CHAPTER VIII

MILITARY OPERATIONS ON URBANIZED TERRAIN

A. DESCRIPTION

Military Operations on Urbanized Terrain (MOUT) is the capability to operate and conduct military operations in built-up areas and to achieve military objectives with minimum casualties and collateral damage. MOUT includes nonlethal weapons, precise weapons, surveillance, and situation awareness via communications effective in urban areas.

MOUT is not so much a unique capability as an environment in which the operational concepts of *Joint Vision 2010*—specifically precision engagement, full-dimensional protection, dominant maneuver, and focused logistics—will be tested under the most demanding conditions. In the near term, the emphasis will be on the exploitation and integration of existing technologies into systems offering improved capability for firepower, force protection, and maneuver in the urban environment. The long-term emphasis—which will form the basis for a true transformation of the traditional functions of strike, protection, and maneuver—will be a flattened command, control, and intelligence structure that will permit the warfighter, at any level, to employ forces and mass effects in revolutionary ways.

In a broad sense, MOUT crosses all spectrums of general warfare. Our combat forces must be able to fight and survive better than their adversaries. MOUT is unique because it is perhaps the most complex and resource-intensive environment in which they will have to fight.

B. OPERATIONAL CAPABILITY ELEMENTS

Urban centers increasingly are the sites of conflict throughout the world. MOUT is, and will continue to be, a major area of concern for U.S. forces. MOUT entails military actions that are planned for and conducted in terrain that features manmade infrastructure designed for habitation, cultural and recreational use, and economic activities by civilian population where tactical options might be complicated by the proximity of noncombatants. Actions involve small units, and the potential for incurring casualties is high. MOUT requires extensive use of Army and Marine light forces whose mission success tends to focus more on the operational effectiveness at lower echelons (e.g., battalion and below) than larger scale conflicts. The U.S. operational advantage—typically associated with long-range, high-technology weapon platforms that use mass and mobility—is significantly reduced in urban environments. Therefore, the system of choice for MOUT remains the individual warrior working within a small unit.

As for warfare in general, for MOUT the key operational capabilities are firepower, force protection, and maneuver. C^4I and the associated situation awareness enable each of the operational capabilities. Within these three broad areas, we have defined specific operational capability elements that, if achieved, will lead to a significant improvement in our capability to effectively operate in a MOUT environment.

Firepower. MOUT firepower will consist of a "system of systems" that enables our forces to locate the objective or target, provide responsive command and control, generate the desired effect, assess the level of success, and retain the flexibility to reengage with precision when required. The specific operational capability elements are listed below.

- *Situation awareness*. The key to success in all types of operations on urban terrain is knowledge—knowledge of one's own position(s) and intent, and of the position(s) and intent of the enemy. That knowledge must be readily available at every level down to the individual warrior, regardless of whether he has line of sight to the source of the information.
- *Weapon effectiveness*. MOUT engagements require overmatching lethality in terms of direct and indirect firepower tailored to effectively engage targets commonly encountered in MOUT, using smart and precision-guided munitions. We must build on current U.S. advantages in delivery accuracy and all-weather and night capabilities. Moreover, we must foster the development of nonlethal technologies to provide selective response and the ability to minimize collateral damage.

Force Protection. MOUT force protection will enable the effective employment of our forces while degrading opportunities for the enemy. We must protect our own forces from the very technologies we are exploiting. Specific operational capability elements are:

- *Situation awareness*. Situation awareness will be built on information superiority, which will provide multidimensional and all-environment awareness and assessment as well as positive identification of all forces in the battlespace.
- *Weapon effectiveness*. A key to surviving in any environment is the ability to engage the enemy accurately and effectively in all conditions before he is able to engage us. A flexible response option such as nonlethal weapons will lessen the chance of indecision associated with noncombatants in the battlespace.
- *Individual protection.* If our warriors are to be successful in MOUT, they must survive. Individual systems that enhance survivability are essential to force protection.

Maneuver. MOUT maneuver is the ability to apply the multidimensional aspects of information superiority and the ability to insert forces where and when we want them to accomplish assigned tasks within the constraints of the urban environment.

- *Situation awareness*. The application of rapid, unpredictable yet precise insertion of the right forces at the right time without the knowledge of the enemy will enable the broader operational capability of maneuver. Situation awareness is one critical enabling ingredient.
- *Precision insertion*. Not only must we know where the enemy is, but we also must be able to approach him from where he least expects it and when he least expects it—at night and in inclement weather.
- *Individual mobility.* The individual warrior must be able to move quickly and precisely, unencumbered by heavy and bulky body armor, weapon systems, and communications packages. His mobility—the ability to move vertically as well as horizontally—must be increased to allow him to engage where least expected. The warrior also needs a lightweight, simple means to rapidly breach the walls, ceilings, and floors in order to enhance maneuverability and survivability by avoiding traditional passageways that are normally covered by fire, mined, or boobytrapped.

The goal is to enhance the operational capability elements mentioned above to increase the effectiveness of the individual warrior in the urban environment. Situation awareness is the major enabler that is essential to the effectiveness of each of these elements, as shown in Figure VIII–1.

