MIT COMMUNICATIONS FORUM

(4)

"The 21st Century Land Warrior: Technical and Operational Issues"*

Colonel Arnold Canada, Dismounted Battlespace Battle Lab, Fort Benning, Georgia

6 April 1995
Building 54-100
Massachusetts Institute of Technology

Col. Canada: My talk today is on the 21st century land warrior, the future soldier in the U.S. Army. The Army Chief of Staff, General Sullivan, is taking a bold leap based on one premise: that we are going to power-project our army in the future. The U.S. Army during the Cold War was a totally different army than the army you see today and will see in the future. Our soldiers are much more capable then they were in the past. We are probably one of the best armies in the world today. We have technology overmatch. We made investments in technologies 15 years ago that paid off in the Gulf War: the M1 tank, the Bradley fighting vehicle, laser-guided munitions for the air force, and Cruise missiles.

But the problem now is that we as a nation are downsizing, which has a great impact on the Army. The Army faces the problem of modernizing and downsizing at the same time. Tomorrow's army will be smaller and more lethal. It will have global reach and force projection and will make use of new technologies. In 1983, 75% of the Army was based overseas. We were a forward deploy army. But by 1999, we will be a power projection army. 75% of the Army will be here in the United States and we will have to project ourself on global missions. This is a different way of doing business. The reason we were so successful in Europe was that we had established an infrastructure and a technology base which could support a large standing army. But today, we are a come-as-you-are army. If we go somewhere, we must take everything with us or rely on the infrastructure there.

How will the army change by the year 2000? As of August 1994, we had about 15,900 soldiers deployed abroad at any given time on U.N. peacekeeping missions. There were over 65,000 soldiers forward-stationed in Europe. We will keep a base of about 52,000 as our contribution to NATO. In the Pacific Rim, we had over 50,000 soldiers in August 1994. This may go down as well. The more than 3,000 soldiers stationed in Panama in 1994 will go away completely as of 1999 according to the Panama Canal treaty. Overall, our force structure is going down to 10 divisions, active component; 15 enhanced bigades in the reserve component; and eight Army National Guard divisions. If there are more cuts, we may have to reduce the number of active divisions even more. By 2000, the end strength active component, at 495,000 soldiers, will be the lowest since before 1939. The reserve component will go down to 575,000. Most of the units in the reserve component are combat support and combat service support units. In today's army, these units are called up to go on missions such as Somalia, because we no longer have the infrastructure in the active force abroad.We also face an infrastructure problem here in the United States. We are trying to take a 15% cut in infrastructure, which means closing bases. It is not possible to keep bases open and soldiers on the payroll, and still project a global army. There is only one dollar and it must go one way or the other. This is the dilemma we are in.

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* This is an edited summary, not a complete transcript of the speaker's remarks.

My business is impacted by this dilemma. My business is in a manual called Field Manual 100-5, which is the basic Bible of the U.S. Army. In that manual there is a term called Battlespace. Battlespace is a physical space where a commander operates: its dimensions are length, width, height and time. The elements of combat power which define the operations of the commander in Battlespace are: maneuver, firepower, protection, and leadership. Combat power works within four dimensions: time, tempo, depth, and syncronization. These dimensions apply both in war and in operations other than war. When we ran into the dilemma about how to keep down costs and still maintain technology overmatch against any threat, the previous commander of TRADOC, General Freddy Franks, changed the way we do business. In the old army in 1989, operational requirements came up through the channel of the U.S. Army TRADOC, Training Doctrine Command, which I am in. Material developers work together with industry and academia to develop the piece of equipment. General Franks did not like this process, however, because the field user requirements never really surfaced. So after the Gulf War, he formed something called Battle Labs, to work in dynamics minus Battlespace. This involves the field as a user; TRADOC as a user representative; academia; industry; and other agencies, in coming up with a cost-saving process that will still allow us to maintain technology overmatch. The Battle Labs take doctrinal concepts, ideas from the field, or technological ideas, and put them in either a field environment or in a study and analysis. Then we work the concepts in simulations. If we find a a good idea, we simultaneously work on the materiel, the doctrine, the training, how to integrate the equipment into the force structure, and how the leaders must use the new equipment to enhance their force fighting capability.

There are Battle Labs at a number of Army installations. Fort Benning has a Dismounted Battle Lab. Fort Knox has the Mounted Battle Lab which works on tanks, Bradleys and trucks, for example. Fort Sill focuses on depth and simultaneous attack. They work on theatre missile defense, missiles, deep strike capabilities, and precision strike capabilities. Fort Monroe has the Early Entry Battle Lab, which focuses on how to get an early entry force into a country. Fort Leavenworth is the Battle Command Battle Lab, which deals with communications technology. There are two subsets of that, the Intel Battle Lab at Fort Watchuca and the Signal Battle Lab at Fort Gordon. Those three together integrate command-control communications technology across the board. Fort Lee deals with combat service and support arena: how to transport and track the beans and bullets. The Battle Labs have the authority to deal with any group we think is necessary to come up with a solution for an army problem. For example, we do a lot of the work with the U.S. Department of Justice, the Drug Enforcement Agency, and the local police departments, because a lot of our equipment is dual-use equipment. It can also be used by soldiers, policemen, firemen and security guards in their jobs.

Every year we put out a broad agency announcement of the technologies and solutions we are looking for in the commerce business daily, where the government advertises for contracts. Anyone who has a proposal can send it in. If it is chosen, we fund their investigation, and we give the equipment to soldiers in real units who tell us whether the solution is right. Two major problems the Battle Labs are working on now are: 1) continuous operations, and 2) "owning the night". The second problem involves how to improve ambient light intensification but still reduce the weight and complexity of the systems being used. A third problem the Battle Labs are working on is weapons of mass destruction — biological, chemical and nuclear weapons. This involves coming up with solutions such as bio-detection for early entry forces, to negate the use of those weapons against them. In 1997 the Army will field the first bio-detection system to identify biological agents in the field. We are also trying to reduce the time it takes to get new technologies out into the field. The normal time frame of acquisition from the time a project is started in the Army to the day the equipment is put in the hands of the soldiers is eight years. But a special task force of the Army is breaking this acquisition paradigm in its work on a project to acquire the latest thermal technology for our armored vehicles. On this project the acquisition time frame has been reduced down to four years. Furthermore, the

technologies we develop are not used only in war. Technologies such as phototelesis and image-identification beacons have been used in the missions to Somalia and Haiti.

Historically, the paradigm of the U.S. Army has been massed formations of soldiers with limited dispersion, whose sensing was based on what could be seen with the naked eye. That technology has improved iteratively over time, but we are still basically at the same point we were at in 1865. While we have improved our weapons systems, we still use the same basic concept of ironsights that we did in the Civil War. We want to move beyond the old paradigm to a new paradigm based on fewer forces on the battlefield, more dispersion, and better communications, especially at night. Our idea is to start with a prototypical breadboard design, take it to the field and have soldiers use it under adverse conditions, and then iteratively work the design function to get it right. We want to make sure the design is user-friendly and acceptable to the soldier in the field.

The operational requirements that are key to the 21st century land warrior program we are working on are: increased but controlled dispersion, improved survivability, and complete situational awareness. First, let's consider dispersion. A squad leader in the Army controls nine men. In the past they were not spread beyond double the width of this auditorium. In the future, the squad leader will control those nine men from here to the Marriott (several blocks away). He will know exactly where each of those soldiers is from his computer heads-up display and be able to direct their movement and actions without even seeing them. Another operational requirement is overmatching lethality. This means a completely new weapons system that can range and employ itself intelligently to give the same ballistic solution that a tank has today, all within a small lightweight weapons system that can calculate wind data, temperature, overpressure, and humidity. Another requirement, probably the most important, is real time automated targeting. Today our soldiers' manuals specify two tasks: engage a target with direct fire at ranges up to 300 meters, and engage a target with indirect fire. These are two divergent solutions. In the future there will be one solution: engage the target. The soldier will have the capability of deciding how to do it. This change will lead to increased versatility, and to better endurance because the equipment will be built in such a way that the soldier does not have to carry as much weight. Our soldiers in Somalia carried 180 pounds on their backs. The approach or combat load is supposed to be 45 pounds. In Somalia it was 80. We have to get the weight down, so the soldier can do what I call "stop, drop and roll". Today we take a box with the capabilities a soldier needs and hang the equipment on him. We must get past this mode and make it easier for the soldier to function.

