Requirements
TTPs
Mission Planning

Theater/
Campaign

(Force Package)
Mission/Battle

(Many-on-Many)

Engagement

(One-on-One)

(System)

Engineering

(Subsystem/Component)

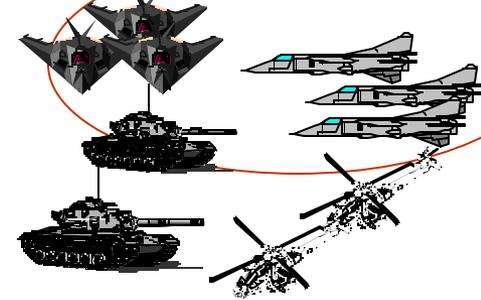
MOOs

MOEs

MOPs

Data Elements

Joint/Combined Forces



Company
Platoon
Squad
Fire team



Individual
Combatant



Weapon System



M-16



Integrated
Sight

Modeling & Simulation Hierarchy



Where We Are



State of the Art for Dismounted Combatant Analysis

Survivability	Lethality	Mobility	Command & Control	Sustainability
Pk/Ph Vulnerability to projectiles/ fragments Thermal stress Chemical agents Simple barriers Statistical use of open field terrain cover / concealment	Pk/Ph, Pdet, Pacq Direct/Indirect fire Independent error budgets Simple suppression Pre-set or HITL target selection	Terrain/load dependent movement rates Perfect navigation Pre-set or HITL route/speed adjustments MOUT movement formations/rules	Perfect communications Perfect Situation Awareness HITL decisions based on perfect knowledge HITL decisions	Expenditure of consumable resources Limited re-supply Estimation of metabolic workload Macro-nutrient physiology and energy balance
Incremental addition of ballistic protection Non-lethal weapon effects Blunt trauma	Improved target acquisition process Integrated error budgets Stressor effects on error budgets	Terrain dependent movement Intra-building movement	Imperfect & incomplete knowledge IFF Combat ID Simple rule-based situation awareness	Limited fatigue Dynamic redistribution of unit resources
Dynamic, protection/operability tradeoffs Dynamic terrain interaction Task dependent incapacitation Integrated Insights	Suppression as a function of situation awareness Realistic close combat in MOUT and the open field	Dynamic human response to terrain: - Route selection - Cover and concealment - Optimal use of "Position"	Situation Awareness as dynamic contingency response (pattern recognition/integrated factors)	Soldier load item utility-based optimization Integrated effects of fatigue on performance

Key: Current Capability 1-2 Years 2-5 Years

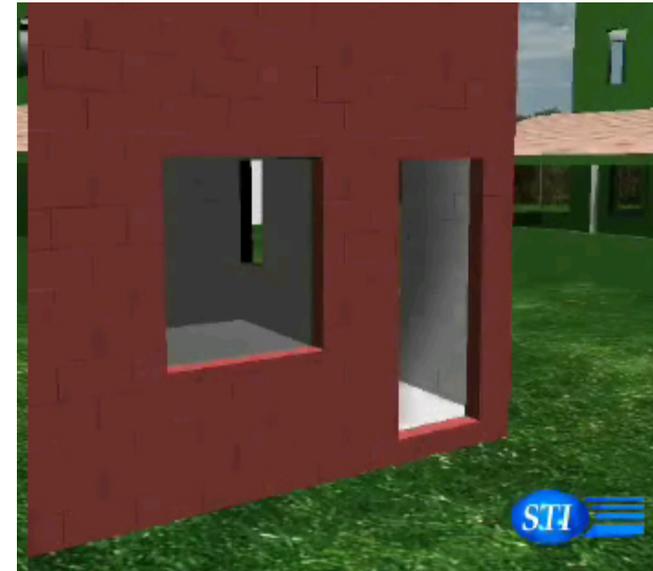


My Crystal Ball Indicates:



- **Next-generation models must**
 - **better represent dismounted combatant behaviors**
 - **include non-combat actions, e.g. peace keeping & humanitarian roles**
 - **consider maneuver and attrition warfare**
 - **become platform independent**
 - **embrace modular, plug & play capabilities**

Proper behavior?



