

TRADOC PAMPHLET 525-92-1
THE CHANGING CHARACTER OF WARFARE
THE URBAN OPERATIONAL ENVIRONMENT



APRIL 2020

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Foreword

The U.S. Army faces numerous challenges in our current and near-term future operational environments. None will be more difficult than conducting operations in the world's urban areas. We need only cast our eyes over recent historical events to see that those operations will span the scope of possible contingencies: large scale combat operations (Baghdad and Mosul, for example), counterinsurgency (Kabul, Kandahar, and Iraq's cities once again), counterterrorism (9/11, London, Paris, and Mumbai), humanitarian assistance/disaster relief (Great East Asian Earthquake and the Fukushima-Daiichi nuclear reactor failure), and others. In short, our Soldiers will confront both nature's raw power and enemies' use of increasingly sophisticated technologies and tactics that will at times constrain employment of our own capabilities to maximum effect. Employment of innovative concepts applicable to both competition and armed conflict contingencies such as those inherent in Multi-Domain Operations will underlie our preparations, operations, and ultimate successes.

Technology will be an ally. Combat proficiency will be essential. Soldiers of every rank will also be diplomats: ambassadors to urban populations that are characterized more by how different their members are from us – and each other...even in the same city – than they are alike. As General Brown, Commanding General of U.S. Army Pacific noted recently, the most supportive urban areas still have criminal, terrorist, enemy, or other elements that seek to oppose us. Even if they represent only one percent of the population, that's 20,000 individuals in an urban population of 2 million. How much the other ninety-nine percent is behind us – or chooses instead to support our foes – will greatly depend on the decisions we make and choices we take. Nowhere else will a Soldier's actions have such immediate and longer-term effects at not only the tactical but the strategic level.

Like its parent document – U.S. Army Training and Doctrine Command Pamphlet 525-92, The Operational Environment and the Changing Character of Warfare – the assessment in the pages that follow does not seek to predict the future. Rather, it strives to describe the future operational environment. It is fundamental that we understand what challenges the future operational environment will present to our leaders and other Soldiers. This in-depth look at urban operations to come should cause us to consider their implications for the competition, armed conflict, and return to competition components of multi-domain operations. This publication provides a solid foundation for our thinking regarding the future operational environment, and its companion publications will help us further shape how the Army thinks, decides, competes, and fights for decades.

Army Strong!



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TRADOC Pamphlet 525-92-1

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Military Operations

The Changing Character of Warfare: The Urban Operational Environment

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History. This is a new U.S. Army Training and Doctrine Command pamphlet.

Summary. This pamphlet provides the future urban operational environment that Army forces will encounter as described by the U.S. Army Training and Doctrine Command G-2. It presents a continuum divided into two distinct timeframes: The Era of Accelerated Human Progress (2017-2035) and the Era of Contested Equality (2035-2050), which depict different doctrinal and technological challenges that the U.S. Army will face in the near to mid-future.

Applicability. This pamphlet applies to all Department of the Army activities that develop doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy capabilities.

Proponent and exception authority. The proponent of this document is the U.S. Army Training and Doctrine Command, Deputy Chief of Staff G-2, 950 Jefferson Avenue (ATIN), Fort Eustis, Virginia 23604-5763.

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Summary of Change

TRADOC Pamphlet 525-92-1

The Changing Character of Warfare: The Urban Operational Environment

This is a new pamphlet, dated 9 April 2020.

o This is a new publication intended to describe the future urban operational environment the Army will face now through 2050 in collaboration with U.S. Army Futures Command.

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Chapter 1

Introduction

1-1. Purpose

U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-92-1 describes the conditions future Army forces will face when operating in the world's urban areas across two distinct timeframes as described just below. It characterizes near-term advantages adversaries may have as well as breakthroughs in technology and convergences in capabilities in the far term that are likely to change the character of warfare. TRADOC Pamphlet 525-92-1 accounts for both timeframes to allow Army forces to train to an accurate and realistic future operational environment.

1-2. Scope

This pamphlet supports the collaborative Army transition to an operational environment (OE) developed by TRADOC and U.S. Army Futures Command (AFC). Critical inputs, thoughts, and lessons about the future resulted from a number of sources. A sampling in this regard includes historical and current literature on urban areas and the output from two megacity conferences, the first held in [New York City \(April 2018\)](#), the second in [Tokyo \(July 2019\)](#). The result draws on the expertise and experiences of cutting-edge leaders and thinkers from academia, media, nongovernmental and inter-governmental organizations, and the U.S. military and government to provide insights and recommendations regarding past and present urban operations as they advise preparations for future contingencies in these environments. Work from across the TRADOC G-2, particularly the monitoring and assessment of 12 key trends and technological game changers, further added to the body of knowledge for this pamphlet.

1-3. References

See [appendix A](#).

1-4. Explanation of abbreviations and terms

See the [glossary](#).

1-5. Records management requirements

As mandated by AR 25-400-2, the records management (recordkeeping) requirements for all record numbers, associated forms, and reports are included in the Army's Records Retention Schedule-Army. Detailed information for all related record numbers, forms, and reports associated with this regulation are located in RRS-A at <https://www.arims.army.mil>.

Chapter 2

The Changing Character of Warfare: The Urban Operational Environment

2-1. Considering the Future of Urban Operations

Taking a holistic approach when anticipating trends is essential when considering the future character of warfare and operational environment. It is no less fundamental to understand what lies ahead for urban operations. We are currently in an era of accelerated human progress, a period in which we, our adversaries, and other parties seize on new technologies, doctrine, means of communication, and revised concepts to enhance (in our case) or challenge U.S. military advantages. It is also a time of increasing urbanization. Fifty percent urbanized some 10 to 15 years ago, estimates expect 60 percent of the planet's population to be living in urban areas within the next decade and a half.

a. These evolutions will have – already have had – significant security implications for the United States and its global partners. At times challengers go toe-to-toe with U.S. capabilities; think enemy uses of unmanned aerial vehicles in 2017 Iraq. Other advantages are sought in entirely different competition spaces in order to avoid head-to-head confrontations given the extent of U.S. dominance. Foes' use of social media to undermine domestic U.S. support is an example. TRADOC Pamphlet 525-92, *The Operational Environment and the Changing Character of Warfare* (the parent document to that here), informs us that this period of accelerated human progress will continue. Another era will join it circa 2035: an era of contested equality, an event that will likely see advances in technology and capabilities significantly, even dramatically, altering the nature of warfare as we know it today. See figure 2-1, for a description of this era.

The era of contested equality [will be] marked by significant breakthroughs in technology and convergences in terms of capabilities which lead to significant changes in the character of warfare. During this period, traditional aspects of warfare undergo dramatic, almost revolutionary, changes which at the end of this timeframe may even challenge the very nature of warfare itself. In this era, no one actor is likely to have any long-term strategic or technological advantage, with aggregate power between the U.S. and its strategic competitors being equivalent, but not necessarily symmetric.

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Figure 2-1. The era of contested equality

b. Twelve trends are of particular note with respect to both the era of accelerated human progress and that of contested equality. See figure 2-2 for the twelve trends being monitored by G-2, TRADOC.

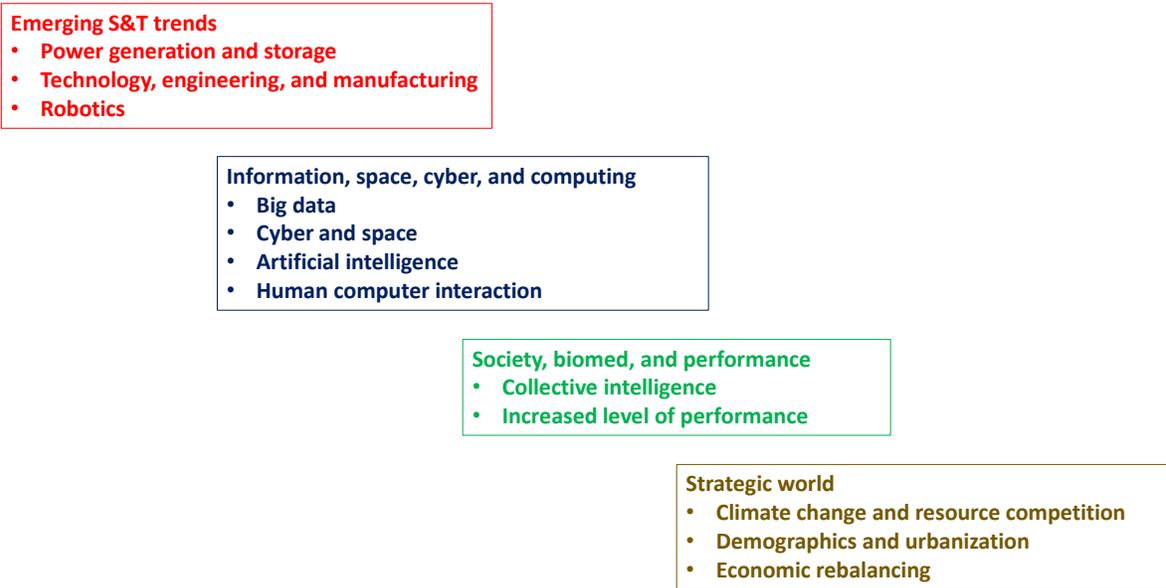


Figure 2-2. Twelve trends being monitored by G-2, TRADOC

c. TRADOC Pamphlet 525-92-1 focuses on one of these trends, “Demographics and Urbanization,” in order to consider its implications for future operational environments. Figure 2-3, details these implications.