There are five main capabilities in the Army: lethality, survivability, sustainability, mobility and command and control. We will increase these capabilities, for example through an eight-pound piece of equipment that provides microclimatic conditioning of the soldier. For survivability, today we use a flak (protective) vest. This vest was designed to prevent shrapnel penetration. What we need to go to in the future is a bullet-proof vest. But to get proper protection of the vital organs, you need some sort of plate. The weight becomes prohibitive from a cost and a carrying perspective. To increase lethality, we want to use automated target detection. We must increase the probability of a target hit, which is .2 with the current systems of ironsights and an M-16. We are also working on a projectile and kinetic-energy bullet to increase the probability of target suppression. And we want to be able to use directional acoustics, replacing our current weapons with an acoustic weapon that incapacitates rather than kills, allowing us to gain intelligence or do other things.

To increase survivability, we need better combat identification. We have a solution in in the Air Force and Marine Corps for identifying a friendly helicopter, tank or Bradley, called millimeter wave. The problem is that the transponders we use are small, but the receivers are too big to fit on our soldiers. To increase survivability, we must also increase protection for soldiers. Soldiers engaged in mine detection need ballistic protection and they must be able to reduce their noise, electronic and thermal "signature." Other survivability improvements we want are medical monitoring; laser/dew protection; and bio-detection and micro-climatic conditioning, which I have talked about. To improve mobility, we must

increase speed and accuracy in navigation and increase situational awareness. We must enhance our long distance and nighttime communications ability. And we need imbedded training capability in case soldiers are tired or forget the steps they must go through.

The 21st century land warrior will be a digitized soldier. Working with industry, we have a government contract for about $250 million to develop a system for the next-generation soldier. The system will include visual devices such as a daylight camera and thermal weapon imagery. The heart of the system is a computer which has a 80-megabyte hard drive. Its menu includes a first aid quick-reference, and it has the ability to capture still-frame imagery. The system is powered by a standard radio battery and transmissions go out over a small hand-held radio. It can send pictures and a digitized report up to eight miles in under 60 seconds. The entire system weighs 26 pounds and the cost should end up being $50,000 to $80,000 per soldier. The computer component costs about $10,000 to $12,000. The costs must be weighed against the added lethality it provides for the soldier. In an experiment we will be conducting in November with the 10th Mountain Division, we will outfit 181 soldiers with the system to see how it works. Ultimately, in a brigade experiment in 1996, we will put 450 of these systems out there, equipping unit members from the scout to the cook to the truck driver with complete or partial systems.The simulations in the field will supplement the data collection in the lab, to help us determine what parts of the systems have a war-fighting payoff. We are looking for "golden nuggets", things that have a high return for the soldier on the battlefield and can be produced at a low cost.

The basic goals we have for the next-generation soldier system are: 1) improved command, control and communications via link to the digital network; 2) improved lethality in all environments; 3) weapons interface; 4) improved situation awareness; 5) modular multiple threat protection; 6) operationally compatible systems engineering; 7) small, lightweight and rugged components; 8) a producible system capable of continuous technology upgrade; and 9) affordability. Several groups are involved in developing the system. In addition to the Battle Labs, these include the Marine Corps Systems Command; the Marine Corps Combat Development Command; and the U.S. Army Special Operations Command. The industry team includes Motorola, the prime contractor; Hughes, Arthur D. Little, Honeywell, Battelle, and Gentex.

Perhaps the most complex problem we face is developing the integrated head system which provides all tactical and sensor information to the soldier. The question is how to get a system that does what we want it to do, but not have a weight distribution or neck problem. The soldier is going to wear it for 18 to 19 hours per day. The challenge is to miniaturize the equipment so it can be used by a soldier on the ground, a pilot, or a soldier in an armored vehicle. The weight goal is five pounds. The other program components are the computer/radio; the weapons interface system; the protective subsystem and the microclimate cooling subsystem. The supporting programs of the soldier system include: the objective individual combat weapon; integrated sight modules; image intensification devices; high resolution flat panel display system (although we may go with a see-through display); multi-purpose individual munitions; and combat identification.

Another big problem we have with the next-generation soldier system is battery-power supply. We cannot fly with lithium manganese dioxide conformer batteries because they are a serious hazard to aircraft. They must be taken out of the weapons and then reloaded upon arrival. We need a better battery technology that is more environmentally safe and more functionally adapted for what we want to do. To conclude, we are working on a number of problems in order to integrate and articulate how we want to build the soldier of the future. It all boils down to this: if we do not build it right, we will not be able to project decisive power in the 21st century.

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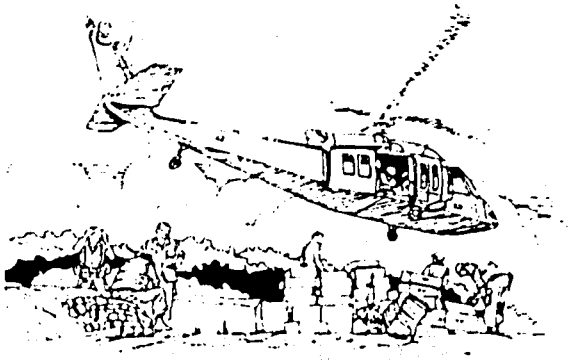
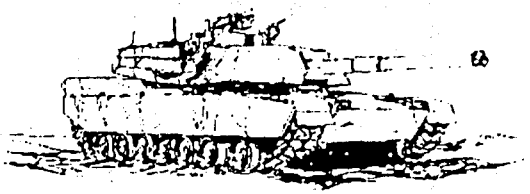
THE 21st CENTURY LAND WARRIOR: TECHNICAL AND OPERATIONAL ISSUES

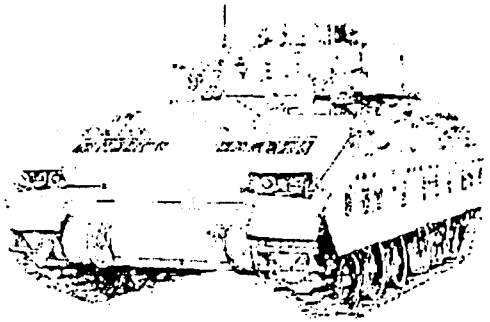
COL. ARNOLD CANADA

MIT COMMUNICATIONS FORUM, APRIL 6, 1995

PROJECTING DECISIVE POWER







MOVING FORWARD TO THE 21ST CENTURY

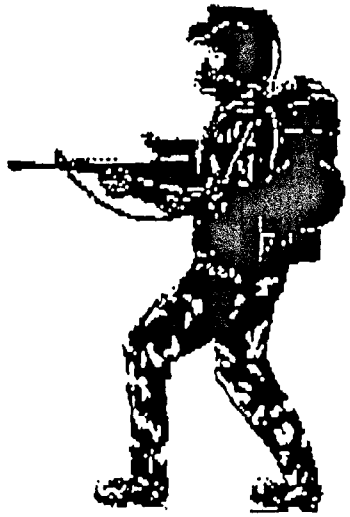
TODAY'S REALITY...

- WINNING ARMY... WORLD CLASS EXCELLENCE
- TECHNOLOGY OVERMATCH
- DOWNSIZING
- AUSTERE RESOURCE ENVIRONMENT

TOMORROW'S ARMY...

