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14. ABSTRACT Urban operations are not new to the military or the Marine Corps but the urban operating environment is changing rapidly. This paper is informed by the 2015 Marine Corps Security Environment Forecast (MCSEF) and the Marine Corps Information Agency's Future Operating Environment (MCIAFIO) and the proliferation of the mega-city or other large dense urban areas. A review of the Marine Corps' current operating concept, the future operating environment, and the way technology is advancing it is evident that a new approach is necessary. This new approach would capitalize on new technology while employing a new analytical design methodology.					
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FUTURE WAR PAPER

Urban Operations
A New Approach—Embracing the City

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Urban Operation
A New Approach—Embracing the City

Introduction

Fighting in urban environments is not new to the U.S. military or to the Marine Corps. Potential adversaries have often chosen to fight in urban environments due to the perceived advantage for the defender or the political importance of the city. The Marines' first experience in a built up urban area dates back to the narrow dirt streets of Chapultepec in 1847. Other notable experiences for the Marines include Seoul 1950, Hue City 1968, Grenada 1983, Mogadishu 1993, and Iraq 2003-2011. The experience gained in each of these conflicts has added to the rich institutional knowledge of the Marine Corps, but may not be sufficient for the next urban engagement due to changing means and circumstances. The cities that the Marines are projected to operate in are growing in size, making the ability to operate in them in the same manner unrealistic. Additionally, the Marine Corps is starting to operate in smaller units such as the Special Purpose Marine Air Ground Task Force Crisis Response (SPMAGTF-CR) and Company Landing Teams (CLT). By reviewing the Marine Corps' current urban operating concept, the future operating environment (circumstances), and the way technology is advancing (means) it is evident that a new approach is necessary. *The Marine Corps needs to adopt a new approach to urban operations that embraces the city by employing a new analytic design methodology and advances in technology to effectively fight in the urban environment of the future.*

Current Operating Concept

While not identified in a formal "operating concept," the Marine Corps employs a combination of maneuver and siege warfare. This concept developed during the last decade of the twentieth century, when the Marine Corps put significant effort into the urban warfighting

concept. In 1997, Lieutenant General Paul Van Riper, as head of Marine Corps Combat Development Command (MCCDC), commissioned “A Concept for Future Military Operations on Urbanized Terrain.”¹ This paper emphasized the maneuver nature of Marines and called for by-passing certain areas and the avoidance of attrition style warfare. The following year, the Marine Corps published MCWP 3-35.3 *Military Operations on Urban Terrain* (MOUT) into its doctrinal library. Predominantly a tactical publication, it was the most up to date and best doctrine for urban combat available and is arguably still very useful. Additionally, throughout the late 1990s and early 2000s, the Marine Corps, spearheaded by the Marine Corps Warfighting Laboratory (MCWL), embraced urban operations by conducting experimentation and war gaming in exercises such as URBAN WARRIOR² and PROJECT METROPOLIS³ learning valuable tactics, techniques and procedures. The events of September 11th, 2001 opened the door for the Marines to put their concept into action.

When the Marines entered Fallujah in 2004, they used a combination of maneuver warfare and traditional siege warfare culminating in a “clear, hold, build” methodology of counter-insurgency.⁴ The maneuver warfare philosophy seeks to avoid the city as much as possible but if a city must be engaged, Marines should pit their strength against the enemies’ weaknesses to find the decisive engagement. It has long been recognized that urban fighting should be avoided. Sun Tsu stated that “the worst policy is to attack a city; cities should only be attacked as a last resort.”⁵ The maneuver warfare is evident in the first battle of Fallujah, OPERATION VIGILANT RESOLVE, when Marines maneuvered to engage the enemy in a highly kinetic and destructive way resulting in political pressure that resulted in its early halt. The Marines’ next foray into Fallujah would incorporate an element of siege warfare.