Our adversaries will operate in and among populations and in complex terrain, and endeavor to mitigate many of our own traditional technological advantages and force us to operate with degraded capabilities and take advantage of the infrastructure and other resources cities offer. They will adopt hybrid strategies that take advantage of a range of capabilities that deny us a conventional force-on-force fight unless the situation is advantageous to the adversary. They will use proxy forces that provide plausible deniability yet directly allow them to not only shape the battlespace, but even achieve their objectives without risking a wider conflict.

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Figure 2-3. Demographics and urbanization implications for the operational environment

d. Further complicating responses to urban challenges is the requirement to prepare for operations anywhere along the range of military operations. Release of sarin nerve agent in the Tokyo subway in 1995; the 9/11 attacks on New York City and Washington, D.C.; more recent acts of terrorism in London, Paris, Boston, and elsewhere; and events targeting those working or residing in other urban areas verify that prominent cities are lucrative targets for an adversary wishing America and its partners ill. Yet it is stability and humanitarian operations, those at the other extreme of that range, that will prove more common – assistance rendered domestically or to a partner nation in the aftermath of a natural disaster, for example. The following pages consider the full scope of potential operations at the tactical, operational, and strategic levels.

2-2. Select assumptions

a. Urban areas of the future will retain the key feature of density in structures, people, networks and infrastructure. These densities will present a number of challenges and opportunities during combat and other operations. This is true even though public policy decisions have driven a reduction in some urban areas' densities despite increases in those cities' populations as built-up areas expand geographically. This trend could hasten its pace in the future given advances in information technology and decentralization in producing and delivering consumer goods.

b. Urban operations – particularly those in many of the planet's largest urban areas – inherently have global consequences due to the interconnectedness of the information, social, and economic spheres. These linkages will increase during the next 30 to 40 years.

c. The growth of urban areas and their influences on munitions (both lethal and nonlethal); intelligence, surveillance, and reconnaissance (ISR) systems; and additional capabilities will reinforce their centrality to military operations as foes seek the cover and concealment offered.

d. Urban areas serve as hubs for major transportation infrastructure (airports, ports, rail, and road systems), further reinforcing the conclusion that cities will inevitably be foci for military undertakings if for no other reason than a military force must move personnel, equipment, and logistical support through them.

Chapter 3 A Constantly Urbanizing World

3-1. Context: The urban world

The U.S. population became more urban than rural in 1920. The world did the same during the first decade of this millennium. Over half of the planet's politically significant urban areas lie within 100 kilometers of a coast, a situation of notable consequence given the coincidence of coastal areas' vulnerability to powerful storms, likelihood of being in an earthquake zone (many are located along the Pacific rim), and projected estimates of sea level rise during this century. These exposures put hundreds of millions of people at risk, but true recognition of the extent of that risk comes only with understanding urban areas' potential to impact the lives and security of others thousands of miles distant from a particular densely populated center. While India is de-urbanizing in some locations due to public policies guaranteeing minimum income to farmers, the world writ large continues its march toward increased urbanization. This is somewhat ironic from a historical perspective given past fears that too great a concentration of national treasures in one location was strategically unwise (recall the dispersal of economic and other hubs born of Cold War nuclear targeting concerns). Virtually all countries have now cast such fears aside in the face of urban consolidation's efficiencies of scale and inexorable human migration. Urban disasters – a consequence of Mother Nature or human malfeasance – will have consequences well beyond a built-up area as will, potentially, military responses to affected areas. As observed by former U.S. Pacific Command combatant commander Admiral Locklear, it is responses in the aftermath of natural disasters that are the more likely for our Army and its partners. That

disasters natural in origin will worsen in intensity is a near-given for select coastal cities as sea levels rise.

a. This interconnectedness means it will be difficult to determine the impact military operations will have on an urban area. Unfortunately, ascertaining higher-order effects in urban environments is particularly hard. We might think of rural operations as a pool table on which sit two or three numbered balls. Striking the cue ball might impact one, two, or all three of those numbered spheres...or, quite possibly, none. Regardless, determining the immediate and consequent effects of the interactions would be fairly straightforward. Now allow a full rack of numbered balls to represent 1 million urban residents. Using the popular definition of a megacity as one with 10 million or more in population, the higher-order effects become all but impossible to determine when one strikes the cue ball on a table with 10, 15, or more racks of numbered balls. Among the many factors comprising this complexity is the presence of multiple political and other authorities. Consider the megacity of Los Angeles. The political entity that is the City of Los Angeles (estimated population just short of 4 million in mid-2017) has a city government encompassing its police and fire authorities and many other organizations. The much larger entity that is the megacity of Los Angeles (2017 population over 15 million) contains numerous county, city, town, state, federal, and additional organizations.

b. The result. A very large number of governing authorities a coalition commander must deal with during future contingencies. Add to this the frequent non-line-of-sight interruptions imposed by structures above, below, and at ground level; the difficulty of distinguishing between noncombatants and enemy forces; the density of people, structures, and vehicles; and further factors and the magnitude of the challenge becomes all too apparent. Furthermore, weather and environmental effects such as rising sea levels, corruption, vulnerability to infrastructure interruptions, and the susceptibility of individuals to disinformation are sure to further burden any leader having to operate in these densely populated environments.

c. Fortunately, there are opportunities among an urban areas' buildings and populations. They are information-rich surroundings with every urban resident a potential source for intelligence. Cities are also wealthy in other potential resources: building supplies; means of communication; civilian vehicles; and members of police, fire, and other authorities who will have intimate knowledge of their environments.

3-2. The urban world challenges and opportunities

Understanding current and future political, military, economic, social, information, infrastructure, physical environment, and time (PMESII-PT) considerations during urban operations requires thinking of these environments in terms of challenges and opportunities offered at the tactical, operational, and strategic levels while constantly keeping possible second and higher order effects in mind. This will mean recognizing and ever-improving our comprehension of cities as systems. They are systems consisting of many subsystems. Each urban area is also a subsystem of its immediate environs and the country of which it is a part. It may also be a component of broader regional or even more far-flung systems. In no other setting will a coalition need to so persistently and consistently maintain focus on near-, mid-, and long-term objectives to maximize the likelihood that today's actions support rather than undermine those of tomorrow.

Chapter 4

Political, Military, Economic, Social, Information, Infrastructure, Physical Environment, and Time (PMESII-PT) and Urban Operations at the Strategic Level

4-1. Strategic political implications of urban operations

a. The potential strategic consequences of decisions made and actions taken by U.S. Soldiers during urban operations will reverberate politically well beyond the battlefield. They may also do so diplomatically with these political and diplomatic implications being both domestic and international. This is all the truer when the city is a major one: a capital, megacity, notable cultural center, or, as may be the case, all three. Reactions to the accidental bombing of the Chinese embassy in Belgrade and dramatic impact of the 9/11 attacks on New York and Washington, D.C., provide two examples. Similarly, identifying and responding appropriately to those segments of a population most in need of assistance during or in the aftermath of a disaster will set the tone for domestic and international public opinion regarding military operations. Bringing the appropriate authorities onside will be critical to coalition success in both the immediate and long terms.

b. And what of the world's most influential cities' political influence in 10, 20, or 30 years' time? As select cities account for a growing percentage of their country's gross domestic product, concentration of social elites, and ties to international counterparts, urban areas less constrained by centralized national or sub-state (for example, province) level governments may assert increasing degrees of autonomy. This evolution is most likely where sub-national political entities retain significant independence in terms of taxation authority, setting social policy, and economics. Yet more centralized country-level governments could also find themselves following a major urban area's lead; consolidation of influential social elites in major urban areas and the economic leverage these individuals wield could increasingly dictate national policies favoring the cities in which the wealthy and powerful live. This is all the more likely if the many separate political authorities that constitute larger urban areas recognize the value in cooperating rather than competing for resources, thereby creating synergies that magnify their collective power.