- SMALLER
- NEW TECHNOLOGIES
- MORE LETHAL
- GLOBAL REACH
- FORCE PROJECTION

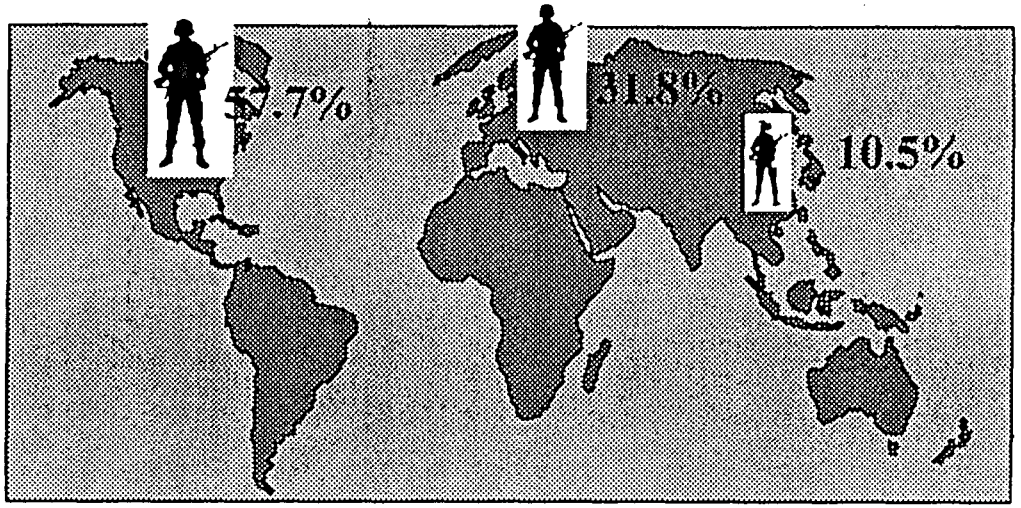
...RESPONDING TO THE NEEDS OF TOMORROW



THE NEW POWER PROJECTION ARMY

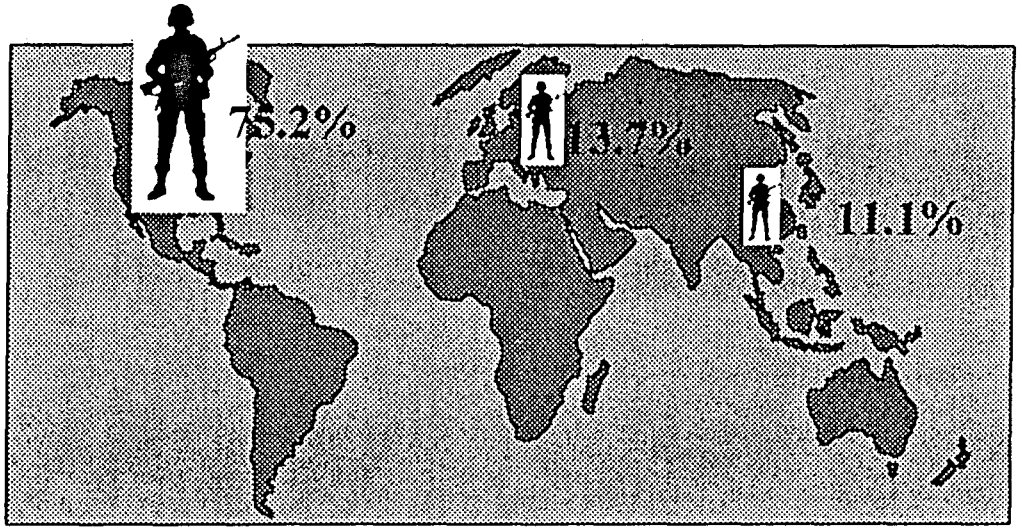
1989
FORWARD DEPLOY ARMY

Combat Division
AC 18/ARNG 10
End Strength
AC 770K/RC 776K
TOA $90.58



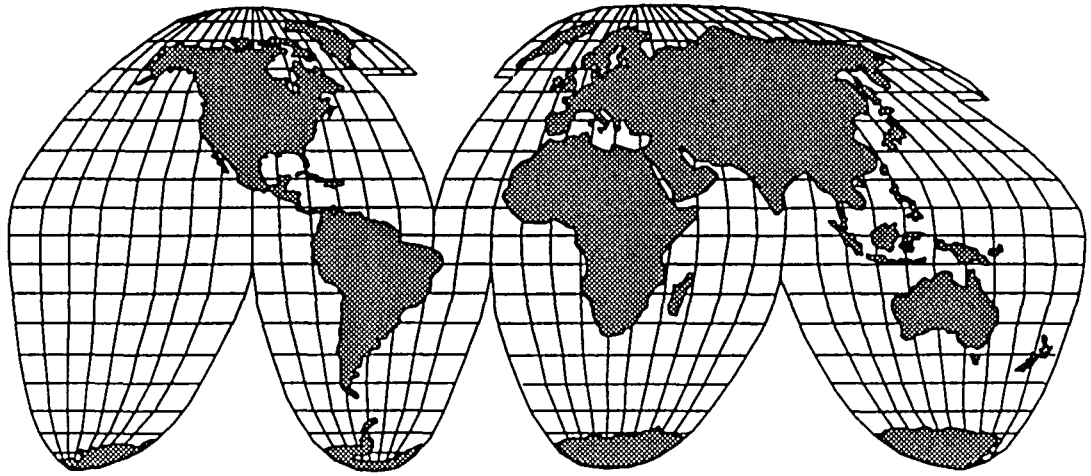
1999
POWER PROJECTION ARMY

Combat Divisions
AC 10/ARNG 8
End Strength
AC 495K/RC 575K
TOA $58.88



*CONUS BASED
*READY TO DEPLOY ANYWHERE IT IS NEEDED

THE ARMY TODAY
ENGAGED WORLDWIDE