- **Terrain format issues must be resolved**
 - **SEDRIS (Synthetic Environment Data Representation & Interchange Specification) objectives must be met**



The Way Forward:

Cooperation, Collaboration and Leveraging Are The Keys

The significant advances in computer simulation and software technology primarily will be driven by the:

- **movie industry**
- **computer gaming industry**
- **the internet**

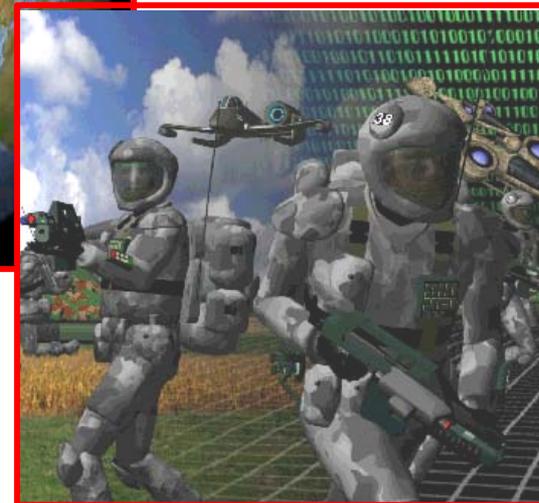




NATO & ABCA Nations Face Similar Challenges

Many of our allies also have embarked on the arduous soldier modernization journey and have adopted the soldier as a system philosophy. These include:

- ✓ Australia
- ✓ Belgium
- ✓ Canada
- ✓ France
- ✓ Germany
- ✓ Italy
- ✓ Netherlands
- ✓ New Zealand
- ✓ U.K.

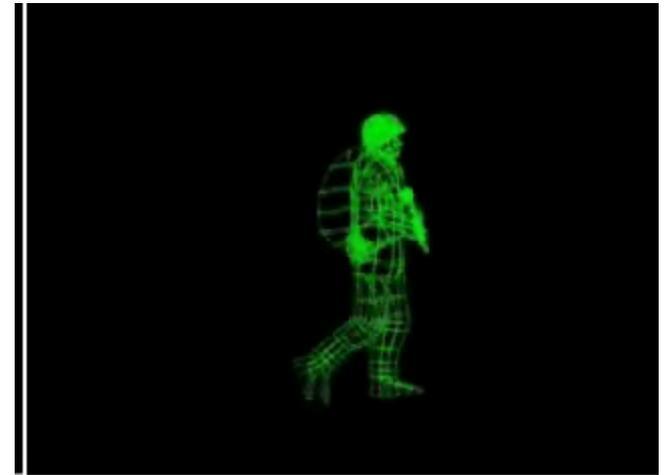




To Reach Our Destination We Must:



- **Team with the Combat Developer, the Technology Developers, PEO/PMs, model developers and testers across the domains.**
- **Develop a more seamless transition across the individual combatant M&S hierarchy.**
- **Cooperate, collaborate and leverage the commercial hardware & software developers/vendors.**
- **Apply comparative advantage with our international partners; there is no monopoly in individual combatant intellectual capital.**





The Bottom Line

Modeling & Analysis Benefits To Customers

Using the principles of Simulation and Modeling for Acquisition, Requirements, and Training (SMART) and Simulation-Based Acquisition (SBA), M&A will...

- ✓ Reduce Program **Costs**
- ✓ Reduce Program **Schedule**
- ✓ Reduce Program **Risk**





Summary



- ✓ **Modeling and Analysis of the Individual Warrior and his unit promises significant dividends to Warrior Systems Research, Development, and Acquisition.**
- ✓ **We have a tremendous amount of challenging work to do.**
- ✓ **If we do it well, the Individual Warrior is ultimate beneficiary.**
- ✓ **That's about as good as it gets!**