4-2. Strategic military implications of urban operations

Armed forces' responsibilities demand simultaneous responses to competing requirements. Failure lurks at all three levels of war for any force that merely views operations sequentially: win the battle, then address noncombatant concerns. In addition to understanding the immediate strategic consequences of combat actions, military leaders must realize that every yard of advance toward tactical victory represents three feet of increased noncombatant security and welfare responsibilities. Ideally these responsibilities will remain with the local government; in reality, a coalition will likely find itself supporting if not answerable for guaranteeing noncombatant security and providing aid/sustainment. Effective strategic level objective, mission, and commander's intent statements will be crucial to execution of mission command at the operational and tactical levels to preclude tactical-strategic objective disconnects. So too will being able to compete successfully in influencing key audiences as the many parties seeking to sway opinions employ increasingly sophisticated ways of spreading their version of truth or other propaganda. These will often appear in combination with traditional coercive means that

include use of para-military or armed civilians to influence situations via use of violence against friendly forces or members of the noncombatant population.

4-3. Strategic economic implications of urban operations

a. Strategic urban economic implications are a function of a city's size and role. Smaller urban areas tend to have local economic interactions with only limited reach beyond their immediate surroundings. Broader strategic issues are therefore less likely to arise than in larger cities.

b. Economic power translates into political, social, and therefore nation-wide influence, possibly resulting in dominant urban areas dictating policy to less well-financed or influence-constrained national governments. The result will be a virtual Medusa's head of challenges for a coalition leader: Which receives priority, the suffering members of an urban area's noncombatant population or those communities and infrastructures whose recovery will hasten local, national, and perhaps regional economic recovery, recovery that itself will influence citizen survival? Does the influential urban area continue to receive disproportionate aid even as less powerful, more dispersed, and thus difficult to service rural areas lack critical resources?

4-4. Strategic social implications of urban operations

Urban areas are ultimately and primarily *social* constructs. Analysis must consequently be viewed through a social lens. Adversaries and other interested parties will be aware of the preeminence of the social arena and attempt to influence an urban population accordingly. The increasing sophistication of influence capabilities is a notable concern in this regard. Improving means of targeting specific audiences with disinformation or biased reporting poses a threat to urban stability, thereby establishing conditions for inciting panic or undermining legitimate authorities' directives. For example, employing techniques such as Russian efforts to influence select audiences during the 2016 U.S. federal elections that capitalized on existing social fissures. Larger urban areas' populations will be particularly attractive in this regard as they may offer ethnic, cultural, economic, and other potential frictions ripe for manipulation. Internally displaced persons and others with a sense of alienation – those who recently moved into a city, for example – could be particularly vulnerable to such exploitation.

4-5. Strategic information implications of urban operations

Information is both an incalculable strategic asset and continuous headache for a force operating in urban areas. Urban areas tend to concentrate traditional media thanks to cities being transportation hubs and their capacity to house and offer other amenities to representatives of the vocation. As such, coalition members and host nation government authorities will have greater opportunity to communicate a narrative for consumption by nearby, national, and international audiences. Contrarily, maintaining a consistent narrative will be difficult given the number of authorities and coalition members present and with what are often conflicting objectives. For example, of local versus national politicians or between various members of a coalition. Added to this challenge is the need to account for the narratives of coalition adversaries. Furthermore, social media resources allow virtually any member of an urban population to report on, post photos of, or otherwise present their version of ongoing activities. These will vary from supportive to antipathetic. A particular source's effectiveness in influencing key audiences will

often be indiscernible until after the fact. It is crucial to understand what means of communicating with target audiences will be most effective. Radio? Television? Newspapers? Social media? (If so, which social media platforms?) Word of mouth? Other? Nor are informational considerations limited only to communications of the spoken or written sort. The most effective communications may take the form of action rather than words. Early 21st-century Shia murders and other forms of intimidation in Baghdad's Sunni neighborhoods provided messages impossible to misinterpret. A civilian infrastructure-crippling cyberattack coinciding with a coalition's arrival would undermine a population's trust even without accompanying threat disinformation in support.

4-6. Strategic infrastructure implications of urban operations

The complexity of today's urban interconnectedness – and urban areas' nature as systems – is nowhere more evident than in the realm of infrastructure. Recognition that infrastructures include both *physical* and *social* components is fundamental. The two are not so much linked as inextricably intertwined. An example from the 1991 Persian Gulf War demonstrates this relationship. Coalition forces struck military targets, avoiding the bombing of Baghdad's hospitals in the interest of humanitarianism. Fuel supplies, power generation facilities, and transportation nodes of potential use to Iraqi armed forces suffered while medical facilities remained untouched. The result: hospitals lacked the power needed to function. Backup generators ran out of fuel. Doctors, nurses, and patients could not reach their place of work. The physical infrastructure elements (petroleum storage, electrical plants, bridges, hospitals) were parts of Baghdad's medical care system. The social components (for example, providers, patients, and maintenance personnel) could not function without the supporting physical infrastructure despite medical structures themselves remaining intact.

a. What does this mean for future urban targeting or operational security? More sophisticated use of critical path method-type target analyses must become the norm. Urban areas' hyper-complexity means that artificial intelligence (AI) will inevitably find use here. For example, adversaries employing AI should be better able to:

(1) Identify single or multiple physical infrastructure nodes along critical paths, (in other words, nodes that will maximize desired effects when targeted and thus must be protected if we are in a defensive mode);

(2) Gauge higher-order effects able to provide synergistic consequences of targeting, for example recognizing that a strike miles distant or different in character can neutralize an ultimate target (for example, destroying a pump station servicing a neighborhood magnifies the effects of bombing as firefighters cannot extinguish the flames); and

(3) Obtain complementary effects by targeting key components of both physical and social infrastructures, thereby making defense and recovery more difficult.

b. Sophisticated AI-supported analysis may eventually additionally allow adversaries (or friendly forces) to perform "boutique targeting," targeting that affects only those parties or creates only those effects that best service targeter ends.

4-7. Strategic physical environment implications of urban operations

An urban area's physical environment consists of both natural and manmade terrain. As with physical and social infrastructure, the two are interwoven. Tactical and operational targeting can have immediate strategic implications. These include the difficulty of precluding noncombatant casualties due to innocents seeking shelter in buildings and the resultant international pressures to cease further operations. Adversaries use of proscribed targets for cover and concealment (hospitals, religious structures), and foes positioning themselves adjacent to or in civilian housing and similar features can result in similar calls for constraining or ceasing further action. Interruptions in normal air, ground, and sea traffic will also have local consequences for sustaining operations and supporting local populations. Further, as noted in the discussion of strategic economic implications just above, larger cities in particular will have both local and broader interdependencies, for example, the implications of interrupting commerce in Los Angeles will quickly impact food, medical supplies, and additional goods and services not only in the United States but also worldwide. Pressures to reopen key transportation nodes will be significant. The difficulties will be more severe in years to come. Sea level rises mean the consequences of natural disasters such as hurricanes, earthquakes, and tsunamis will be greater in magnitude, broader in geographic scope, and more far-reaching in negative consequences for the urban populations suffering their vagaries.

4-8. Strategic time implications of urban operations

The variable of time underlies many of the above strategic observations. To reiterate what is the critical consideration in this regard, orchestrating coalition member activities such that actions taken and decisions made today are optimized in light of mid- and long-term objectives is essential to avoid undercutting ultimate success. There is also a cultural element to time. Authorities in some cultures will require extensive demonstrations of social courtesy before addressing questions at hand. In other cases, those meeting with coalition leaders may have to converse with peers, confirm with superiors, or generate community support before providing a decision. Such cultural mores will differ between urban neighborhoods; in some cases, processes will vary even within a neighborhood. Such delays will be frustrating for leaders, but patience in the short-term may well hasten cooperation in the longer.

Chapter 5

PMESII-PT and Urban Operations at the Operational Level

5-1. Operational level political implications of urban operations

The difficulty of determining possible second- and higher-order effects means orchestrating tactical actions in the service of strategic objectives is rarely more difficult than during urban operations. The highly politicized nature of urban environments adds to the challenge, the more so when the city in question is a national capital or urban area with extraordinary international influence in one or more sectors. Ensuring multi-disciplinary consideration during planning and execution is essential and requires substantive participation by a whole-of-government and broader team. This will be no less a truth in 2035 and 2050 than today, just as it has been consistently since the beginnings of World War II, yet achieving even a modicum of the full potential of this cooperation remains elusive.