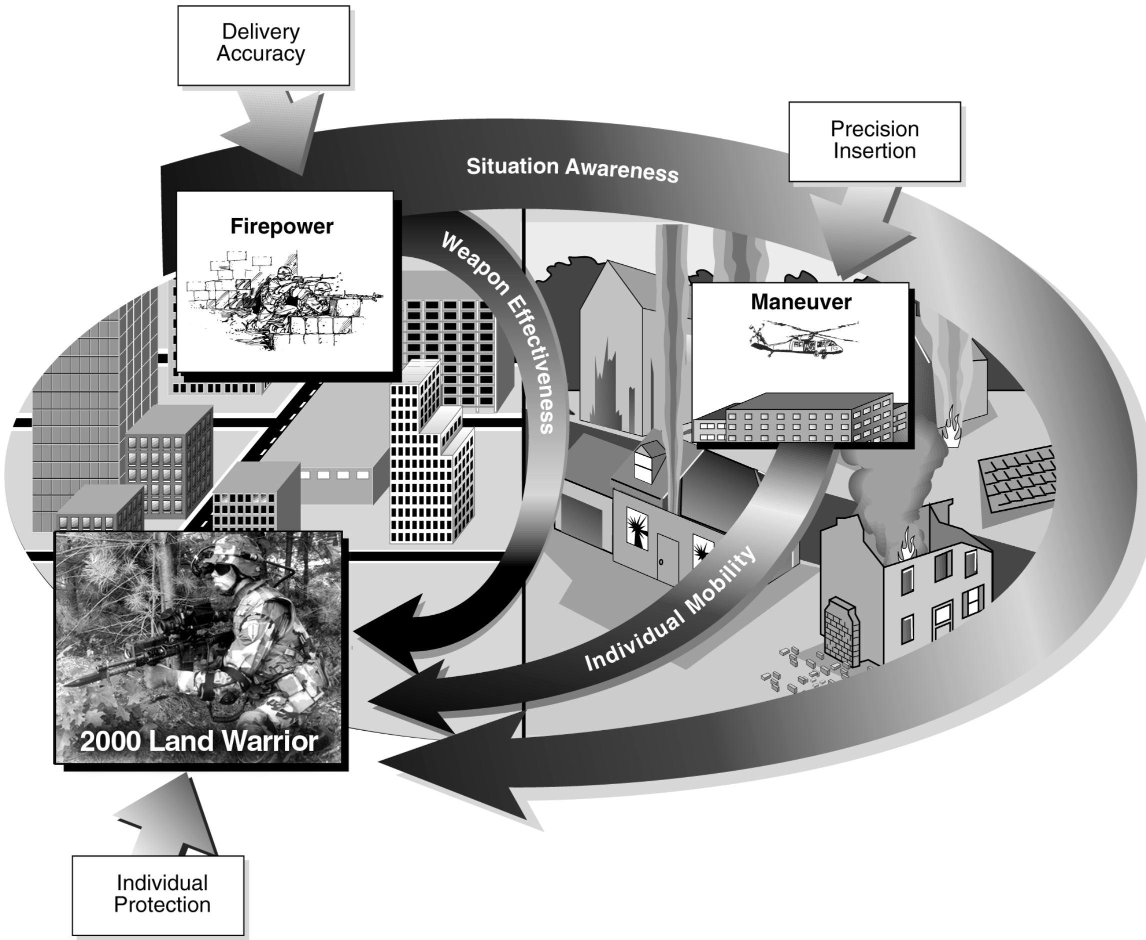


Figure VIII–1. Concept—Military Operations on Urbanized Terrain

C. FUNCTIONAL CAPABILITIES

To achieve the needed operational capabilities and to create a greater U.S. military advantage, MOUT requires, at a minimum, the functional capabilities described below and shown in Table VIII–1 as they relate to the operational capability elements.

Table VIII–1. Functional Capabilities Needed—Military Operations on Urbanized Terrain

	Operational Capability Elements							
	Firepower		Force Protection			Maneuver		
Functional Capabilities	Situation Awareness	Weapon Effectiveness	Situation Awareness	Weapon Effectiveness	Individual Protection	Situation Awareness	Precision Insertion	Individual Mobility
1. Ability To Accurately Place Self and Enemy With Complete Knowledge of Environment							●	
2. Flattened C^2I Structure Allowing Distribution of Essential Information to Every Level of Command Down to Individual Combatant	●		●			●		
3. Increased Individual Weapon Effectiveness Day/Night, All-Weather, Long Range With a Measured Response Capability		●		●				
4. Increased Crew-Served Weapon Effectiveness Against Fortified, Defilade, Dug-In Targets		●		●				
5. Enhanced Target Acquisition Indirect Viewing and Through-Wall Sensing	○	●	○	●	●	○		
6. Decreased Sensor-to-Shooter Engagement Time		●		●				
7. Hands-Free Communication	●	○	●	○		●		●
8. Lighter, Less Bulky Body Armor and Lighter Equipment and Compact Weapon Systems					●			●
9. Enhancements for Individual Combatant To Negotiate and Breach Obstacles					●			●
10. Ability To Differentiate Friend From Foe in Reduced Visibility/No Visibility	●	○	●	○	●	●		
11. Increased Capability To Detect Mines and Explosives		○			●	●		○
12. Increase Capability To Target Snipers and Mortars	●		●	○	●			
13. Reduction of Multispectral Signature of Individual Combatant					●			○
14. Reduction of Susceptibility of Individual Combatant to Small Arms, Fragmentation, and Environmental Hazards Such as Fire and Chemical Sources					●			
15. Ability To Monitor and Transmit Physical Well-Being of Individual Combatant	○		○		●	○		
16. Precision, Survivable Clandestine Insertion of Combat Forces					○		●	
17. Ability To Control Individuals, Crowds, and Vehicles With Nonlethal Capabilities		●		●	●			

● Strong Support ○ Moderate Support

Firepower. Improved individual and crew-served weapons with full-solution fire control, coupled with improved bunker-defeating weapon systems, will enhance target engagement capabilities against fortified, dug-in, or defilade targets. Multispectral sensors will provide enhanced target acquisition under all operational conditions. In addition, the sensor-to-shooter linkages will provide effective target handover to supporting standoff precision weapon systems. Irritants, barriers, and incapacitants will provide nonlethal capabilities to augment crowd control and deal effectively with the noncombatant population.

Force Protection. Improved small-arms protective vests will stop 7.62-mm armor-piercing rounds. Multispectral signature-reducing materials and techniques will reduce detection by enemy sensors. Lightweight, multifunctional protective materials will allow survival in flame and fires and other environmental threats and hazards. Combat identification, indirect viewing/unexposed firing, mine detection, antisniper and countersniper systems, and personnel status monitoring will also enhance survivability, as will overall improvements in situation awareness, particularly when digitally linked.

Maneuver. Self-contained navigation technologies capable of better than 3-meter accuracy for GPS augmentation, urban databases and digital mapping (better than 1-meter resolution), and simulations fed by the rapid generation of terrain, feature, and building data, will provide increased command tempo, control, intelligence, and mission planning and rehearsal, while enhancing maneuverability of individuals and the force. Precision clandestine personnel aerial delivery technologies capable of providing 25-meter circular error probable accuracy will heighten warrior mobility and survivability. Lightweight, rapidly emplaceable individual mobility tools will enhance the warrior's ability to move vertically and horizontally in and around buildings and other obstacles. These tools need to be offered in a variety of capabilities such as stealthy emplacement and a rapid shoot-through mode in order to defeat obstacles, open barriers/walls, and attack fortifications in an urban environment.

Advances in command, control, communications, computers, and intelligence (C^4I) capabilities will be required across each of the operational capability elements if we are to achieve the Chairman of the Joint Chiefs of Staff's *Joint Vision 2010*. Near-real-time vertical and horizontal C^2 from the battalion down to the individual warrior will enhance situation awareness at all levels. This will be accomplished through hands-free, robust communications; high-data-rate communications for rapid voice, data, and video transmissions; and video capture. Fusing, filtering, and disseminating technologies will ensure that essential information is distributed to the appropriate small units. Near-real-time sensor-to-shooter linkages are needed to facilitate the processing and dissemination of data. Improved multispectral sensors and optics, combat identification systems, topographical systems, countersniper systems, unattended ground vehicles (UGVs) and unattended aerial vehicles (UAVs), and other emerging systems will be necessary to accommodate these near-real-time sensor-to-shooter linkages.