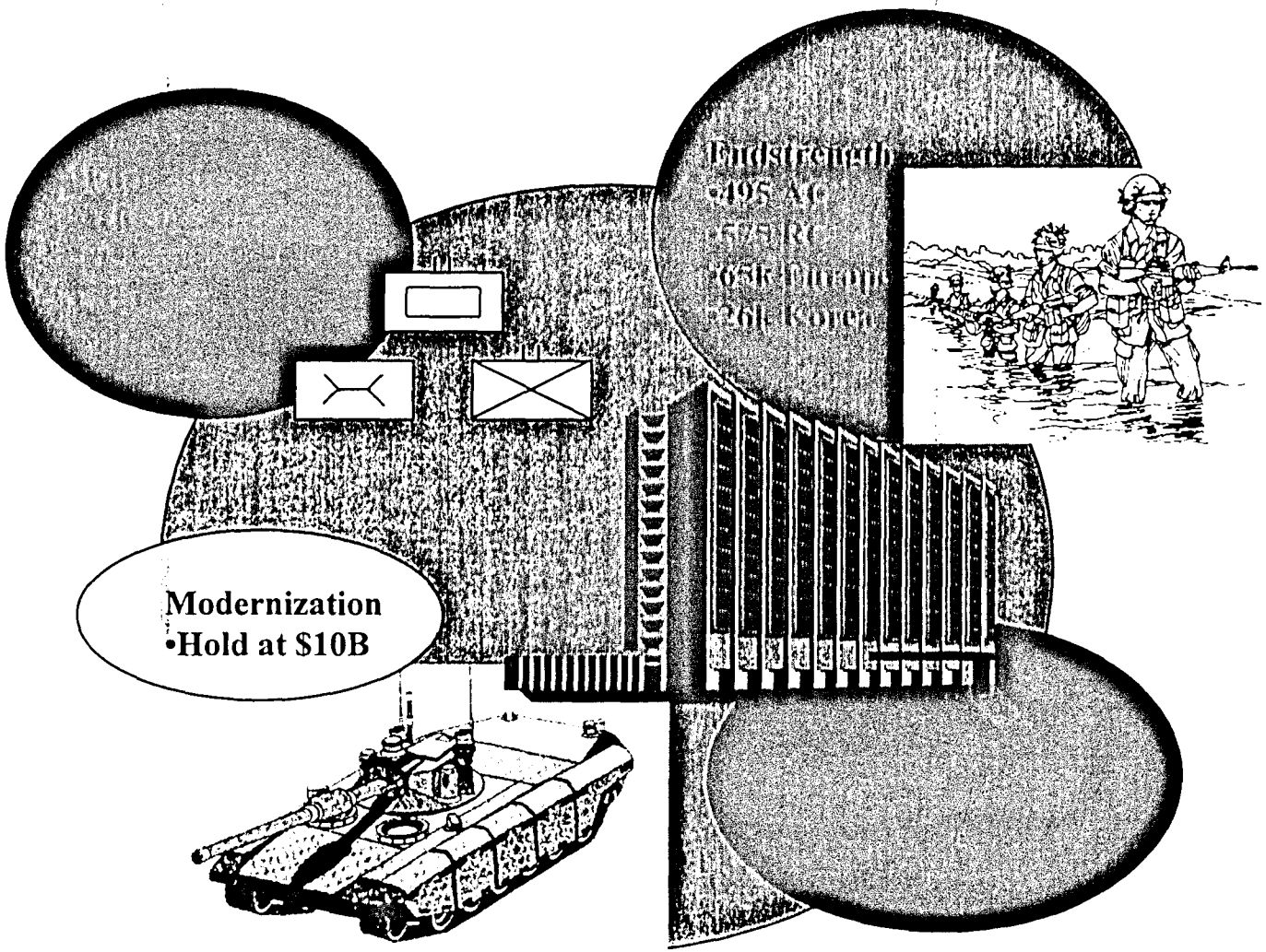


5 AUGUST 1994

PERSONNEL	TYPE	COUNTRIES
15,941	OPERATIONAL DEPLOYMENTS	105
65,000+	FORWARD STATIONED-EUROPE	5
50,000+	FORWARD STATIONED-PACIFIC	3
3,000+	FORWARD STATIONED-PANAMA	1
133,941		

43% of TOE Army is
Performing Overseas Presence Missions
RIGHT NOW!

AFFORDABILITY DILEMMA 96-01



FM 100-5 OPERATIONS "BATTLESPACE"

PHYSICAL SPACE
LENGTH X WIDTH X HEIGHT X TIME

- MANEUVER
- FIREPOWER
- PROTECTION
- LEADERSHIP

COMMANDER'S VISION

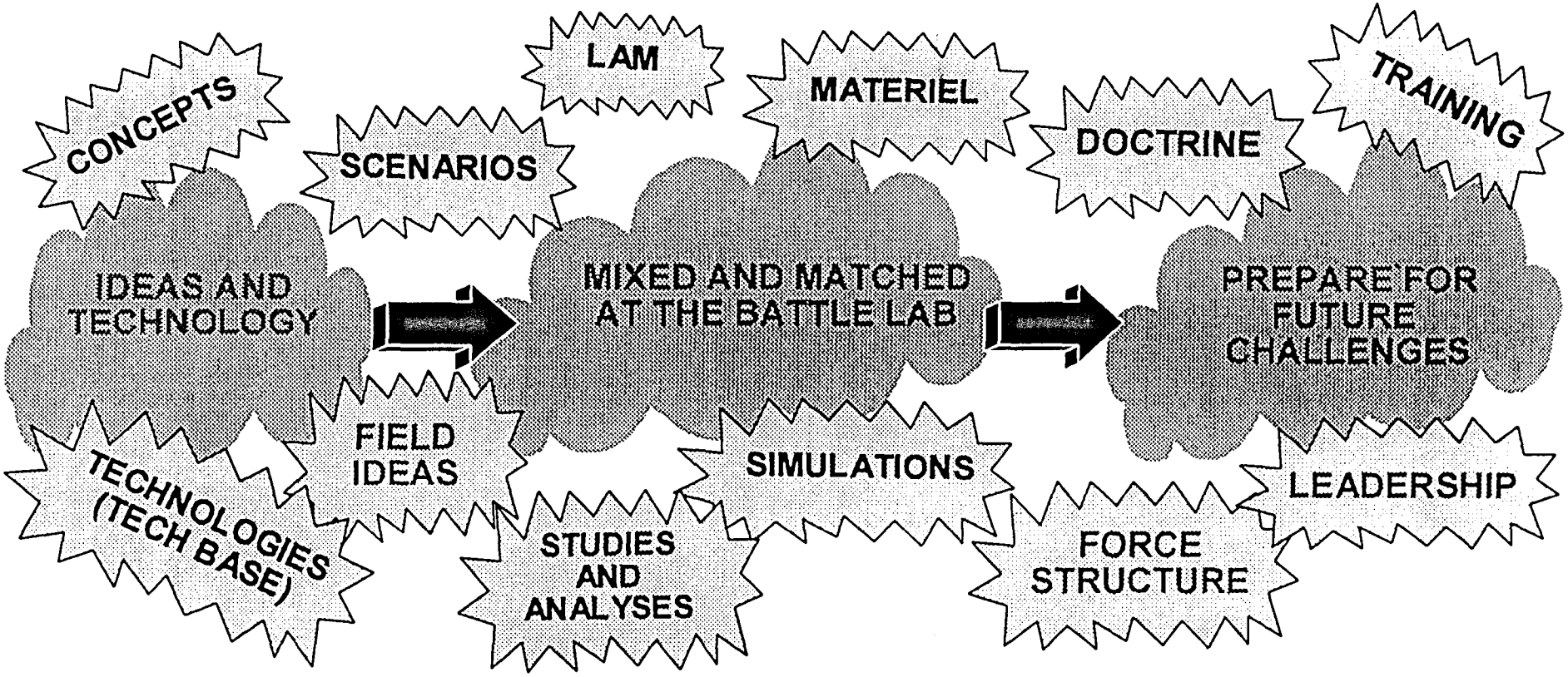
- TIME
- TEMPO
- DEPTH
- SYNCHRONIZATION