5-2. Operational level military implications of urban operations

Leaders at the operational level benefit from clear and regularly-adapted strategic mission command guidance. They in turn need to provide similarly helpful direction to military subordinates to keep them abreast of evolving political, diplomatic, and other strategic considerations. The compartmentalized character of tactical operations in cities requires senior leaders to wisely craft missions and intents for their subordinates. This guidance needs to be broader in scope than is the case in most other environments given that units at even the lowest echelons are likely to find themselves quickly transitioning between combat, stability, and noncombatant support activities if not conducting all three simultaneously. Similarly, urban operations will often see the multi-domain operations (MDO) stages of competition, armed conflict, and return to competition occurring simultaneously in time and space. An inevitable but thus far unaddressed challenge: instilling mission and intent such that both are accurately incorporated into AI analysis and – as we achieve singularity in various fields – automated decision-making. (Singularity refers to the point at which AI or other technological capabilities exceed human intelligence.)

5-3. Operational level economic implications of urban operations

Operational level leaders must remain aware of the economic implications of tactical activities as they seek to orchestrate the immediate, interim, and distant-in-time goals of the many parties involved. Remaining aware of economic consequences helps decision-makers by identifying which commercial processes are most important to sustaining operations and minimizing the resources needed during recovery (for example, food availability, employment for noncombatants) or facilitating quick return of private sector functions in this regard, thereby reducing coalition support and urban recovery burdens. Alternatively, both offensive targeting and operational security will demand understanding of primary and higher-order effects so that the goals sought are achieved with acceptable collateral damage or critical nodes are defended in light of both immediate and higher-order effects. Savvy targeting (or defense) in key urban areas will recognize which and what types of strikes – cyber, informational, or others via lethal or nonlethal means – will have the impact desired locally, nationally, and internationally in the economic arena.

5-4. Operational level social implications of urban operations

Favorably influencing social perspectives and related behaviors is an unceasing struggle during urban operations regardless of the level of war. The social and information components of PMESII-PT will constantly be bonded, demanding that course of action evaluations and red teaming efforts include relevant urban populations' perspectives. (It must be populations', plural, as an urban population should never be considered a homogeneous whole. Course of action evaluations and red team processes have to include identification of mission-relevant civilian individuals and groups, thereafter representing their views and interrelationships separately or collectively during war-gaming as environmental conditions dictate.) Capabilities to mold perceptions via ever more sophisticated marketing tools, hyper-realistic animation, and spoofing of legitimate information sources will proliferate just as have other communications technologies during the past generation. (AI may assist in this regard in the future.) This poses what is perhaps the primary threat to coalition operations in the 20 to 30 years to come. As with higher-order effects, meeting this challenge will be complicated by the virtual impossibility of pre-recognizing the potential effects of messages on various recipients, both those initially

targeted and others who receive messages via retransmission. Intelligence requirements will include identifying intra-population fault lines on which an adversary or our forces can capitalize to exacerbate social divisions, for example, separating key supporters from a government or other group as was done in isolating the regime of Slobodan Milosevic from Serbian elites circa 2000.

5-5. Operational level information implications of urban operations

The information realm potentially extends the reach of even low-level tactical influence initiatives far beyond any geographic control measure. Virtually every tactical event can have positive or negative effects on operational level or strategic narratives. Tactical-level decisions will impact how those events influence strategic narratives. The operational level by default must become the adjustable lens through which these tactical actions and messages pass to audiences worldwide, a task that will be increasingly demanding as means of influencing populations become more sophisticated.

5-6. Operational level infrastructure implications of urban operations

Understanding higher-level interactions between infrastructure components has proved surprisingly difficult in the past. It will become a greater challenge yet in those urban areas where currently competing political authorities increase cooperation, thereby magnifying the complexity of infrastructure systems linked across wider geographic and social spectrums. Effective coordination at the upper tactical and operational echelons could preclude resource wastage and local lack of confidence in coalition initiatives. For example, unit funding of water supply or sewage removal piping should not be initiated unless it is destined to be linked to a system-wide design that ensures those pipes are connected to pumping stations and subsystem components (a seemingly obvious observation yet one violated in practice during Operation Iraqi Freedom). Understanding that cities today often obtain water from sources tens if not hundreds of kilometers distant from the urban area itself means higher-level headquarters will need to synchronize infrastructure initiatives that influence multiple units' areas of operation. Construction of school buildings without consideration of cultural norms (can male and female students be taught together?); the ability to fund furniture, textbooks, latrines, water, and other needs; local presence of teachers and assurance of their salaries; and post-construction facility maintenance by local authorities is only a sample of the types of issues that accompany planning for any structure. Here again, the essentiality of maintaining a systems perspective comes to the fore. Operational-level commanders will find that this systems approach demands managing the efforts of multiple organizations and funding streams, a complicated task given that recent history shows even identification of relevant parties can prove daunting. Consideration must also include urban areas' role as nodes in larger infrastructure systems. Leaders having to allocate resources to an urban area can expect plentiful "assistance" as some in better-connected urban communities seek precedence over others in greater need. As with water supplies, the vulnerabilities of urban areas to cyber and other forms of attack against power-generating infrastructure components that may be distant from an urban area will pose management challenges beyond tactical-level capabilities. Cyber or physical targeting of ports, airfields, telecommunications facilities, fuel distribution, or other resources can have immediate and far-reaching security and stability consequences. As means of performing such attacks become more refined and varied, so too must our ways of denying success to adversaries and overcoming

their efforts to conceal their identities. For example, through the use of robots or surrogate computers used unbeknownst to their owners.

5-7. Operational level physical environment implications of urban operations

Physical environment considerations at the operational level will require orchestration of tactical initiatives throughout an urban area (as alluded to in the infrastructure discussion above regarding water-delivery systems). Use of waterways, reservoir and lake water, airspace, and perishable resources such as wooded areas must be coordinated across the geographic and social space while maintaining an eye on longer-term objectives and the urban area's recovery.

5-8. Operational Level Time Implications of Urban Operations

As is evident from review of the strategic implications of time, it is operational level leaders who will have to mold guidance and provide necessary supervision to ensure actions taken today promote further success tomorrow while ensuring that time's changing demands are addressed to maximum effectiveness.

Chapter 6

PMESII-PT and Urban Operations at the Tactical Level

6-1. Tactical political implications of urban operations

As has been noted, larger urban environments have multiple formal political authorities. There will also be many less formal but nonetheless politically-influential leaders and organizations, to include neighborhood associations, unions, faith-based organizations (FBOs), and other stakeholders. Understanding local dynamics allows units to operate more effectively during armed conflict, low-intensity contingencies, or when in support of reconstruction efforts. The ability to understand the political landscape aids commanders in their decision-making process and limits confusion in these complex environments. Ground commanders should know the form of government and the relevant actors within their respective areas of responsibility regardless of operation type. They should also understand the limitations of local governments and end goals of all relevant local players in the context of U.S. objectives. Additionally, commanders should focus on understanding the relationship a population has with its government and any baseline expectations its members have regarding support from host nation or multinational participants. Knowing where the enemy enjoys popular support helps commanders and staff during planning and abets understanding of requirements needed from potential partners as well as informing force ratio decisions (and, conceivably, where to assign coalition assets to greatest effect). Supporting these ends means Army leaders must similarly cultivate a broad grasp of operational and strategic objectives in their subordinates down to the lowest tactical levels. (Though doctrinal guidance has long been that subordinate leaders should be aware of their seniors' intents two levels above, the potential for even the lowest level tactical actions to have strategic consequences during urban operations suggests this might no longer be an acceptable minimum.) They thereby develop perceptive leaders whose decisions and actions support rather than undermine coalition goals. Such leaders epitomize what U.S. Marine Corps General Charles Krulak hoped to find in his "strategic corporals," those in charge of sections, squads, and other lower echelon units whose decisions can have dramatic strategic consequences.

6-2. Tactical military implications of urban operations

Dense urban environments consist of multiple military components spanning the continuum from adversarial through neutral to friendly. These may include militia (government-, faction-, or individually-sponsored) or other organizations manned by members of the local population that will oppose or support friendly forces or seek to serve what they see as a neutral function such as defending their neighborhoods. Tactical ground commanders must understand how to employ manmade structures, local infrastructure, underlying terrain, and communications to their advantage while also cultivating popular support. They must be equally savvy regarding how other military and civilian parties are likely to do so. The density of features in urban terrain means that each bomb, bullet, and missile carries with it a potential for collateral damage causing increased hostility or diminished support from the civilian populace. An artillery strike might make eminent sense in terms of the immediate tactical situation while creating rubble that later impedes maneuver, provides the foe an effective defensive position, or turns popular support away from coalition forces. Barring a significant near-term leap forward (for example, small arms munitions capable of honing in on designated individual cell phone signals), engagements will inevitably unintentionally wound or kill. Only by recognizing potential second and higher-order effects can a commander hope to mitigate risks to force and mission while establishing a foundation for ultimate success at all levels of war. Tactical patience, precision effects, and the judicious application of lethality or nonlethal capabilities will remain the hallmarks of successful tactical commanders during combat operations. Similar restraint will underlie effective action when missions do not involve combat.