The 1996 DSB Summer Study identified three technology areas that must be exploited if we are to be successful in urban operations: virtual line of sight; precise location of friends, innocents, and foes; and the need for minimum or no collateral damage. Virtual line of sight could be enabled with through-the-wall sensor concepts, miniaturized UAVs and UGVs, or robots. Microbots could provide significant increases in functional capabilities for MOUT situation awareness. Robots could act as "point men" for force protection to precede our warriors and act in a sentry role to cover building exits. Nonlethals would help the small urban force deal with innocents and avoid any unnecessary collateral damage. The principal issue is identifying the "acceptable limits of effects."

D. CURRENT CAPABILITIES, DEFICIENCIES, AND BARRIERS

The operational capabilities required to be effective in the urban environment are identical to those for land warfare in general. They are just harder to achieve. The current U.S. military capability was developed to conduct large-scale, rural warfare in central Europe. Many current systems are not fully suited to the MOUT mission and environment. Heretofore, the U.S. military strategy and doctrine called for avoiding urban areas and controlling them from without. Our currently fielded capabilities are optimized for this wide-open land battle and do not adequately support warfare in the much more difficult urban environment. Table VIII–2 details the limitations and solutions for each of the operational capability elements.

Table VIII–2. Goals, Limitations, and Technologies— Military Operations on Urbanized Terrain

Goal	Functional Capabilities	Limitations	Key Technologies
Firepower			
Operational Capability Element: Situation Awareness			
Provide a system of systems that will enable our forces to locate the objective or target, provide responsive command and control, generate the desired effect, assess the level of success, and retain the flexibility to reengage with precision when required.	Ability to accurately place self and enemy with complete knowledge of environment Flattened C^2I structure allowing distribution of essential information to every level of command down to individual combatant	Ability to maintain accurate position coordinates over time Limiting effects of urban environments on communication reliability, range, and line-of-sight-dependent operations EMI and RFI problems associated with tightly packaged combatant sensor, communication, and weapon systems See-through flat-panel displays of limited resolution Uncooled thermal sensors of limited resolution No available shared aperture IR/radar sensor No available “smart ground station” processing capability Limitations presented at Table IV–2 (Information Superiority) apply	Multichannel RF links Wireless networking Data compression technologies Real-time video Lightweight power technologies Electronics packaging Low-power electronics Microelectromechanical systems (MEMS) Advanced, lightweight multispectral sensors Lightweight, downrange wind sensing Advanced man-machine interfaces Automated artificial intelligence-assisted sensor/data fusion Systems miniaturization technologies High-bandwidth datalinks Smart remote/ground station processing with ATR Technologies listed in Table IV–2 (Information Superiority) apply
Operational Capability Element: Weapon Effectiveness			
	Increased individual weapon effectiveness; day/night/all-weather long-range operation with a measured response capability Ability for individual weapon to defeat defilade targets Increased crew-served weapon effectiveness against fortified, defilade, dug-in targets Enhanced target acquisition capability—indirect viewing and through-wall sensing Decreased sensor-to-shooter engagement time	Ability to defeat defilade targets Uniform fragmentation distribution Stability of lightweight individual weapon platforms Accurate laser rangefinding in all environments Boresighting weapon-mounted sensors Cost, weight, and power for individual combatant acquisition, data processing, display, and weapon systems No available tunable (lethality selectable) nonlethal weapons/munitions Limited bioeffects database on personnel effects of nonlethal technologies	Multichannel RF links Electronics packaging Low-power electronics System miniaturization technologies High-bandwidth datalinks Lightweight, high-power density batteries/power cells Advanced materials Efficient recoil mitigation Accurate all-environment laser ranging techniques Lightweight optoelectronics Directed air-burst mechanisms Integrated range feedback with selectable lethality (nonlethal to lethal) munitions on a single weapon platform Variable-velocity weapon mechanisms Airburst fusing for antipersonnel use

Table VIII–2. Goals, Limitations, and Technologies—Military Operations on Urbanized Terrain (continued)

Goal	Functional Capabilities	Limitations	Key Technologies
Force Protection			
Operational Capability Element: Situation Awareness			
Provide the necessary systems to significantly increase personnel warfighter survivability in urban terrain	Ability to accurately place self and enemy with complete knowledge of environment Flattened C2I structure allowing distribution of essential information to every level of command down to individual combatant Ability to differentiate friend from foe in reduced/no visibility Increased capability to detect mines and explosives Increased capability to target snipers and mortars Enhanced target acquisition capability—indirect viewing and through-wall sensing Decreased sensor-to-shooter engagement time	Ability to maintain accurate position coordinates over time Limiting effects of urban environments on communication reliability, range, and line-of-sight-dependent operations EMI and RFI problems associated with tightly packaged combatant sensor, communication, and weapon systems Current flat-panel displays of limited resolution No available shared aperture IR/radar sensor No available "smart ground station" processing capability Limitations presented at Table IV–2 (Information Superiority) apply Automated mine detection capabilities limited	Low-cost millimeter-wave radar Projectile detection/tracking algorithms processing Laser propagation RF antenna design/construction RF spread-spectrum signal transmission and processing Accurate all-environment laser ranging techniques
Operational Capability Element: Weapon Effectiveness			
	Enhanced target acquisition capability—indirect viewing and through-wall sensing Decreased sensor-to-shooter engagement time	Cost, weight, and power for individual combatant acquisition, data processing, display, and weapon systems. No available tunable (lethality selectable) nonlethal weapons/munitions Limited bioeffects database on personnel effects of nonlethal technologies	Multichannel RF links Electronics packaging Low-power electronics System miniaturization technologies High-bandwidth datalinks Advanced materials Lightweight optoelectronics
Operational Capability Element: Individual Protection			
	Reduction of multispectral signature of individual combatant Reduction of susceptibility of individual combatant to small-arms fire, fragmentation, and environmental hazards such as fire and chemical sources Ability to monitor and transmit physical well-being of individual combatant	Lack of affordable, lightweight, flexible small arms materials Limited understanding of fundamental penetration mechanisms Independent component approach—not integrated Integration of thermal camouflage technology into a textile material Site-specific camouflage Electronics miniaturization and integration Lack of knowledge of appropriate essential elements of information Lack of personal medical sensors No automatic transmission of medical information Integration of low-cost flame protection technology into multifunctional textile materials	Electronics packaging Low-power electronics Advanced man-machine interfaces Automated artificial intelligence-assisted sensor/data fusion Advanced materials Enhanced numerical modeling to understand fundamental penetration mechanics Increased strength and low-density materials Improved specific toughness, high-modulus polymers Lightweight, flexible, multispectral textile materials Accurate medical sensors on individual