OPERATIONS OTHER THAN WAR

DECISIVE VICTORY & MINIMAL CASUALTIES

WAR

DISMOUNTED BATTLESPACE BATTLE LAB



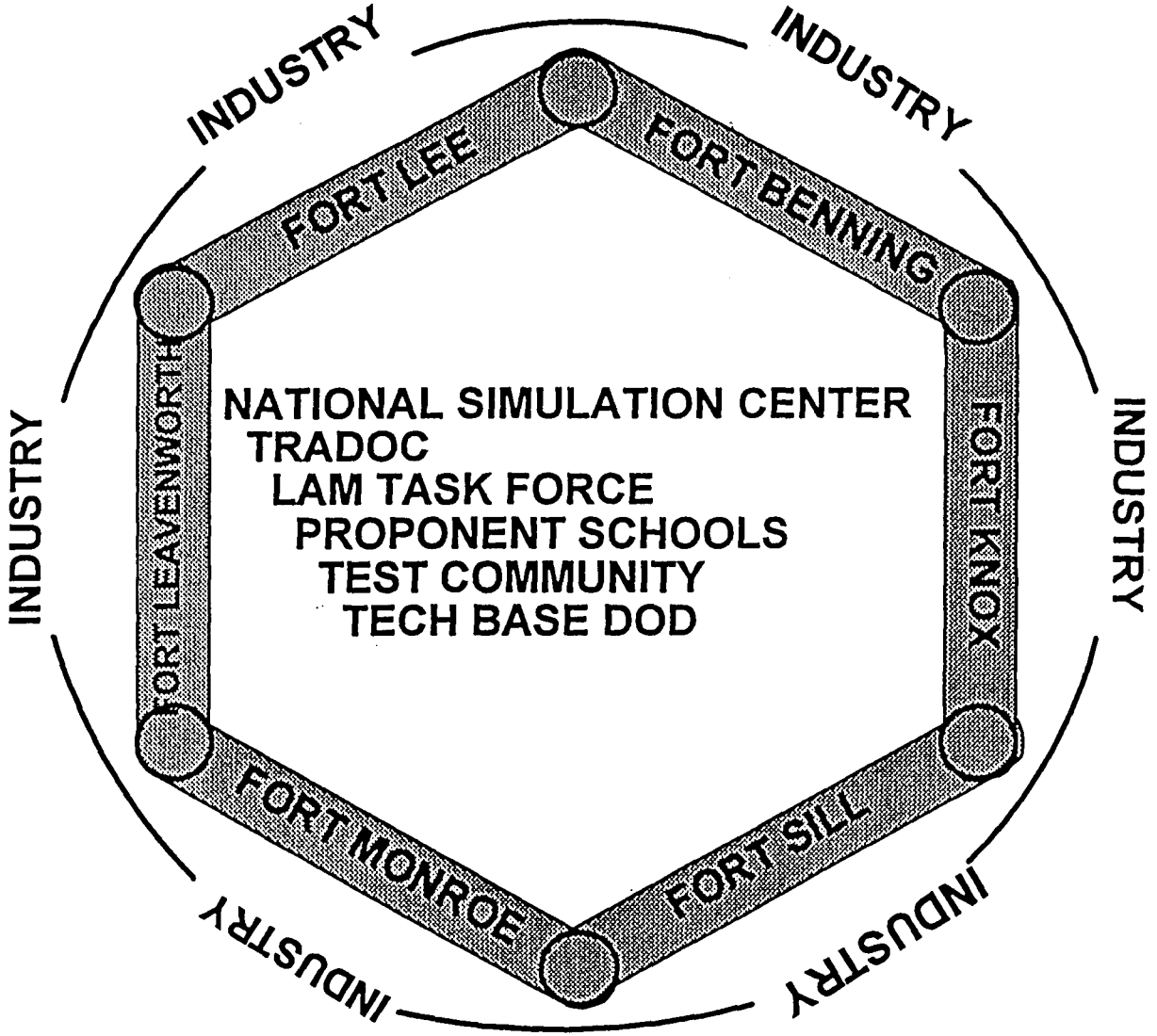
ONGOING PROGRAMS

- CONTINUOUS OPERATIONS
- DA STF 2D GEN FLIR
- OPERATIONS OTHER THAN WAR
  - NON-LETHAL TECH
  - OPN ABLE SENTRY
- OWN THE NIGHT

- SOLDIER COMBAT ID
- WEAPONS OF MASS DESTRUCTION
- RAPID FORCE PROJECTION INITIATIVE OSD/DA
- 21 CLW TOP LEVEL DEMO
- SENSOR TO SHOOTER LINKS
- BIO DETECTION
- SOLDIER LOAD/ SURVIVABILITY TECHNOLOGIES