6-3. Tactical economic implications of urban operations

a. Tactical leaders must likewise be aware of local economic conditions. They should seek both to minimally disrupt civilian economic pursuits and support timely post-disaster recovery. Sustaining life can be a fragile state of affairs in today's cities, especially so for the most destitute of urban poor. Seemingly minor disruptions of economic functions can create life and death situations for those living hand to mouth on a daily basis. Loss of a single sheep, truck, or house is an unfortunate but limited-impact event in rural environments. (However, Soldiers should not be surprised to find crops and livestock in urban areas; the former are common even in developed world megacities as residents seek to provide alternative food sources.) Such limited damage will unfortunately be less common during operations in cities due to close proximities imposed by urban densities. Damage to infrastructure, food chains, or community housing compounds will have magnified consequences when throughput capacity at air and sea ports of debarkation is strained as will often be the case during active operations. Leaders must also understand that the impact of their operations will be amplified for better or worse when interacting with particularly influential individuals or groups.

b. Integrating civil affairs and maintaining a whole of government approach that includes other government agencies such as U.S. Agency for International Development and nongovernmental/inter-governmental organizations increases knowledge of local conditions while at the same time bringing additional capabilities to bear in the service of common or overlapping objectives, to include noncombatant welfare. Locations of banks and financial centers may be named areas of interest worthy of special consideration when developing rules of

engagement for lethal, cyber, or other forms of engagement, particularly when those or similar institutions are connected with national, regional, or global markets.

6-4. Tactical social implications of urban operations

The cohesiveness and volatility found in an urban environment is largely determined by its social dynamics. Chances of mission accomplishment are enhanced if leaders understand the character and relationships of groups and sub-groups within their areas of responsibility. While social groups in rural environments are often delineated by ethnicity, religion, or tribe, divisions in larger cities can be more subtle. Understanding these dynamics helps commanders interpret the actions of and determine information requirements regarding the people within areas of operations. Commanders need to know who the influential members of various groups are to understand formal and informal power structures.

6-5. Tactical information implications of urban operations

a. Leaders will discover that information moves quickly through these social infrastructures, easily outpacing ground force maneuver. The numerous ways of communicating and urban areas' population densities mean coalition (and other) messages can reach farther faster. Matching means to message and target audience will be crucial. A new billboard in a small town noticeably impacts the information environment; twenty new billboards in a city the size of Jakarta is likely to have negligible effect while blanket text messaging can reach throughout its population in a matter of minutes.

b. Tactical commanders will find the information environment no less contested than a battlefield. As seen in Iraq during the fight against the Islamic State of Iraq and Syria, enemy combatants will use platforms such as Twitter to mobilize supporters, coordinate tactical activities, and intimidate. Understanding how to co-opt messengers (to include those re-tweeting messages) or influence local narratives will be significant during information campaign competition. The playing field is not a level one. Adversaries and other significant influencers (often remote from an area of operations) will spread disinformation to discredit U.S. forces or otherwise advance their own goals. The global interconnectedness of cities also increases the likelihood that near-peer competitor states such as Russia and China will monitor and attempt to influence coalition force actions, to include via direct communication with our and host nation domestic populations. Operational and information security both become increasingly difficult due to the ubiquitous flow of information.

6-6. Tactical infrastructure implications of urban operations

a. Cities require massive infrastructure to maintain their populations, meaning commanders must be aware of the consequences of damage to these critical systems. Vital infrastructure such as power plants, dams, hospitals, and water supplies may constitute key terrain for tactical commanders. The flow and connectedness inherent in urban environments include providing residents' food and other resources that are fundamental to survival. These lifelines need to be preserved. Unfortunately, most military leaders have only limited training or experience regarding the processes underlying successful civil administration. Host nation elements will be key to understanding integrated processes and identifying which aspects of the infrastructure

require the most attention, conditions that will change over time depending on season and other factors. Cyber and telecommunications can be among the most important infrastructure elements. Recent examples in Ukraine and Egypt demonstrate that disrupting the information infrastructure can lead to civil uprisings or panic, either of which further complicates operations. Commercial and public security concerns regarding node vulnerabilities may influence the character of future power, water, sewerage, communications, and other distribution as organizations seek to avoid loss of these vital services due their current reliance on a limited number of distribution points.

b. A trend likely to pick up pace in the coming years: more building down to accompany that going up. Building down – whether for security purposes as with Pyongyang’s deep subway or Tokyo’s massive underground flood control system – means infrastructure below ground will offer new threats and opportunities. The likelihood of future expansion in this direction is evident in the Tokyo government’s dictates that define land or property rights more than 40 meters underground.

6-7. Tactical physical environment implications of urban operations

Urban environments’ physical environment characteristics present unique challenges in any of their three dimensions of above, below, or at ground level. Maneuver, protection, intelligence gathering, communications, fires, and battle damage assessment are among the issues. Vertical and subterranean features will disrupt line-of-sight (LOS), complicating situational awareness, increasing risk, and requiring adaptive leaders trained and practiced in the nuances of mission command. Concentrations of tall buildings mask potential target areas and create taxing angles, thereby complicating employment of fires. Obstacles also complicate access to landing zones. Bridges and tunnels canalize movement. Drainage and utility conduits run under roadways, on the underside of bridges, and along the sides or ceilings of tunnel features. The weight or size of military vehicles may exceed the capacity of such structures, especially in developing countries, necessitating the use of smaller vehicles that lack armor. The physical environment can dramatically influence force ratios as commanders find themselves dealing with greater densities of potential firing positions, mobility corridors, and other tactical features than are apparent on a map. Additionally, the effects of weather in urban environments can be even more unpredictable and damaging than in an open environment (for example, flooding of subterranean and already canalized areas due to heavy rain, creation of heat islands and micro-scale wind patterns between buildings impacting unmanned aerial vehicle operations, and smog obstructing surveillance).

6-8. Tactical time implications of urban operations

Urban environments tend to increase the tempo of military operations. Further, the complexity of urban environments combines with its dynamic nature to make maintaining situational awareness a never-ending challenge. Terrain features – moveable and immovable – can change rapidly over time thanks to construction, vehicle traffic, and population movement, making intelligence analysis a process akin to weather forecasting. Daily events such as rush hour complicate even basic movement. Work-day cycles determine where and when population numbers will spike, offering clever adversaries concealment for nefarious activities. Holidays, celebrations, special events, and religious practices further influence urban population behaviors. Unit rotation complicates understanding in this regard; year-long or shorter tours mean Soldiers

experience an annual event once, if at all. It took multiple deployments for many tactical commanders in Iraq to adapt effectively to key events like Ramadan.

6-9. PMESII-PT summary

Urban areas are replete with challenges for the twenty-first-century Soldier. Yet the shrewd leader and perceptive operator will see plentiful opportunities where others see only difficulty. Recall that a numerous and dense population provides myriad eyes and ears that can provide invaluable input to intelligence collectors. The same hum of daily activity potentially shielding an adversary's wicked intentions offers coalition forces equal opportunity. The larger the urban area, the greater the number of surface, subterranean, and super-surface approaches available to flank or envelop enemy defenses. Innovation, initiative, and discipline will favor the bold.