**Table VIII–2. Goals, Limitations, and Technologies—
Military Operations on Urbanized Terrain (continued)**

Goal	Functional Capabilities	Limitations	Key Technologies
Maneuver			
Operational Capability Element: Situation Awareness			
The multidimensional application of information, engagement, and mobility capabilities to position and employ widely dispersed joint air, land, sea, and space forces to accomplish the assigned operational tasks	Ability to accurately place self and enemy with complete knowledge of environment Flattened C2I structure allowing distribution of essential information to every level of command down to individual combatant	Ability to maintain accurate position coordinates over time Limiting effects of urban environments on communication reliability, range, and line-of-sight-dependent operations EMI and RFI problems associated with tightly packaged combatant sensor, communication, and weapon systems Current flat-panel displays of limited resolution No available shared aperture IR/radar sensor No available "smart ground station" processing capability Limitations presented at Table IV–2 (Information Superiority) apply	Multichannel RF links Wireless networking Data compression technologies Real-time video Lightweight power technologies Electronics packaging Low-power electronics MEMS Advanced, lightweight multispectral sensors Lightweight, downrange wind sensing Advanced man-machine interfaces Automated artificial intelligence-assisted sensor/data fusion System miniaturization technologies High-bandwidth datalinks Smart remote/ground station processing with ATR Technologies listed in Table IV–2 (Information Superiority) apply
Operational Capability Element: Precision Insertion			
Precision clandestine insertion of airborne combat forces	Precision, survivable clandestine insertion of combat forces	Accurate characterization of decelerator aerodynamic coefficients of performance Maneuvering around urban obstacles at night Gliding characteristics of parafoil	Multichannel RF links Computational fluid dynamics applications for decelerator characterizations Low-observable transport platform with short or vertical takeoff and landing capabilities
Operational Capability Element: Individual Mobility			
	Hands-free communications Lighter, less bulky body armor and equipment and compact weapon systems Enhancements for urban warrior to negotiate and breach obstacles	Helmet weight Current sensor technology dependent on full-time MITL teleoperation of UGVs Current sensor technology not size/weight/cost optimized for UGV applications Inability to capture and effectively use 100% of body's energy expenditure Heavy, short-lived power sources	Advanced man-machine interfaces Voice-controlled communication and nondistracting control mechanisms Advanced materials Miniaturized propulsion Biomechanics and robotics Lightweight, long-life power sources

Our warriors are unable to communicate through walls and other obstacles. They cannot determine their exact positions accurately enough, nor are they able to pinpoint targets for supporting arms. Urban databases do not exist from which they can draw to increase situation awareness. Warriors cannot determine the position of or defeat an enemy who chooses to remain covered. Individual equipment is bulky and heavy, and it degrades mobility in the oftentimes cramped urban environment. In addition, there is no capability to choose the type and degree of force to use, which puts noncombatants at risk and might inhibit the use of any force.

For the most part, technologies necessary to achieve the operational capabilities of MOUT firepower, force protection, and maneuver already exist either on the shelf or as short-term Defense Technology Objectives in other JWSTP or DTAP technology areas. The challenge is to integrate these technologies into coherent, interoperable systems optimized for MOUT.

Technological barriers exist that will have to be surmounted. For MOUT, these occur primarily in C^4I, an area that is key to situation awareness. The greatest concern is the limiting effects of urban environments on small-unit communications, reliability, and range. The technology does not currently exist, nor does a breakthrough appear imminent, that will allow the non-line-of-sight transmission (through obstacles) of the large bandwidths needed to carry necessary information to the individual warrior. Research will center on innovative new signal routing techniques and exploitation of low-frequency technology.

E. TECHNOLOGY PLAN

Tackling the challenges imposed by the MOUT environment is a formidable endeavor. As such, a four-component approach is undertaken to focus efforts on key challenges in a comprehensive manner. Each component is a primary DTO and will be ready for demonstration at a different point along the roadmap. The DTOs are described below:

- *E.01, Small-Unit Operations (SUO) TD*, will demonstrate the capability to provide scaleable, nonhierarchical networks with robust communications to enhance decision making at all echelons involved in MOUT operations.
- *E.02, Military Operations in Urbanized Terrain ACTD*, will focus primarily on the integration, linkage, and interoperability of MOUT system components, and will include demonstrations in joint field exercises. This *Joint Army/USMC* ACTD provides the first opportunity to demonstrate a MOUT system of systems in the FY 1999-2000 timeframe. It will demonstrate available technology items (i.e., NDI/COTS/GOTS) during FY1998. This initiative cuts across the services and will capture the efforts of the Army, DARPA, Marine Corps, and U.S. Special Operations Command (USSOCOM). Ten squad/platoon-level experiments and two joint company-level experiments (4Q99) have been successfully completed, and some technologies have successfully undergone transition to formal acquisition or follow-on programs.
- *E.04, Joint Nonlethal Weapons*, will develop an advanced nonlethal technological capability to support the activities of military forces as they conduct various missions such as crowd control; localizing or dispersing noncombatants; denying an area to personnel or vehicles; and disabling vehicles, aircraft, vessels, facilities, and equipment.

Figure VIII–2 depicts the integration of supporting technologies to achieve operational capabilities. Table VIII–3 shows the demonstrations supporting MOUT JWCOs.