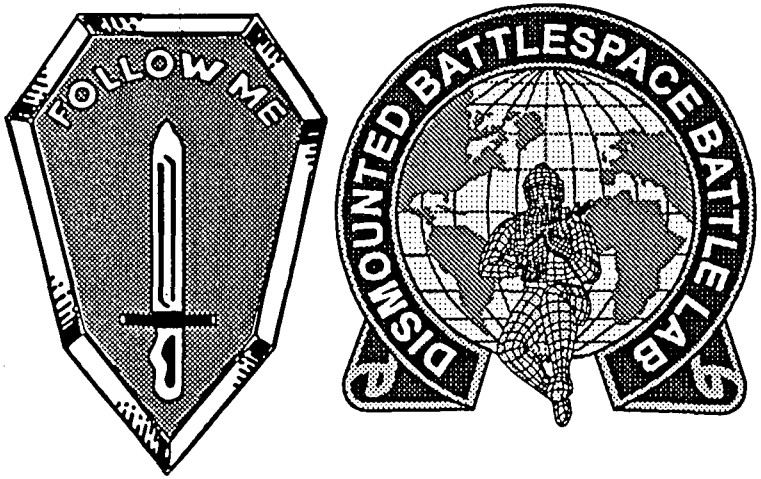
DISMOUNTED BATTLESPACE BATTLE LAB

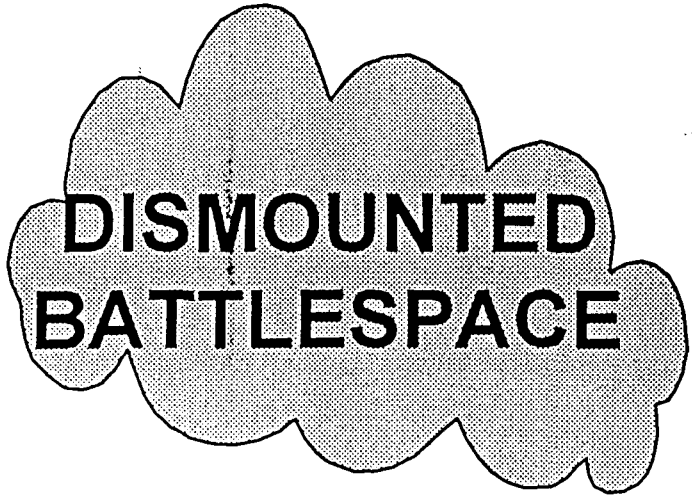
INSTITUTIONALIZE NEW RELATIONSHIPS



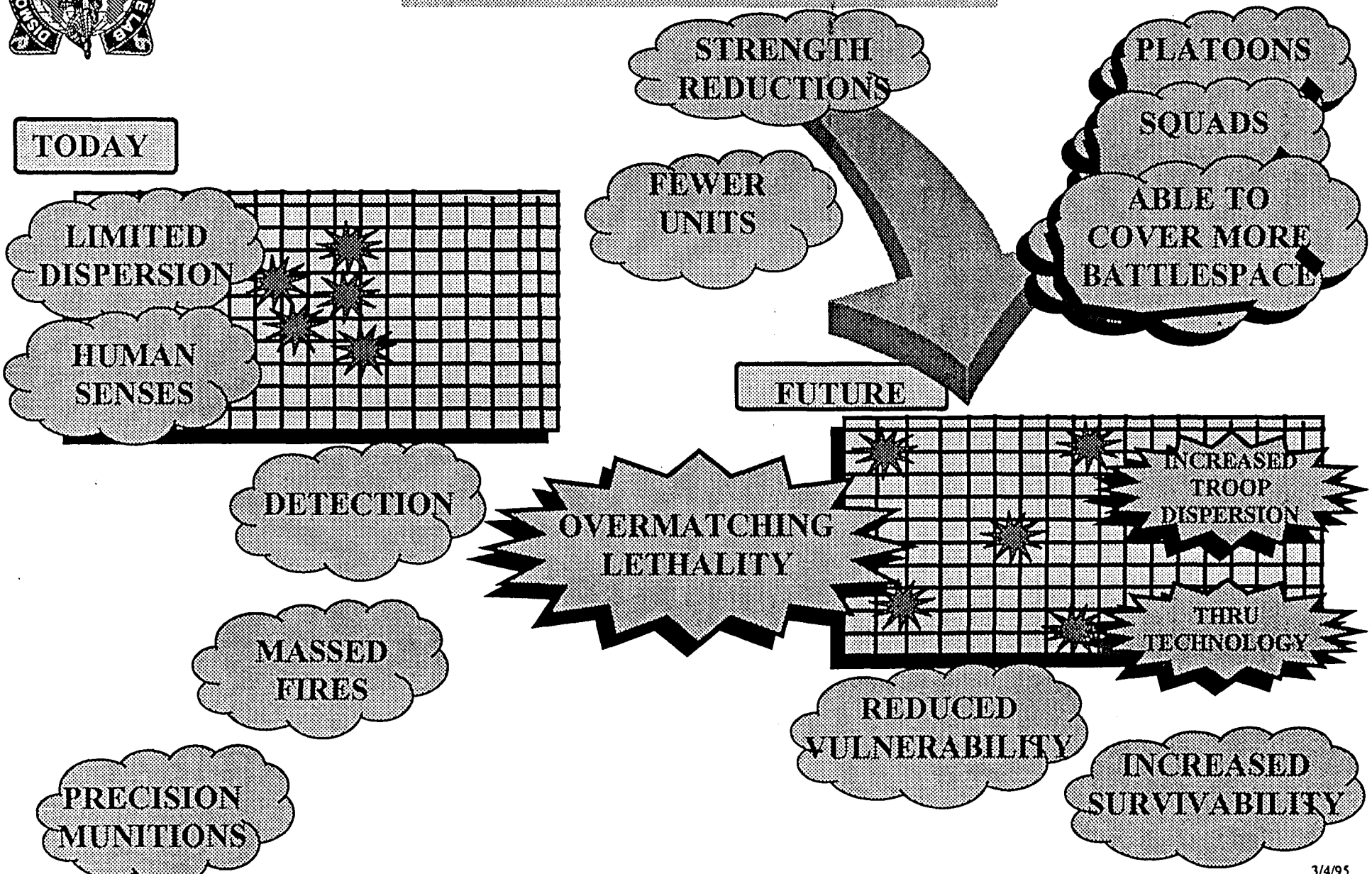
DISMOUNTED BATTLESPACE BATTLE LAB

UNIT AFFILIATION



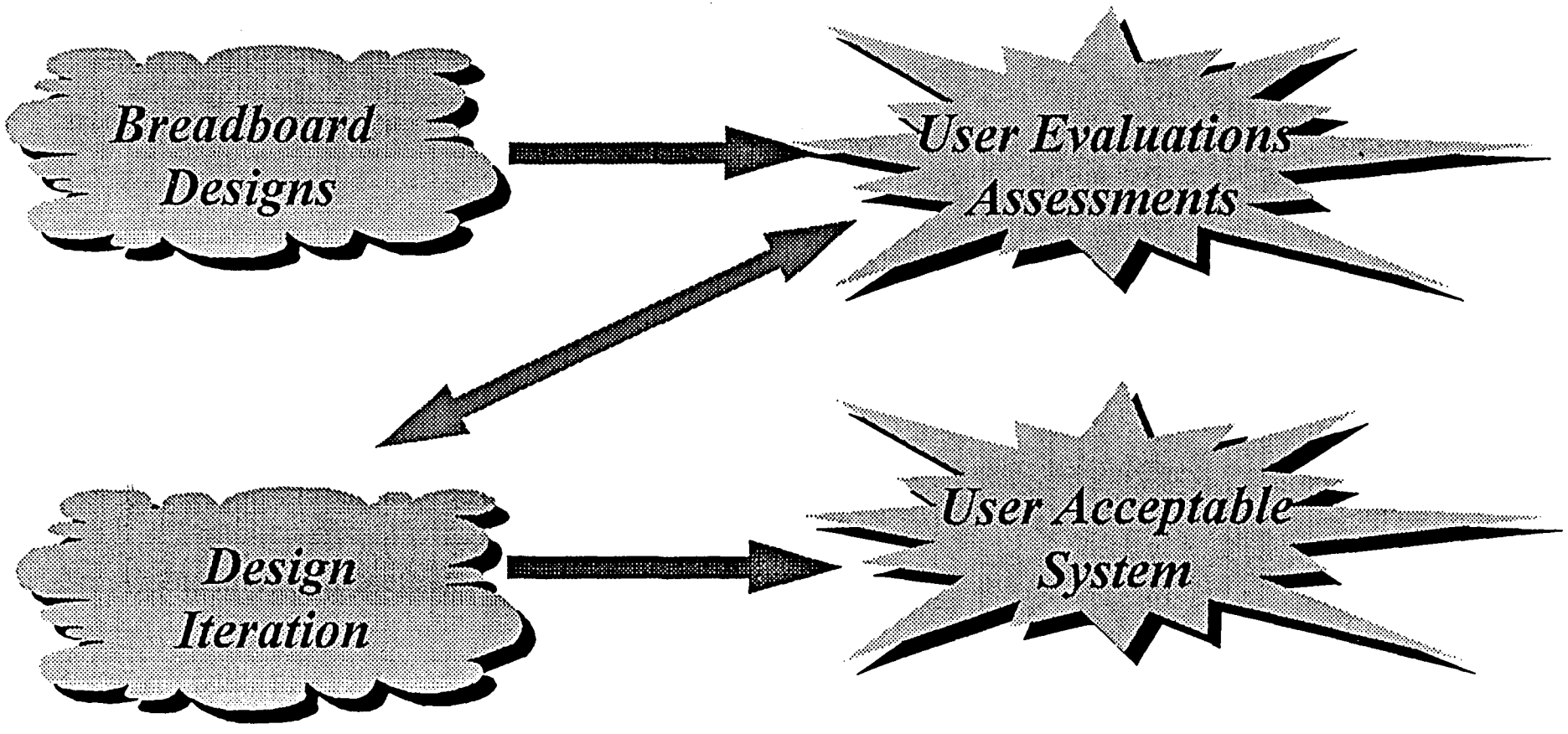


21st Century Land Warrior



3/4/95

Risk Mitigation Through Continuous User Involvement



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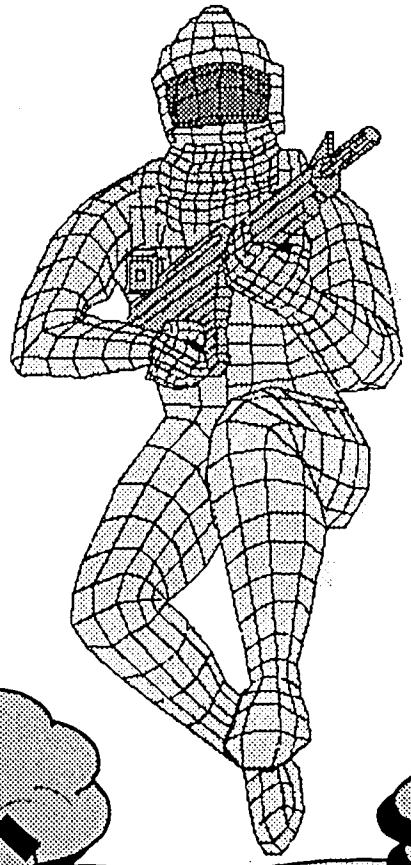
21st Century Land Warrior