Siege warfare dates to pre-medieval times and is characterized by surrounding and isolating a city. Moltke the Elder supports this approach by stating the premise that “a city will fall to its own weight.”⁶ By cutting off a city’s lines of communication and subjecting it to continued pressure or attack it is only a matter of the aggressor waiting out the defender. This approach requires that the defender be cut off from his resupply and reinforcements to be effective. It is questionable whether this is possible in the large megacities of today. Numerous examples of sieges failing due to ineffective cordons can be found in Stalingrad, Hue City, and even Fallujah. After VIGILENT RESOLVE in April 2004, nearly six months were spent shaping the environment for OPERATION PHANTOM FURY, before the Marines went back into Fallujah. These shaping efforts effectively emptied the city of noncombatants and allowed the Marines to freely use high explosives and clear the city with little concern for the collateral damage that halted the first operation. This second battle of Fallujah is an example where a concerted effort was made to secure the city then maneuver through, clearing it from one end to the other of enemy. During both of these fights for Fallujah a significant number of enemy combatants, to include Abu Musab al-Zarqawi, were allowed to escape to fight another day. While the Marines’ combination of both siege and maneuver warfare, had varied success in Fallujah—it can be argued that the urban environment of Fallujah is not the battlefield of tomorrow. With a pre-conflict population of 350,000, 15,000-20,000 buildings (the tallest being 5 floors), in an area approximately 5 square miles,⁷ it is not a good representation of the current or future urban operating environment. By contrast, future urban environments are likely to be much larger, denser, complex, and connected than Fallujah. It is also doubtful that the Marines will have six months of preparation before executing operations as implied by the Marines’ immediate crisis response mantra.

Future Operating Environment

The Marine Corps faces a new paradigm based on changing circumstances as a result of the emergence of megacities in the future operating environment. The Marine Corps Futures Directorate's *2015 Marine Corps Security Environment Forecast* (MCSEF) and the MCIA's *Future Operating Environment 2015-2025* (MCI AFIO) make a compelling argument that the world will be increasingly littoral⁸, urban, complex, and connected.⁹ Likewise, it is estimated that up to 75% of the world's population will live in cities by 2030.¹⁰ In some of the world's more developed regions, the percentage of those living in urban areas is estimated to reach up to 84%.¹¹ Much of the urbanization will be in so-called "mega-cities" defined as having populations of over 10million.¹² Megacities offer a significant challenge but the "middle-weight"¹³ or secondary cities will be equally challenging. In fact there are 30 times more middle-weight cities than there are megacities.¹⁴

It is not so much the size of the city that matters as it is the density of the city, which consists of not just people but also their buildings and infrastructure. This density, when combined with the growing connectedness of the population, offers a threat that has drastically evolved. Cell phones and internet access are now common in even rural areas. In Africa, more people have access to cell phones than they do to clean water, with the World Bank reporting that 94% of Africans lived within cell phone reception in 2010.¹⁵ The ability to raise a mob as experienced in Somalia in 1993, a significantly less advanced technological era, has increased dramatically. David Kilcullen repeatedly reinforces this point in his book *Out of the Mountains* through examples such as how insurgents in Libya conducted "crowd-sourcing" to learn how to employ seized weapons.¹⁶ He goes on to compare Napoleon's advantage in mobilization to what has been coined the "electronic Levee en Masse."¹⁷ The Arab Spring is an example of the

effective use of how social media can quickly change the strategic situation. In fact, some analysts have labeled the Arab Spring the “Facebook Revolution” or “Twitter Rebellion.”¹⁸ This highlights the new reality that the speed of communication is allowing users to rapidly connect with others and organize.