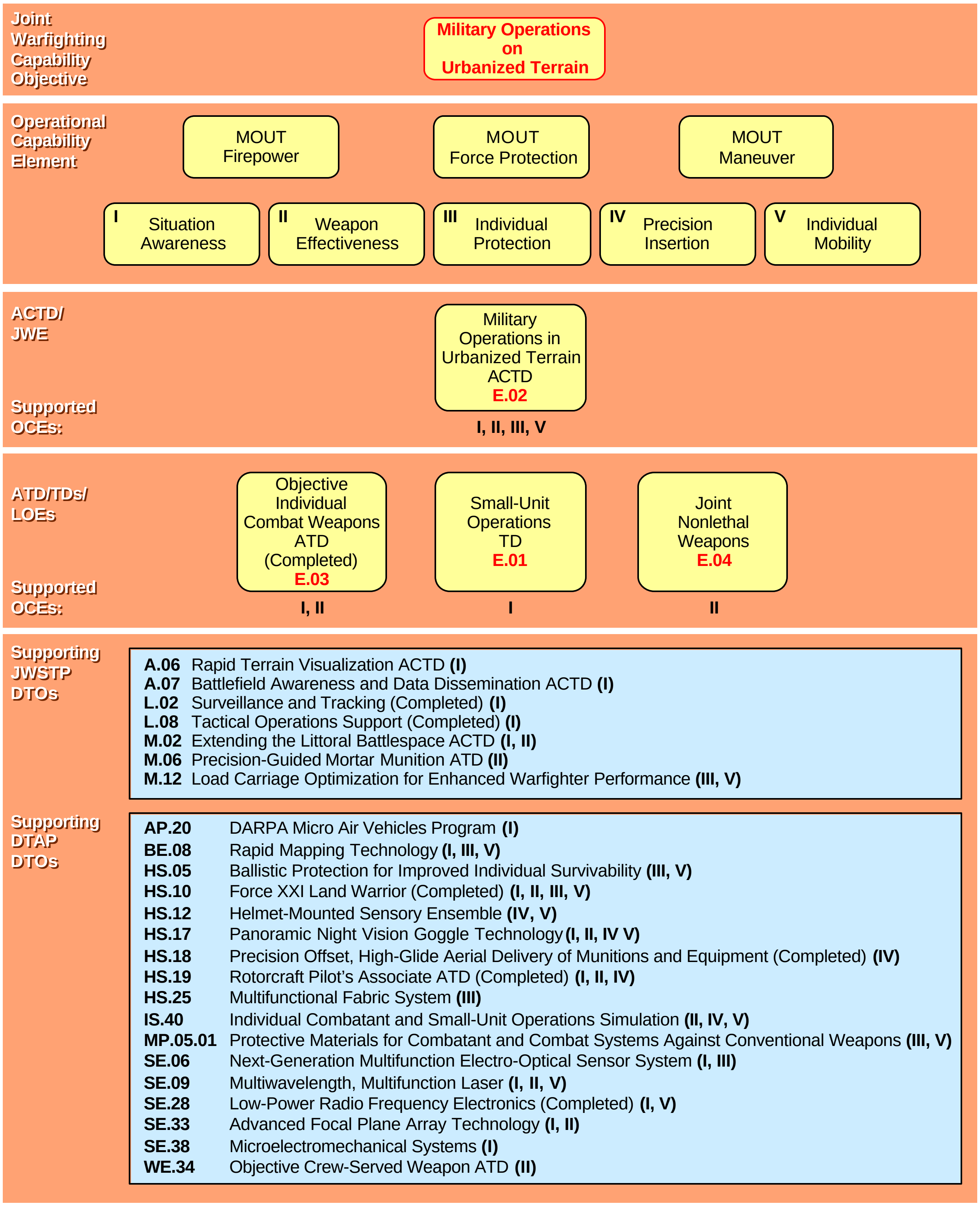


Figure VIII–2. Technology to Capability—Military Operations on Urbanized Terrain

Table VIII–3. Demonstration Support—Military Operations on Urbanized Terrain

	Operational Capability Elements										Type of Demonstration			
	Firepower		Force Protection			Maneuver								
Demonstration	Situation Awareness	Weapons Effectiveness	Situation Awareness	Weapons Effectiveness	Individual Protection	Situation Awareness	Precision Insertion	Individual Mobility	Service/ Agency	DTO	ACTD	ATD	TD	LOE
Small-Unit Operations TD*	●		●			●			DARPA	E.01			X	
Military Operations in Urbanized Terrain ACTD*	●	●	●	●	●	●		●	Joint	E.02	X			
Objective Individual Combat Weapon ATD*	○	●	○	●					Joint	E.03		(C)		
Joint Nonlethal Weapons*		●		●					USMC, Army	E.04				X
Rapid Terrain Visualization ACTD*	●		●			●			Joint	A.06	X			
Battlefield Awareness and Data Dissemination ACTD	●		●			●			DARPA	A.07	X			
Surveillance and Tracking	●					●			Joint	L.02			(C)	
Tactical Operations Support	○		○			○			Joint	L.08			(C)	
Extending the Littoral Battlespace ACTD	●	●	●			●			Navy, USMC DARPA	M.02	X			
Precision-Guided Mortar Munition ATD		●		●					Army	M.06		X		
Load Carriage Optimization for Enhanced Warfighter Performance					○			●	Army	M.12			X	
DARPA Micro Air Vehicles Program	○		○			○			DARPA	AP.20			X	
Rapid Mapping Technology			○		○	●		●	Army	BE.08			X	
Ballistic Protection for Improved Individual Survivability					●			●	Army	HS.05			X	
Force XXI Land Warrior*	●	●	●	●	●	●		●	USMC, Army	HS.10			(C)	
Helmet-Mounted Sensory Ensemble							○	○	Air Force, Navy	HS.12		X		
Panoramic Night Vision Goggle Technology	○	○	○	○		○	●	●	Air Force, Navy	HS.17		X		
Precision Offset, High-Glide Aerial Delivery of Munitions and Equipment							●		Army	HS.18			(C)	
Rotorcraft Pilot's Associate ATD			○	○		○	●		Army	HS.19		(C)		
Multifunctional Fabric System					●				Joint	HS.25			X	
Individual Combatant and Small-Unit Operations Simulation				○			○	○	Army, USMC	IS.40			X	
Protective Materials for Combatant and Combat Systems Against Conventional Weapons					●			●	Army, Navy	MP.05.01			X	
Next-Generation Multifunction Electro-Optical Sensor System	●		●		●	●			Army, Air Force	SE.06			X	

Table VIII–3. Demonstration Support—Military Operations on Urbanized Terrain (continued)

	Operational Capability Elements										Type of Demonstration			
	Firepower		Force Protection			Maneuver								
Demonstration	Situation Awareness	Weapons Effectiveness	Situation Awareness	Weapons Effectiveness	Individual Protection	Situation Awareness	Precision Insertion	Individual Mobility	Service/ Agency	DTO	ACTD	ATD	TD	LOE
Multiwavelength, Multifunction Laser	○	●	○	●		○		○	Joint	SE.09			X	
Low-Power Radio Frequency Electronics	○		○			●		●	DARPA	SE.28			(C)	
Advanced Focal Plane Array Technology	●	●	●	●		●			Army, Navy	SE.33			X	
Microelectromechanical Systems	●		●			○			Army, Air Force, DARPA	SE.38			X	
Objective Crew-Served Weapon ATD		●		●					Joint	WE.34		X		

*Strong support for counterterrorist operations ● Strong Support ○ Moderate Support (C) Completed

The U.S. warfighter currently has basic capabilities for conducting the full spectrum of operational missions in most environments; however, there are significant deficiencies associated with MOUT. The intent of the MOUT technology plan is to provide a path for resolving those deficiencies and advancing critical technologies needed for MOUT. The group of functional capabilities identified here must be developed to ensure that the United States can overmatch any adversary in a conflict set in urban terrain. The roadmap for the development and demonstration of the MOUT system of systems is shown in Figure VIII–3.

The technologies required to achieve the functional and operational capability elements that are critical for MOUT are at varying levels of maturity. They will be demonstrated at the component, subsystem, and system level primarily through the completion of the DTAP DTOs. The full suite of products and functionality that evolves from these technologies is required for seamless operation in a MOUT environment. To maximize our warfighting edge, these technologies must be integrated into a MOUT system of systems.

One of the greatest technical challenges for MOUT is the integration of a wide range of equipment, which will operate effectively and reliably given the particular challenges of the urban environment. In addition, integration of much of this equipment onto the human platform—with all its peculiarities, variations, and individual preferences—is critical, given that most MOUT operations focus on the individual warrior and small units. Experience has shown that a systems approach must be aggressively pursued, as opposed to a “stovepipe” development of each technology component. This is a key objective for the MOUT ACTD.