The Cornerstone of Force Projection



INCREASED CONTROLLED DISPERSION

OVERMATCHING LETHALITY

REDUCED VULNERABILITY

REAL TIME AUTOMATED TARGETING

IMPROVED SURVIVABILITY

BETTER ENDURANCE

COMPLETE SITUATIONAL AWARENESS

INCREASED VERSATILITY

LINKAGE & INTEGRATION TO THE TOTAL FORCE

30/3/95

CAPABILITIES/GEN II SOLDIER

WEAPON INTERFACE SUBSYSTEM

COMMAND AND CONTROL

LETHALITY

INDIVIDUAL SOLDIERS COMPUTER/RADIO

INTEGRATED HEAD GEAR SUBSYSTEM

MOBILITY

SURVIVABILITY

MICROCLIMATE CONDITIONING SUBSYSTEM

SURVIVABILITY SUBSYSTEM

SUSTAINABILITY

30/3/95

LETHALITY

TARGET DETECTION AND IDENTIFICATION

INTEGRATED HEADGEAR SYSTEM

ENGAGED GONE-TO-GROUND TARGETS

AUTOMATED TARGET DATA TRANSFER

DIRECTIONAL ACOUSTICS

HIGH PROBABILITY OF TARGET HIT

WEAPON INTERFACE SUBSYSTEM

HIGH PROBABILITY OF TARGET SUPPRESSION

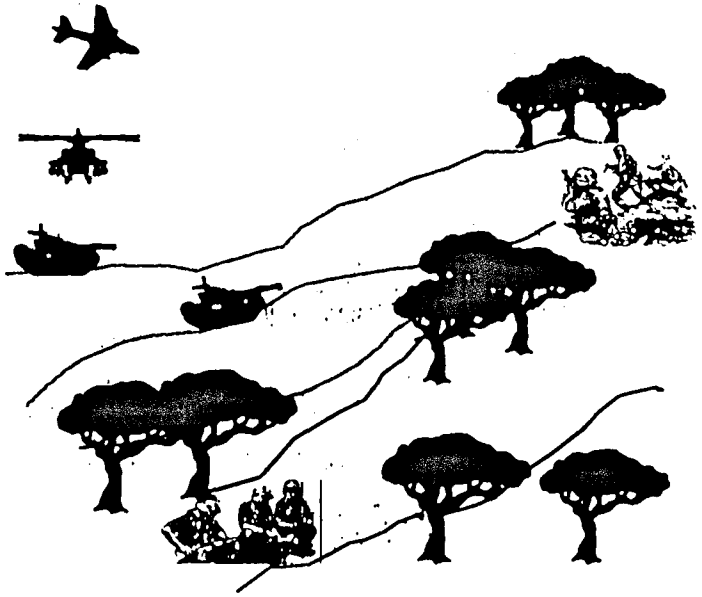
SURVIVABILITY

COMBAT ID

FIRE UNEXPOSED

MICROCLIMATE CONDITIONING

MINE DETECTION



NBC DETECTION/ PROTECTION

BALLISTIC PROTECTION

LASER/DEW PROTECTION

SIGNATURE REDUCTION

MEDICAL MONITORING

COMMAND AND CONTROL

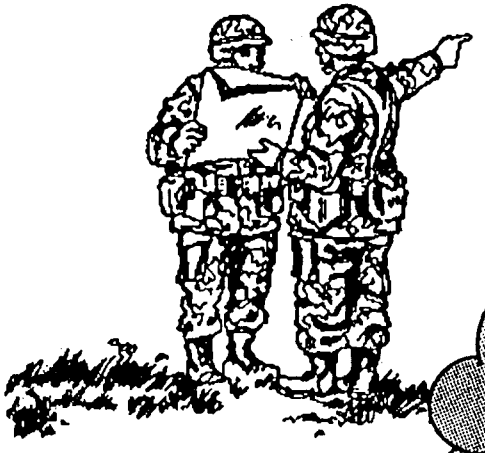
INDIVIDUAL SOLDIER'S COMPUTER / RADIO

SPEED / ACCURACY IN NAVIGATION

DECISION MAKING, PLANNING AND REPORTING

SITUATIONAL AWARENESS

VIDEO INTELLIGENCE



TARGET MARKING

EMBEDDED TRAINING AND REHEARSALS

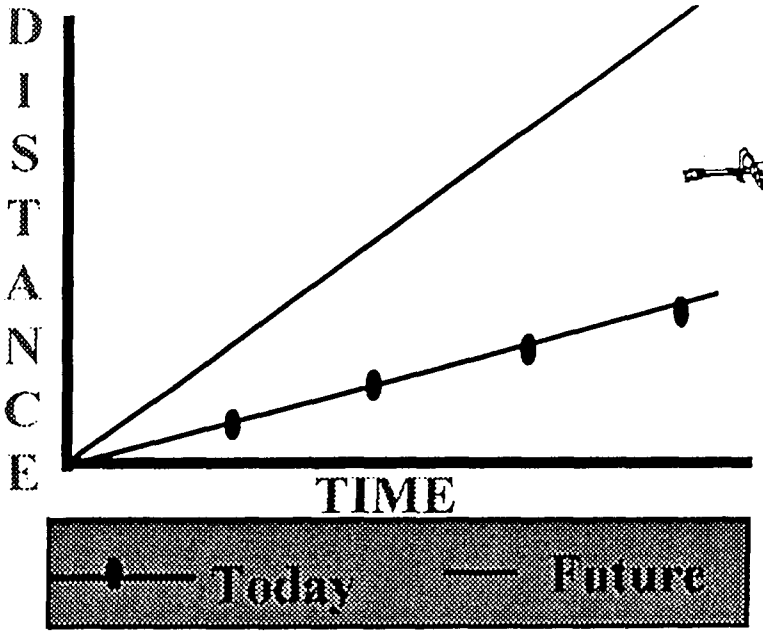
INTRASQUAD COMMUNICATIONS

MOBILITY

Low Light Level Maneuverability

Navigation Accuracy

Route Planning



Weight Reduction

Modularity

Microclimate Conditioning

GEN II Soldier System - Goals

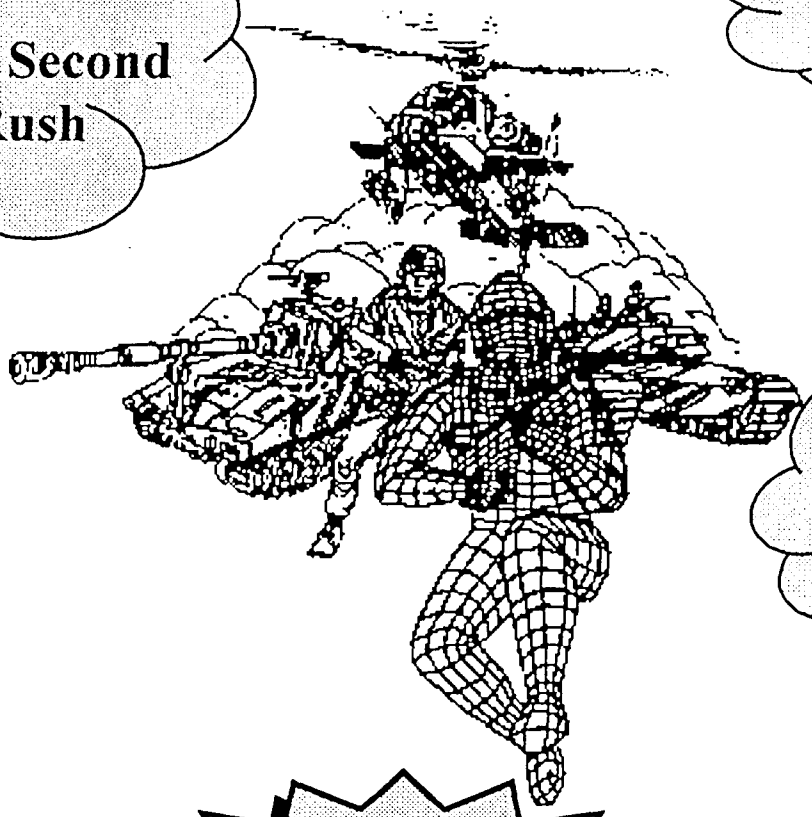
- √ *Improved command, control and communications via link to the digital network*
- √ *Improved lethality in all environments*
- √ *Weapons interface*
- √ *Improved situational awareness and reduced fratricide*
- √ *Modular multiple threat protection*
- √ *Operationally compatible systems engineering*
- √ *Small, lightweight and rugged components*
- √ *A producible system capable of continuous technology upgrade*
- √ *Affordability*

SOLDIER FUNCTIONS

* Low Crawl
* High Crawl
* 3-5 Second Rush
* Run

* Move Thru Brush
* Stealth
* Climb

Fire From Prone



* Dexterity
* Ease of Access

Observe Left and Right

Report

FORM
FIT
FUNCTION

Center of Balance

30'3 95

GEN II Soldier System-

Operational Interface

Army Involvement:

Dismounted Battlespace Battle Lab (Lead)

Battle Command Battle Lab

Early Entry Lethality and Survivability Battle Lab

USMC Involvement:

MARCORSYSCOM

MCCDC

SOF Involvement:

USSOCOM

DCD/USASOC

21st Century Land Warrior - Program Components - GEN II System

Integrated Headgear Subsystem (IHS)

- Provides all tactical and sensor info to soldier via HMD
- Modular components mount on ballistic shell (e.g., comms, mobility sensor, 1000 x 1000 HMD)
- Weight goal = 5 lbs (total system)

Individual Soldier Computer/Radio (ISC/R)

- Secure, voice-controlled voice/data comms linked to CAC2 via SINCGARS gateway (at platoon)
- GPS, maps/overlays, message reporting/info mgmt, video capture
- Links sensors (combat ID, Personnel status, CB detector and Mine detector) to soldier and higher
- Weight goal = 2-4 lbs (incl battery)

Weapons Interface Subsystem (WIS)

- Overlays weapon sight FOV into soldier's natural view and imports reticle into HMD for target engagement