Chapter 7

Mission Command Considerations during Urban Operations

7. The criticality of mission command during urban operations

a. Properly employing mission command is nowhere more critical than in urban environments. Interruptions of communications will be commonplace. See Army Doctrine Reference Publication 6-0, where mission command is defined as “the exercise of authority and direction by the commander using mission orders to enable disciplined initiative within the commander’s intent to empower agile and adaptive leaders in the conduct of unified land operations.... [It] emphasizes centralized intent and dispersed execution.” “Mission orders” are in turn defined as “directives that emphasize to subordinates the results to be attained, not how they are to achieve them.” The same non-line-of-sight challenges complicating communications and fires will also impede situational awareness. This will prove true even with employment of unmanned aerial or ground vehicles and yet-to-be-fielded information and communications technologies given that many activities take place in subterranean cavities, building interiors, or amongst noncombatant concentrations. Monitoring will be difficult due to the narrowness of streets and use of tarps, corrugated metal, and other materials to block overhead monitoring and entryways to alleys in slums, refugee camps, and similar features. While AI and other means of more effectively accessing, compiling, and analyzing the extensive data will enhance situational awareness to an extent – thereby allowing commanders to better “see” the character of the environment than has previously been possible – clear guidance in the form of excellent mission and commander’s intent statements will continue to be crucial given the dynamic nature of urban operations and their associated environments.

b. As there is an ever-increasing need to partner with other-than-military (and other-than-government) organizations during urban contingencies, it is fortunate that some non-military organizations apply forms of command and control akin to mission command. Some police departments, firefighting organizations, and nongovernmental organizations routinely employ a form of mission command. Its fundamental elements – clear mission and intent statements; decentralization based on trust; adapting the extent of guidance and freedom of action based on a subordinate’s proven performance and a leader’s familiarity with the individual; subordinates’ recognizing that the boss needs to check even the most able of more junior leaders; and those

subordinates also keeping seniors informed to the extent feasible – are integral to the convergence sought during undertakings in urban environments. An absence of effective mission command means those at lower echelons are denied the flexibility essential to keeping pace with dynamic circumstances. With it, however, a coalition can practice what Chief of the Australian Army, Major General Rick Burr, called “combat Darwinism.” (See Russell W. Glenn, et al., *Where None have Gone Before: Operational and Strategic Perspectives on Multi-Domain Operations in Megacities*.) According to Burr, it may well be the agile organization able to meet urban operations’ ever-evolving operational demands rather than the strongest that succeeds. Training, intelligence, and other preparations cannot identify every possible contingency. What they can do via mission command is groom men and women to respond effectively when conditions change and new challenges arise. (See *Where None have Gone Before: Operational and Strategic Perspectives on Multi-Domain Operations in Megacities*, 2018.)

Chapter 8

Technological Challenges and Initiatives during Urban Operations

8. Technology and the urban environment

a. Urban operations will at times require significant adaptation of existing equipment. Modeling and simulations (M&S) capabilities will need frequent review and updating given urban environments’ dynamic character. Innovative, even radically new, technologies will in some cases be essential in order for the Army to conduct future urban operations effectively. These capabilities must address requirements throughout the range of possible contingencies. Such technologies’ introduction may in addition require adaptation of one or more doctrine, organization, training, material, leadership and education, personnel, facilities, and policy elements.

b. Urban areas’ sprawl and density present challenges across all warfighting functions. The three-dimensional nature of their environments degrades and can completely interdict communications, ISR systems, sensors, munitions trajectories, maneuver, and global positioning capabilities. Those employing various technologies will need to account for ever-changing environmental factors, both physical and social. Receptiveness to a technology’s employment may differ given cultural norms, requiring commanders and staffs to be aware of potential counterproductive responses. Tactics, techniques, and procedures will accordingly need adjustment.

c. The aforementioned LOS restrictions will present among the most difficult technological hurdles. LOS communications are in particular highly susceptible to degradation if not outright denial. Pending development of communications capable of penetrating or bypassing obstacles, units and personnel will be reliant on relays to maintain reliable, secure, low-probability-of-intercept signals. This is especially true once a unit enters structure interiors or subterranean features. Convoluted navigation routes, movement between floors, and both the thickness and density of building materials can require high numbers of signal relays. Reliance on non-autonomous unmanned systems will compound difficulties. Barring development of new

technologies, solutions will have to draw on capabilities such as atomic clocks and inertial guidance systems in addition to relays. Electronic warfare activities, both signals collection and jamming, will similarly be impacted. Smaller, networked, remote jammers and collection systems will be needed to overcome these restrictions.

d. Sensors supporting intelligence operations, targeting, and command and control will also require solutions to overcome these issues. Capable of overcoming problems posed by subterranean and vertical terrain, they must also be sufficiently difficult to detect or displace to avoid neutralization by human interference or routine urban environmental factors such as vehicle-induced vibration. Geospatial intelligence will be required to accurately represent complex terrain, including that subterranean and internal to structures. Sensors capable of “seeing” through walls and other visual barriers and others with resolution and multi-functional capabilities beyond those currently available would be invaluable for both mapping and detection purposes (for example, providing a visual image while simultaneously testing the environment for the presence of explosive residue). Regardless, even as we reach this century’s midway point, it will be the millions of human eyes and ears whose owners live in, work in, and visit the world’s largest urban areas that remain key sensors. Technologies allowing better filtering of legitimate from proscribed targets will increasingly be in demand as foes seek to shield their human and equipment means of delivering lethal fires and soft influence while immersed in an urban areas’ mass of citizenry and structures.

e. LOS directly impacts engagement systems as well. Structures block munitions trajectories and impede aviation operations. Flight path planning and predicting indirect fire trajectories will be challenging; continuous updating of maps, photo images, and other resources will be fundamental to monitoring what are constant changes to urban landscapes. The former is exacerbated by difficulties in detecting counter-air systems amidst urban physical and signals clutter. Extreme variances in building elevations and urban canyons create challenges for airspace control, deconfliction, and mission planning, a problem made more difficult in the presence of commercial and private air traffic and increased use of unmanned aerial vehicles. Turbulence induced by urban micro-climates adds to these complications.

f. Noncombatants can number in the millions during major force-on-force urban combat operations. Avoiding their injury to the extent possible may be fundamental to strategic success. Positive identification will be far more difficult than in most rural terrain given civilians residing in buildings or other structures and in close proximity to enemy forces. Avoiding collateral casualties is further complicated by munitions effects that differ depending on building material properties and structural designs. Future lethal systems will ideally be capable of discerning between combatant and non-combatant. Munitions capable of scalable effects could additionally reduce the likelihood of collateral injury to innocents and infrastructure.

g. Many benefits will accrue from being able to exploit the physical and social infrastructures of a modern, highly connected city. Knowledgeable systems managers and engineers can exploit the former. The Army must possess the ability to conduct cyber intelligence preparation of the battlefield and ISR; leverage social media and other information sources; and conduct focused, comprehensive information operations in ways favorable to mission accomplishment.

h. Sustainment operations are an area of specific concern during urban operations. Isolated units and those operating in a highly dispersed manner will complicate support operations already hindered by the vulnerability of street-level supply lines. Robotic vehicles capable of delivering supplies autonomously or in conjunction with manned systems will mitigate these challenges, the more so when they can autonomously select routes in real time where interdiction is less likely. (This capability will be no less effective in delivering munitions to otherwise difficult to strike or otherwise inaccessible targets. The operational security and deception opportunities inherent in the pending ubiquity of robots is ripe terrain for future research.) Vertical resupply of forces operating in high-rise buildings, subterranean navigation and movement, and the ability to penetrate barriers (for example, interior walls) when necessary will enhance such systems' value. Similar capabilities will prove valuable for casualty evacuation.

i. High-rise urban canyons can create pockets of micro-climates – local weather conditions distinct from those in more open areas. Swirling winds, updrafts, and other phenomena will impact manned and unmanned air activity; degrade sensor employment; limit visibility or acoustic reflection; influence the movement of chemical, biological, and radiological agents/materials; or generate other effects. Subterranean features such as basements, utility tunnels, and subway systems offer maneuver opportunities even as they similarly present risks such as asphyxiation, sudden flooding, and enemy infiltration. Those operating in urban areas will therefore benefit from the fielding of small, autonomous weather and hazardous material/agent sensors. The last may be encountered due to deliberate or inadvertent release; industrial areas contain hazardous chemicals that can be accidentally dispersed due to friendly force fires. Radioactive materials are commonly found in urban areas given uses that include nuclear medicine and radioactive imaging. Early identification of sites containing such potential hazards and unmanned delivery of sensors to provide early detection are both desirable. Reliance on subterranean features for storage, housing medical units, headquarters, troop rest, or other purposes will merit reconsideration if a foe possesses heavier-than-air agents.

j. AI will be fundamental in compiling and analyzing information from human, vibratory, visual, audio, signals, and other sources, thereafter translating it into a quality and quantity consumable by human decision-makers. Humans will increasingly be removed from select decision-making processes in pending decades as faith in AI “judgment” and capabilities increases, reducing if not eliminating the time those humans need to make, disseminate, and put decisions into effect.

Chapter 9.