As seen in Figure VIII–3, various projects feed into these objective areas. Service and Defense Advanced Research Projects Agency (DARPA) ATDs and TDs will develop the new technologies, and most of the efforts provide for demonstration of those technologies. The primary focus of a few key programs (e.g., DARPA SUO, Army/Force XXI Land Warrior (FXXILW) and its follow-on Future Warrior Technology) is on integrating subsystems, systems, and functionality for the warfighter for subsequent insertion in the Land Warrior or other systems. These programs are the “cement” that will form the cornerstone of the MOUT system of systems. Figure VIII–4 shows how the major infantry integration programs are linked together.

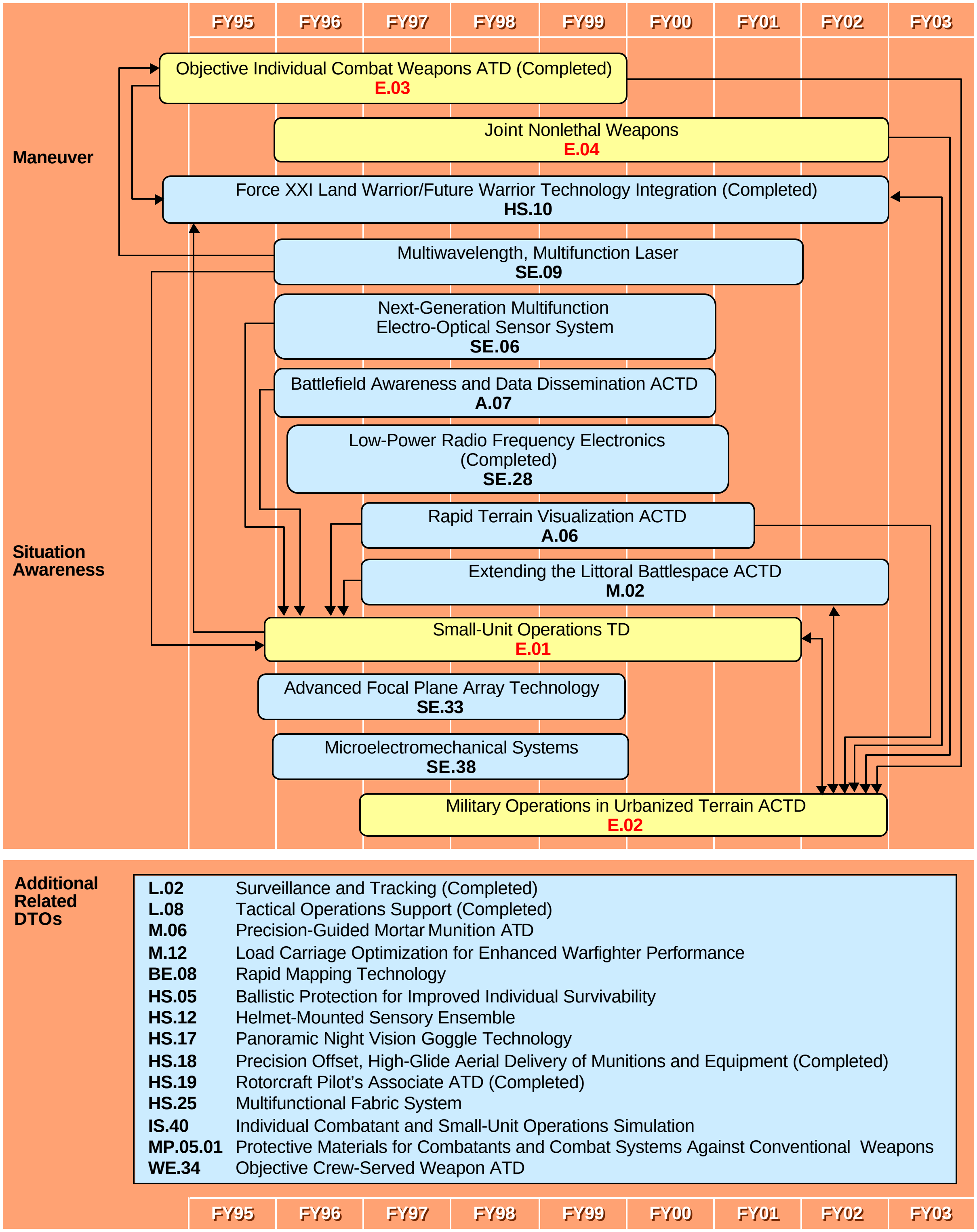
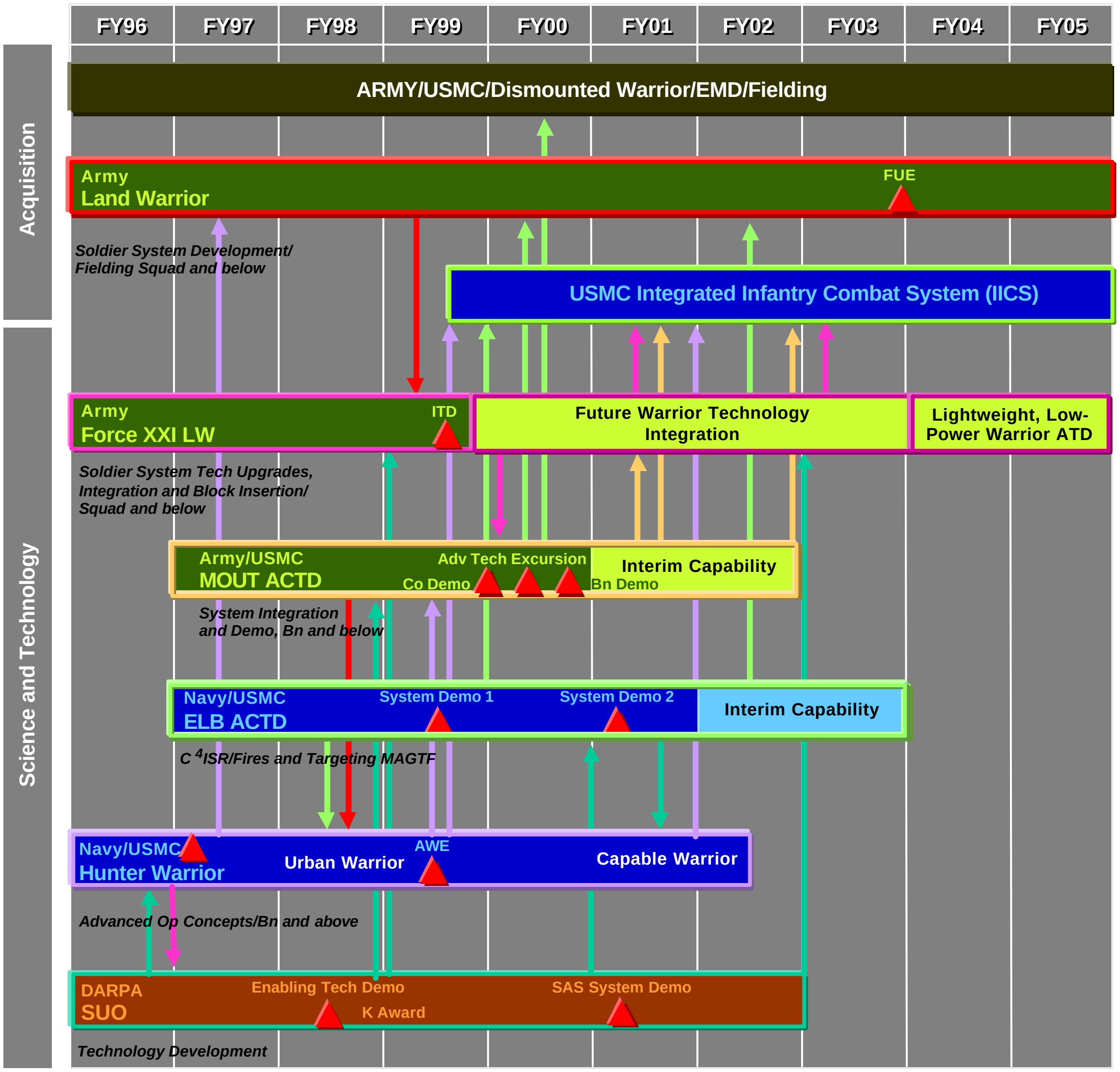