Protective Subsystem (PS)

- Focus on small arms protection, signature control and load carriage with weight reduction (~20%)

Microclimate Cooling Subsystem (MCC)

- Refrigerated MCC (300w metabolic cooling/4 hrs operation) Weight goal = 10 lbs or less

IHS Capabilities

- Integrated Night Vision
- Indirect View of Weapon Sight and Computer
- Weapons Link/ Orientation Sensor
- Communications Link
- Lightweight Ballistics

3/28/95

ISC/R Capabilities

- Link to Digitized Battlefield
- Integrated GPS/Mapping
- Automated Messaging
  - Call for Fire/FRAGOS
  - MEDIVAC/ACE-W
- Decision Aids
  - METT-T Analysis
  - Database
- Voice/Data Transmission
- Voice Controlled

3/28/95

WIS Capabilities

- Provides Field of View Indicator
- Enables Quick Fire
- Provide Indirect View and Firing
- Operates with M16A2 (MWS)/TWS, Javelin, OICW, ISM

PS Capabilities

- Modular
- Lightweight Ballistics
- Integrates all other Subsystems
- METT-T Configurable
- Integrated Load Bearing and Body Armor

GEN II Soldier System
Power Supply

- Battery Functions
- Battery Weight
- Costs
- Battery Chemistry
- Battery Location

21st Century Land Warrior -
Program Components - Supporting Programs

Objective Individual Combat Weapon (OICW) ATD

- Next generation individual weapon with full solution fire control, air burst (20mm) and KE (5.56mm) munitions
- 500m/1000m range for point/area targets
- Links to GEN II IHS and ISC/R for target hand-off

Integrated Sight Modules (ISM) TD

- Optimizes and integrates fire control components (thermal imager, laser rangefinder(2500m), electronic compass, IR pointer)
- Feeds technology/components to OICW fire control
- Mounts on other weapons (e.g., M16A2)
- Links to GEN II IHS and ISC/R; provides "FO" type capability

Advanced Image Intensifier (AI2) ATD

- Medium tech(640 x 480, wide FOV mobility sensor
- Alternate mobility sensor for GEN II IHS

High Resolution Flat Panel Display System

- 2000 x 2000 line miniature (~1") flat panel display with 60 degree FOV, symbology and exportable imagery
- Parallel, higher risk effort to integrate into GEN II IHS

21st Century Land Warrior -

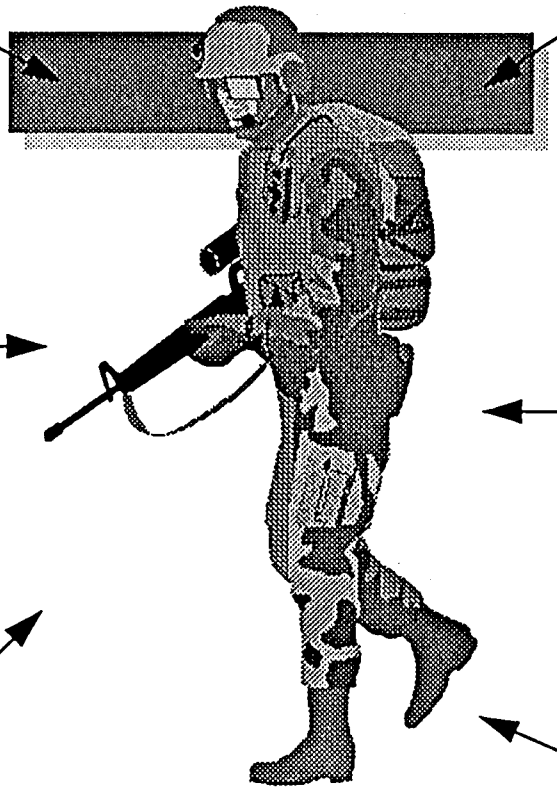
- **Multi-Purpose Individual Munition/Short Range Assault Weapon (MPIM/SRAW)**
  - Lightweight, multipurpose warhead and propulsion unit to defeat light armored vehicles, and personnel in masonry structures or bunkers
  - Can fire from enclosures/ Range = 500m
- **Forward Observer/Forward Air Controller (FO/FAC) - USMC**
  - Quick, accurate target detection, ID and location for attack by supporting arms, and communications of targeting data over tactical radios
  - Links to GEN II system with range to 10km
- **Close-in Man-Portable Mine Detection ATD**
  - In-stride mine avoidance using thermal imager and algorithm integrated with GEN II ISC/R
  - Alert (visual and/or auditory) forwarded to GEN II IHS
- **Combat Identification**
  - Situational Awareness, embedded 21CLW sensors
  - Compatibility with BCIS for some soldiers
  - Links to GEN II IHS and ISC/R (to access digital net)
- **Individual Soldier Power**
  - Lightweight power sources to provide 12 hrs continuous operation for 21CLW components

GEN II Soldier System Team Responsibilities

MOTOROLA
- Prime contractor
- Soldier System IPT lead
- Systems engineering, integration & test
- Individual Soldier's Computer/Radio Subsystem (ISC/R)

HUGHES
- Weapon Interface Subsystem (WIS)
- MANPRINT/Training
- Systems engineering support

ARTHUR D. LITTLE
- Trades/MANPRINT
- Protective Subsystem (PS)
- Load bearing component



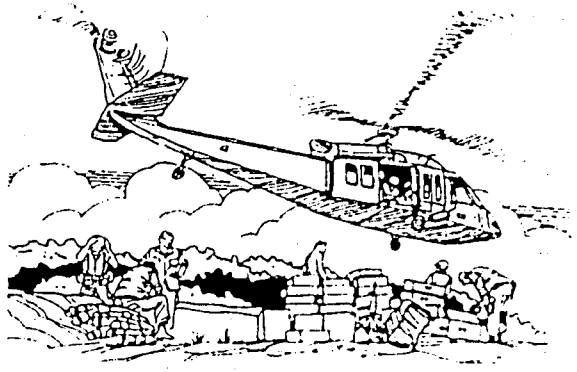
HONEYWELL
- Integrated Headgear Subsystem (IHS)
- Individual Soldier Imaging Subcomponent (ISIS)

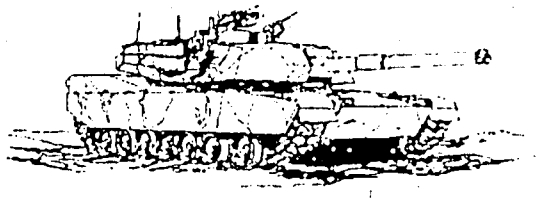
BATTELLE
- Microclimate Cooling Subsystem (MCC)
- Hazards analysis

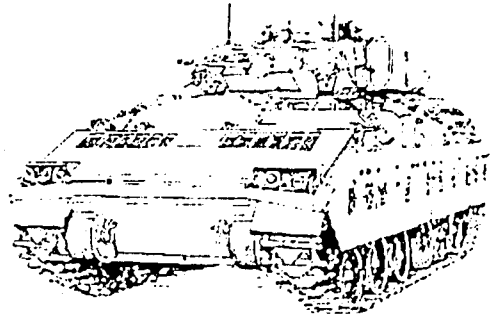
GENTEX
- Integrated Headgear Subsystem support
- Protective Subsystems fabrication
- Ballistic shell

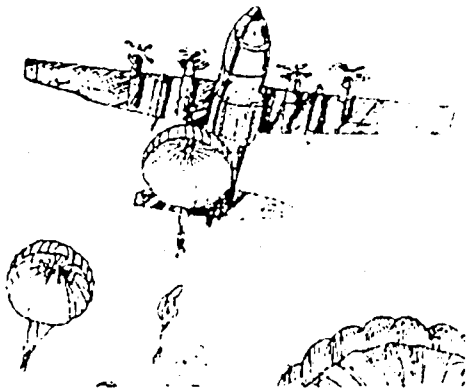
3/30/95

PROJECTING DECISIVE POWER









MOVING FORWARD TO THE 21ST CENTURY