Urban Operations Training at all three Levels of War

9-1. Urban operations training overview

a. Tactical level urban operations training continues to improve thanks to recognition given the inevitability of such operations in the future. Terrain walks in major U.S. cities emphasizing various security challenges are becoming commonplace, allowing leaders and led to grasp the nature of these environments. This increased familiarity with real world environments complements exercises at the many purpose-built training sites around the country and

internationally, revealing opportunities during which Soldiers could use covered and concealed passageways. (Similar approaches may have value when moving noncombatants through contaminated urban terrain or that under fire.) There is an outstanding need for modeling and simulation to effectively represent encounters with enemy personnel; noncombatants of various (and, perhaps, varying) sympathies toward coalition, adversary, or other parties; and members of other coalition organizations, those unassociated with the coalition, and local authorities. These simulations would also be valuable in demonstrating the spectrum of responsibilities junior-most leaders will confront in tomorrow's cities. These include calls for simultaneously conducting combat operations, preserving stability (for example, preventing looting or controlling riots), and providing relief to noncombatants. Well-designed training and simulations will need to demonstrate links between actions taken now and consequences in coming months and years just as they will the consequences of those actions on operational and strategic objectives.

b. There is as of yet little training available to prepare leaders for contingencies at the operational and strategic levels. Managing combat operations will sometimes prove of secondary importance to other diplomatic, informational, military, or economic elements. Integrating these interdependent considerations will be fundamental to converting battlefield successes into lasting victories. Whether training involves experts of appropriate gravitas from all PMESII-PT arenas in a live environment or leaders being forced to face the complexity of urban operations and their local, national, and broader implications via simulation, scenarios must cover the full range of military operations to include contingencies when combat operations are of subordinate concern.

9-2. Urban training facilities

In the Army, the word "urban" when referencing training areas has typically indicated a facility with a cluster of man-made structures replicating a village or town. These are often instrumented using global positioning system trackers and cameras to provide feedback during after action reviews (AARs). Due to various limitations, most Army urban training areas fail to meet the scope of environments inclusive of large towns or cities due to their lack of representing the implications inherent in extensive systems such as sanitation, utilities, communications, and housing. Most also do not create significant channelizing terrain as buildings are often set too far apart. Finally, most do not have a consistent, dedicated opposing force (OPFOR) or role-players in sufficient numbers. Army Training Circulars 25-8 and 90-1, for management of Army ranges, including urban training areas.

9-3. Home station urban operations training

Focusing on non-live-fire capabilities generally, combined arms collective training facilities (CACTF) as found on many installations have several common features. Each consists of 20-26 buildings one of which is three stories tall and three of which are two stories. Any may have basements and/or be connected by a tunnel or sewer system. Most buildings are separated from each other by enough space to allow vehicles to pass between them. The entire facility is generally uncluttered by vehicles, furniture, and other common items found where people reside. Most CACTFs have limited instrumentation and AAR capabilities. They do not have dedicated OPFOR or role-players. The CACTF merely provides man-made terrain for training that can be incorporated into battalion-sized field training exercises (FTXs).

9-4. Maneuver combat training centers

Each of the maneuver CTCs has multiple urban training capabilities. These range from very small villages to fairly robust large towns with multi-story structures. While they only provide limited channelization and have fairly simple replications of infrastructure such as cyber access, wireless phone capabilities, and basic utilities, their most significant difference when compared to CACTF is the presence of professional role-players that interact with training units. These role-players, often speaking a foreign language, require the use of an interpreter, have well-developed biographies and roles that they portray, and add considerable complexity to the training scenario.

a. Another significant CTC capability is the presence of a large, well-trained professional OPFOR. These Soldiers are capable of representing conventional and unconventional forces. Their familiarity with the environment greatly adds to their lethality and training realism. Furthermore, CTC facilities are tied into a robust instrumentation system with a professional team of observer coach trainers to facilitate AARs.

b. The greatest limitation of CTC facilities is the dedication to monthly brigade combat team training rotations. This precludes any unit not associated with the particular brigade combat team (BCT) or its rotation from training at these facilities.

9-5. Other urban operations training facilities

Some other locations provide more complex facilities. These include (but are not limited to) the Zussman Urban Combat Training Center at Fort Knox and Muscatatuck Urban Training Center in Indiana. The Zussman facility is CACTF in size and includes clutter such as abandoned automobiles and furniture in some buildings. Additional details exist, to include rubble buildings; simulated downed power lines; and enhanced sounds, smells, and other effects. It was specifically designed to facilitate the integration of combat vehicles. Zussman also has some capacity for AARs and can support battalion training exercises.

a. The Muscatatuck Urban Training Center is currently the largest and most robust urban training facility in the United States. Consisting of over 200 structures and 1000 square acres of training space, its realism is specifically enhanced by its portrayal of support systems, including subterranean tunnels, cyber, and Wi-Fi capabilities. However, despite the presence of tall buildings (including five- and seven-story structures), the facility is largely suburban in organization. There is relatively little channelizing terrain. Additionally, role players are a separate funding requirement when units request use of Muscatatuck facilities. Muscatatuck has robust AAR facilities available and can support larger training exercises.

b. The U.S. Marine Corps has established a large urban training center at Twentynine Palms, California. Consisting of numerous concrete structures, there are nonetheless limited instrumentation, force-on-force training, role player participation, and professional OPFOR resources.

c. Both Israel and Germany have established very large urban training facilities. Israel's Urban Warfare Training Center outside of Beersheba closely resembles a Middle Eastern town with plentiful channelizing terrain. It's over 600 structures and 5000 acres of maneuver space

present a realistic urban environment. However, complex systems may not be represented to the extent desired and role players are largely absent. Further, instrumentation and AAR capacity are limited.

d. The German Army's urban training facility at Schnoggersburg will, on completion, be the largest in Europe. Schnoggersburg incorporates numerous three-story and taller buildings (one of 7 floors), canals, tunnels, and other infrastructure. Up to fifty percent of its buildings can be instrumented at any time.

9-6. The future of U.S. Army urban operations training facilities

U.S. Army leaders have begun efforts to upgrade urban terrain facilities at Fort Irwin, California's National Training Center and that at Fort Polk's Joint Readiness Training Center, specifically, adding taller structures to better replicate core downtown areas in larger cities.

9-7. Urban operations training challenges

a. The greatest limitation in current Army urban training physical facilities is the inability to realistically replicate urban densities over a sufficiently large area. Joint Publication (JP) 3-06, identifies the "urban triad" as consisting of the man-made physical terrain, population of significant size and density, and infrastructure. JP 3-06 also specifically identifies density as "the overriding aspect of the urban environment." Current Army urban training capabilities by and large fail to realistically represent density in terms of man-made physical terrain or population. Human social systems cannot be effectively analyzed when the number of role players encountered is less than two percent of what would be expected in a dense urban environment. JP 3-06 states that "information is the pervasive backdrop of the urban environment;" there should be a corresponding density of media and messages of all types in dense urban training settings. At CTCs, the US Army's highest fidelity training environments, such operational variables are currently too often simplistically portrayed with single representations of information systems, unsophisticated economic systems, and social and political systems of limited depth.

b. In summary, most domestic and international urban training facilities offer only limited-space man-made terrain. CTCs have larger facilities with OPFOR, role-players, and some infrastructure systems. Yet neither CTCs nor other facilities described yet provide the density or complexity of an urban environment as one would find in even the smallest of cities. Some of these shortcomings may be addressed via the introduction of hologram role players and other features, augmented reality eyewear, and advances in modeling and simulations capabilities. Such innovations will fall short of addressing the full spectrum of urban operations training needs barring a thus far nonexistent coherent and systematic approach to enhancing individual and unit preparation.

**Chapter 10
Urban Operations Modeling and Simulations**

10-1. Current urban operations modeling and simulations capabilities and status

See Army Regulations 5-11 and 350-2, for regulatory responsibilities regarding delivery of the operational environment. TRADOC G-2 conducts OE-based assessments of legacy M&S capabilities across the Army M&S enterprise.

- a. Legacy systems include:
 - 1) The Joint Land Component Constructive Training Capability (JLCCTC) with Warfighters’ Simulation (WARSIM) replicating ground operations;
 - 2) One Semi-Automated Force (OneSAF) simulation. This includes the Battle Lab Collaborative Simulation Environment (BLCSE) variant;
 - 3) Virtual Battle Space 3 (VBS3); and
 - 4) Joint Conflict and Tactical Simulation (JCATS).
- b. Under review at the time of writing are the Advanced Warfighter (AWARS) Simulation, Combat XXI, and the Intelligence and Electronic Warfare Tactical Proficiency Trainer.
- c. The Army M&S enterprise in this context includes the acquisition, analysis, experimentation, intelligence, test and evaluation, and training considerations of M&S-enabled communities. Assessment of models, simulations, and related tools within this enterprise reveals critical gaps in the representation of a holistic OE. This is especially true as applies to the portrayal of megacity fidelity, subterranean features, patterns of life, and PMESII-PT characteristics and behaviors. See Figure 10-1, where red means “no representation” and green indicates “sufficient representation.”