Figure VIII–3. Roadmap—Military Operations on Urbanized Terrain



AWE: Advanced Warfighting Experiment
Bn: Battalion
Co: Company
C^4ISR: Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
ELB: Extending the Littoral Battlespace
EMD: Engineering/Manufacturing Development
FUE: First Unit Equipped
FXXI LW: Force XXI Land Warrior
ITD: Integrated Technology Demonstration
MAGTF: Marine Air-Ground Task Force
MOUT ACTD: Military Operations in Urbanized Terrain Advanced Concept Tech Demonstration
P^3I: Pre-Planned Product Improvement
SUO: Small Unit Operations
SAS: Situational Awareness System

Figure VIII–4. Relationship of Major Infantry Programs

While not a functional capability directly contributing to any of the operational capability elements, modeling and simulation (M&S) will contribute to the assessment of advanced technologies as well as contributing to MOUT mission rehearsal. M&S will complement hardware and system development via an instrumented MOUT testbed. Coupled with upgraded models and simulations, this capability will be used to assess and evaluate hardware and software performance. M&S will also augment the development and assessment of advanced operational concepts and tactics, techniques, and procedures for MOUT operations, in addition to providing a mission rehearsal capability. In aggregate, the M&S effort will allow full operational exploitation of the technological advances.

Figure VIII–4 depicts the relationship of the major ground warfighter-related system developments. Lessons-learned from recent military operations in Bosnia, Macedonia, Haiti, and Somalia have highlighted the need to comprehensively address the needs of the infantry across the services. The ability to provide an overmatch capability does not exist for infantry forces. For example, any potential adversary can procure the same items that are provided to our warfighters. This gap in overmatch capability places our forces at substantial risk. Due to increased complexities of the post-cold war environment, a coordinated division of the associated challenges is an effective way to address shortcomings in military preparedness for today's as well as tomorrow's military threats.

There is no single answer to this complex problem. Several dimensions of the problem require attention: cross-service as well as unique service requirements, immediate versus long-term needs, level of technological risk, materiel versus operational/doctrinal focus, echelon of application (e.g., individual warfighter or battalion and above), and operational basing (e.g., ground, sea, air). As a result, DoD has adopted a multipronged approach to concurrently tackle different portions of the total MOUT operational challenge facing joint combat forces.

This approach ensures that military requirements of dismounted warfighters are being addressed simultaneously in an integrated fashion. In addition, it ensures that adequate attention is given to key challenges in a logical and focused manner to increase overall operational effectiveness. The approach divides the complex challenges into manageable, separable efforts, balancing technological initiatives with advances in operational concepts to address a wide range of MOUT-related problems. Each effort is focused on overcoming specific portions of the total challenge.

The Ground Warfighter Program Integration Council (PIC) was formed in FY97 to ensure appropriate couplings between these programs. Organizations represented in the PIC include Office of Science and Technology/United States Special Operations Command; U.S. Marine Corps Extending the Littoral Battlespace Advanced Concept Technology Demonstration; U.S. Army Training and Doctrine Command Dismounted Battlespace Battle Laboratory and TRADOC System Manager-Soldier; Secretary of the Army, Research, Development, and Acquisition; Joint Staff (J8); OSI/Marine Corps Combat Developments Command; Soldier Systems Command Natick Research, Development, and Engineering Command and PM-Soldier; Army Digitization Office; Army Materiel Command; Office of Naval Research; Defense Advanced Research Projects Agency Small Unit Operations PM; U.S. Marine Corps/Marine Corps Warfighting Laboratory; and Headquarters Department of the Army, Office of Deputy Chief of Staff for Operations and Planning.

The PIC was the catalyst for coherent program collaboration. The PIC objectives were as follows:

- Develop, maintain, and present coordinated and coherent program objectives and schedules.
- Disseminate information between and among programs to increase leverage and performance.
- Provide a forum to preclude programmatic duplication, integrate activities among the member programs, and resolve issues.
- Provide a forum to achieve synergy between programs.

- Identify and resolve issues, forwarding unresolved issues to the DDR&E-chartered Warrior Systems Technology Base Executive Steering Committee or other formal councils as appropriate.
- Provide a forum to ensure that the programs yield a consistent, joint architecture.

The major efforts involved were the Extending the Littoral Battlespace (ELB) ACTD, Urban Warrior AWE, Land Warrior, FXXILW, Small-Unit Operations (SUO), and MOUT ACTD. ELB and Urban Warrior include naval efforts addressing operational needs of forces to maneuver at sea and selectively project into urban areas. The ELB ACTD addresses the unique C^4ISR problems faced by the Navy/Marine Corps team—fighting a battle as a Naval Task Force, using sea-based Marines ashore and Navy ships at sea. The Urban Warrior AWE, the second phase of the Marine Corps' 5-year experimentation plan, is designed to address service-wide warfighting requirements for the Marine Air-Ground Task Force (MAGTF), as sea-based naval power projection forces employing ship-to-objective maneuver. The solutions will include changes in Marine Corps doctrine, organization, training, equipment, and support (DOTES) for urban terrain problems. Materiel solutions will be accelerated through the Marine Corps concept-based requirements process and the standard acquisition system.

The Army's Land Warrior program will field a dismounted soldier warfighting system and provides a platform and mechanism where MOUT enhancements for close combat can undergo transition for further engineering development, if needed, or insertion into production. FXXILW/Future Warrior Technology Integration is the S&T arm of the LW program providing technology risk reduction as well as advanced technology components for insertion into the LW system. It also provides the path for future technology upgrades from other programs within the context of an overall P^3I for LW.

The DARPA SUO effort focuses on leap-ahead, high-risk technologies in the communications, geolocation, and situational awareness areas that will provide evolutionary architectural changes for future block upgrades into appropriate acquisition programs. The communications and geolocation technologies are focused on assured operations in restrictive (urban, mountainous, forested) non-line-of-sight and hostile low probability of detection (LPD), low probability of intercept (LPI), and antijam (AJ) environments. These technologies will be demonstrated in an integrated situational awareness subsystem (SAS). Successful technologies in SUO will undergo transition to the FXXILW/ Future Warrior Technology Integration effort for insertion into LW for fielding or into other acquisition programs, as appropriate.

The Army/Marine Corps MOUT ACTD is the venue to integrate and demonstrate mature and advanced technical and operational solutions to 32 specific user requirements to improve the operational effectiveness of soldiers and Marines at echelons at battalion or below, operating in urban or built-up areas. All the MOUT ACTD technical solutions are leveraged from ongoing R&D efforts, including LW/FXXLW and SUO, and from commercial and government off-the-shelf products. THE MOUT ACTD focuses on the integration of these solutions into a system of systems. The tight linkage of technology enhancements into a system coupled with user operational concepts will enable the MOUT ACTD to assess the military utility of the individual/collective solutions, and to effect the transition of promising technologies to the appropriate acquisition program.

The programs discussed above support general Special Operations Forces (SOF) requirements. However, SOF-specific requirements are covered separately by Program 11 technology and acquisition efforts.

F. SUMMARY

Accomplishment of the objectives delineated in each of the MOUT DTOs reflects the integration of capabilities within a given operational area. These DTOs are, in effect, waypoints on the path to achieving a full spectrum of enhanced operational capability elements in MOUT. Each DTO represents a complement of interim capabilities within that specific area. The MOUT ACTD will complete the integration, interoperability, and linkage across many of these operational areas to achieve the full-spectrum, seamless MOUT capability, as illustrated in Figure VIII–5. The successful implementation of this technology plan will result in substantial improvements in the ability of U.S. forces to effectively and efficiently accomplish missions, including general war, contingency operations, counterinsurgency, and peace and humanitarian operations in built-up areas.

Measures of success will serve as quantitative goals for the MOUT ACTD. Although not defined for all potential technologies, the overall measures of success are defined in terms of percent improvements over the baseline MOUT capabilities, and applicable doctrinal and technical publications. Specific measures of outcome (MOEs) are in the areas of lethality, survivability, force protection, maneuver, C^4I, and unit/individual acceptance. Measures of effectiveness (MOEs and measures of performance (MOPs) for functional experiments and technology components will be developed and refined over the course of the ACTD. The model-test-model methodology will be used where appropriate. The base case and technology excursions will be modeled using the Joint Conflict and Tactical Simulation (JCATS), or other models incorporating technical, field experiment and terrain data, and urban scenarios. Based on runs of the base case and ACTD cases, specific MOE and MOP data can be collected to establish and enhance defensible analytical underpinnings.

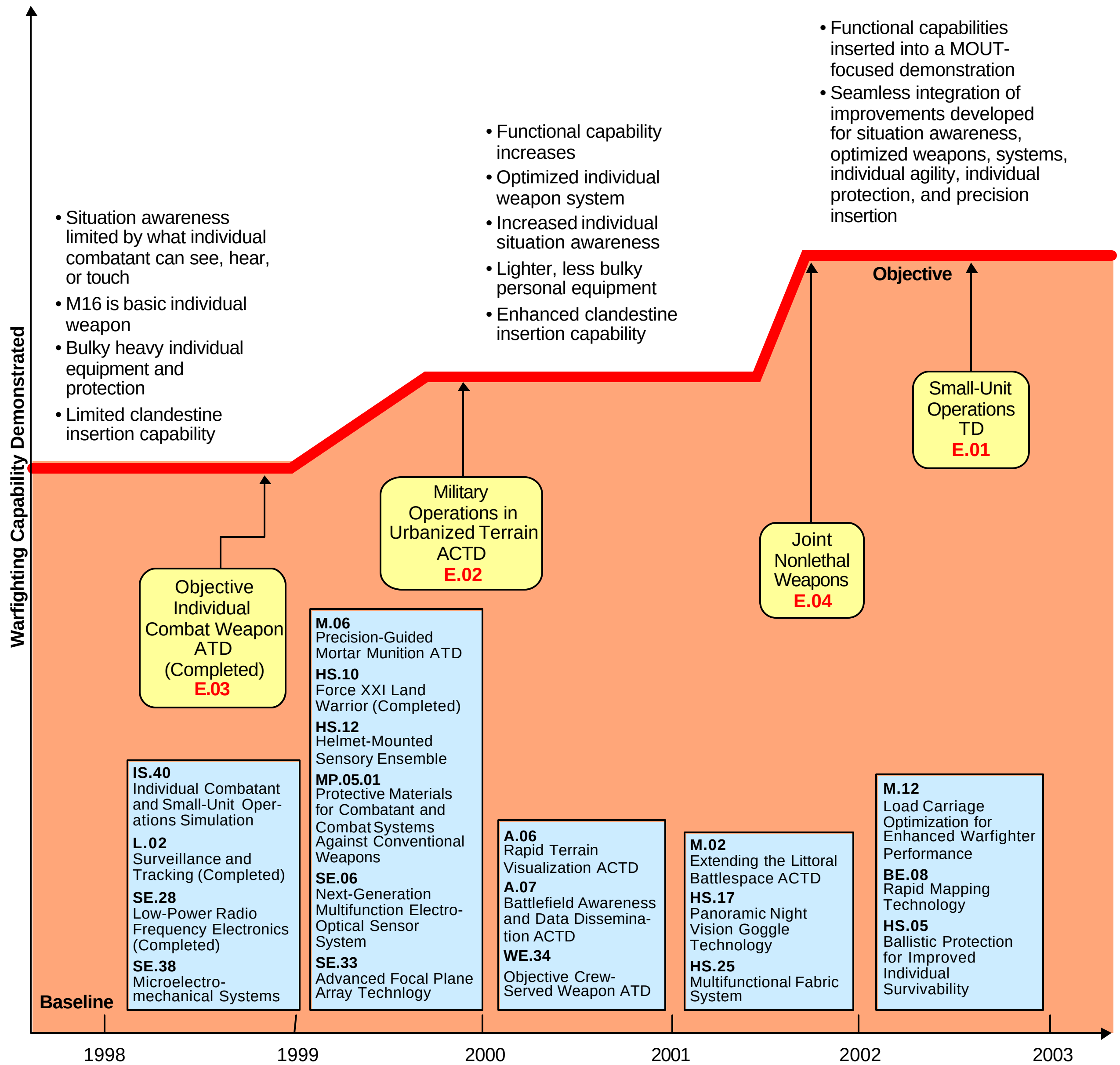


Figure VIII–5. Progress—Military Operations on Urbanized Terrain