Legacy System Assessment	
OneSAF	P M E S I I – P T
VBS3	P M E S I I – P T
JCATS	P M E S I I – P T
JLCCTC - WARSIM	P M E S I I – P T

Figure 10-1. Late 2018 status of urban functionality in Army modeling and simulations

10-2. Urban operations M&S challenges

These shortfalls have particular impact on urban operations replication given the recent inclusion of PMESII-PT operational variables within the readiness standards of standards for training proficiency and need to span live, virtual, constructive, and gaming training domains. Add to this the move from an AirLand Battle paradigm to an emergent requirement to represent MDO

and the gaps only widen and become more complex. (MDO includes holistic consideration of the land, air, maritime, space, and cyberspace domains.) Some progress has been made to incorporate science and technological advances, but even these efforts have significant shortfalls that require too great a reliance on master scenario events list injects and other workarounds. This method unfortunately also provides no means of establishing the accountability, causality, or traceability needed to effectively train commanders.

a. Urban terrain and other features are constantly evolving. Synthetic representation must therefore be dynamic to provide realistic training. For example, portrayal of buildings within the urban environment is fundamental. A training audience must be able to move, shoot, and communicate within, around, and – often – beneath them. Construction, maintenance, and related activities combine with variations in pedestrian and vehicle traffic, weather conditions, and other factors that mean even a fixed structure takes on different characteristics depending on the time of day, week, or year. Other urban operations M&S challenges include but are not limited to accurately representing:

- (1) Bandwidth and fidelity mission demands,
- (2) Joint and coalition interoperability, and
- (3) Training that effectively addresses PMESII-PT variables.

b. No model or simulation can represent all requirements for operating in an ever-changing operational environment, nor do they always need to in great fidelity, but those determined most critical should be incorporated. Constant updating in terms of threats will further be essential. In order to gain an advantage – or at least remain competitive – the Army and its joint and multinational partners must adopt new science and technology approaches and otherwise adapt to mitigate these adversarial challenges. Army M&S has to provide commanders, their staffs, and the Soldier with realistic and relevant OE training opportunities. Modeling and simulation provides the most cost effective, efficient, and traceable means for commanders to evaluate their unit's ability to meet objectives.

10-3. Planned initiatives

a. Initiatives such as the AFC cross-functional team standup, standards for training proficiency employment, and MDO concept development represent some of the Army's recent efforts to move toward a more realistic representation of the capabilities required to remain competitive against future adversaries. TRADOC G-2 is also working in partnership with both legacy and future M&S proponents – for example, the synthetic training environment in the case of the latter – to mitigate gaps and move toward more effective representations of urban environments.

Cross-Functional Teams (CFT)
Air and Missile Defense (AMD)
Assured Precision Navigation and Timing (APNT)
Future Vertical Lift (FVL)
Long Range Precision Fires (LRPF)
Network Command, Control, Communications and Intelligence (NC3I)
Next Generation Combat Vehicle (NGCV)
Soldier Lethality (SL)
Synthetic Training Environment (STE)

Figure 10-2. Army directed CFT pilots

b. AFC will oversee the Army-directed effort to standup the eight cross-functional team pilot programs. See figure 10-2, that, when completed, will first, be integrated horizontally and vertically and second, improve the quality and speed of material development via a cooperative warfighter-developer process. The CFT efforts will play a major part in developing the M&S functionality needed to mitigate urban operations’ replication gaps in a quicker and more efficient manner than experienced heretofore.

10-4. Final modeling and simulations observations

There are gaps in megacity and other forms of urban environment representation across the Army M&S enterprise. Fortunately, the Army has a good understanding of what these gaps are and is currently working gap mitigation efforts with the proponents of both legacy and future M&S initiatives. TRADOC G-2 continues to deliver the OE to ensure M&S efforts in support of Army leadership development, training, education, and readiness provide a relevant and realistic representation of urban considerations.

**Chapter 11
Concluding Observations and Summary**

11-1. Concluding observations

There are plentiful reasons to believe that urban-related PMESII-PT challenges will become more complex as urbanization continues during the eras of accelerated human progress and contested equality. Many of the challenges identified – for example, the cost of building and maintaining urban training sites, the need for more sophisticated urban modeling and simulation capabilities, and the extraordinary difficulty inherent in targeting foes amidst an urban population – have long been recognized yet thus far remain insufficiently addressed. The U.S. Army has in other cases recognized that serendipitous advances in various areas have positive spillover benefits, Soldier use of commercial gaming replications being but one example.

11-2. Concluding summary

The next 10, 20, or 30 years will see exacerbation of known challenges such as sea level rise magnification of storm surges and others new, for example, enemies' increased sophistication in manipulating urban populations' attitudes via misinformation, disinformation, and manipulation. Meeting these challenges will demand adaptive thinking, innovative evolution of U.S. capabilities, and establishing coalitions beyond those with military and whole-of-government members alone. No less than in other environments, adversaries confronting our superior capabilities in one PMESII-PT element will cultivate counters in others to avoid our strengths. Employing systems perspectives during analysis, looking beyond the immediate consequences of actions to account for second- and higher-order effects, and exercising mission command at all levels will be keys to future Army success. Acceleration of our Soldiers' capabilities such that they excel not only in key head-to-head competitions but in new ways that allow them to outmaneuver adversary advances in the land, sea, air, space, and cyber domains will be desirable. Potential adversaries will seek to contest equality in the dominions they believe will provide a competitive advantage. Our response should include maneuvering through multiple domains at various echelons such that a foe's achieving equivalence in one arena leaves him vulnerable via assaults from others. The complexity of the urban environment and its many interconnected systems offers fertile ground for innovative forms of armed conflict and competition in the coming decades.

Appendix A References

Section I Required Publications

This section contains no entries.

Section II Related Publications

A related publication is a source of additional information. The user does not have to read it to understand these implementation procedures.

Army Doctrine Reference Publication 6-0
Mission Command

Army Regulation 5-11
Management of Army Modeling and Simulation

Army Regulation 350-2
Operational Environment and Opposing Force Program

Army Training Circular 25-8
Training Ranges

Army Training Circular 90-1
Training for Urban Operations

Glenn, Russell W., *Achieving Convergence during Humanitarian Assistance and Disaster Relief Operations in the World's Largest Urban Areas: Proceedings of the "Current and Future Operations in Megacities" Conference, Tokyo, Japan, July 16-18, 2019*, Fort Eustis, VA: U.S. Army Training and Doctrine Command, October 1, 2019,
<https://community.apan.org/wg/tradoc-g2/mad-scientist/m/tokyo-megacities-conference-2019/294569>.

Glenn, Russell W., et al., *Where None have Gone Before: Operational and Strategic Perspectives on Multi-Domain Operations in Megacities - Proceedings of the 'Multi-Domain Battle in Megacities' Conference, April 3-4, 2018, Fort Hamilton, New York, Fort Eustis, VA*: U.S. Army Training and Doctrine Command, July 20, 2018,
<https://community.apan.org/wg/tradoc-g2/mad-scientist/m/multi-domain-battle-mdb-in-megacities/244661>.

Joint Publication 3-06
Joint Urban Operations

Section III Prescribed Forms

This section contains no entries.

Section IV Referenced Forms

This section contains no entries.

Glossary

Section I Abbreviations

AAR	after action report
AFC	U.S. Army Futures Command
AI	artificial intelligence
AWARS	Advanced Warfighter Simulation
BCT	brigade combat team
BLCSE	Battle Lab Collaborative Simulation Environment
CACTF	combined arms collective training facility
CTC	combat training center
DA	Department of the Army
FOE	future operational environment
FTX	field training exercise
HQDA	Headquarters, Department of the Army
ISR	intelligence, surveillance, and reconnaissance
JCATS	Joint Conflict and Tactical Simulation
JLCCCTC-WARSIM	Joint Land Component Constructive Training Capability – Warfighters’ Simulation
JP	joint publication
LOS	line-of-sight
M&S	modeling and simulation
MDO	multi-domain operations
NC3I	Network Command, Control, Communications, and Intelligence
OE	operational environment
OneSAF	One Semi-Automated Force
OPFOR	opposing force
PMESII-PT	political, military, economic, social, information, infrastructure - physical environment, and time
TRADOC	U.S. Army Training and Doctrine Command
VBS3	Virtual Battle Space 3

Section II
Terms

This section contains no entries.

Section III
Special abbreviations and terms

This section contains no entries.