With the potential for conflicts in these dense urban environments increasing, as informed by the MCSEF and MCI AFIO, Marines must be prepared to operate in megacities or other large urban cities. While conflict in a megacity may be inevitable, a full scale assault of an overrun or enemy controlled megacity is probably less likely. The Marine Corps is too small to secure or attack middle to mega sized city and the current method of employment, SPMAGTF-CR and CLT, point to a different mission set. The entire Marine Corps, let alone a MEB or MEF, would be swallowed up in these large megacities making a Fallujah type operation untenable. On the other hand, a realistic scenario could easily find a SPMAGTF-CR deployed in a large urban environment in support of humanitarian assistance and disaster relief (HA/DR), NEO, or NEO support mission. Marines will likely find themselves as either enablers for Special Operations Forces (SOF) or Joint Forces or enabled by those forces depending on the mission. In order for these units to successfully operate in these urban operations, Marines must adopt a new urban operations concept that embraces the city; this requires a new way of thinking.

A Different Way of Thinking—a New Design Methodology

The first step in a new concept for future urban operations is a new way of looking at operations in a megacity or other urban dense environment. Marines can no longer view the city as simply another environment comparable to jungles, desert, or mountains, nor can it be viewed as linear or static. In a new way of thinking about urban operations, design and information

preparation of the battlefield (IPB) must be revisited. Design must be able to capture the complexity and connectedness of the city. Traditional IPB often becomes a reductionist formula for understanding that is insufficient for the complex urban environment. The urban environment is more appropriately viewed as a living organism—complex and adaptive, continually changing. David Kilcullen is one of the major proponents of viewing the city as a system, advocating a new design approach developed by Caerus Associates.¹⁹ Their *City as a System Analytic Framework*²⁰ is primarily a program being pursued by the Special Operations Command (SOCOM)²¹ but deserves additional attention from the Marine Corps and consideration for inclusion to MCWP 3-23.3. Through a process of mapping the city, such as mind-mapping, link diagrams, or computer modeling, this robust design process seeks to identify the key nodes resulting in an “environmental center of gravity” (E-COG).²² In 2003, MCI A produced an Urban Generic Information Requirements Handbook (UGIRH) with multiple helpful checklists for looking at the structure of the city.²³ Unfortunately, this reference is seldom used, is out of print, and hard to find. These E-COGs of which there may very well be more than one of, allow Marines to examine second and third order effects and understand how the city is interconnected. This allows a unit to decide on the best time to attack a target, determine how best to attack a target, or operate in the battlespace. Additionally, “E-COGs provide an important conceptual link between defining the environment and framing the problem,”²⁴ which are essential to ensuring the success of any operation. This addition to Marine doctrine, while small, would be a big step to seeing the city as more than just another “environment” in which missions are executed.

IPB will need to consider not just the physical terrain of the city but the social and digital terrain. While the hard to find MCI A publication on generic urban information requirements

offers a starting place to do this, even in 2003 it recognized that changes were needed. In its introduction, it states, “New Approaches are needed to analyze the urban threat. Current intelligence preparation of the battlefield (IPB) analysis tools developed on the Cold War model have limited utility and need modification to be useful on the dynamics of the urban battlefield.”²⁵ This is where the first application of emerging technology fits in. The ability to 3D map and super-impose the physical terrain of buildings and subterranean systems as well as social interactions will provide the information needed for forces to traverse the city effectively and view the city as more than a flat map. These same maps enable and increase the accuracy of the targeting purposes. Mapping must go beyond the traditional physical environment but will need to account for vehicle and pedestrian traffic, movement, and interaction. Social and digital mapping will provide an insight into the “flow”²⁶ of the city, how it operates, and how it acts. This can provide the cues for when and where force should be applied, or where the application of force should be avoided.

The emergence of “Smart Cities”²⁷ provides up to date information on resource usage, traffic, and shopping patterns to name a few analytics available. This data feeds the understanding needed to design an effective operation. Plugging into the city’s control center covertly or in partnership with the city will provide a trove of data speeding up and informing the decision making cycle. Police records and city planning documents can provide additional information on the population and city structures. Data mining of social media and internet usage can provide valuable insight into what a population thinks and possible actions and reactions to military actions. This ability to understand the city allows Marines to make the city work for them, in essence using the city as an advantage.

While the city as a system is one way of observing this dense urban environment, another way is to view it as an organism. Using the analogy of a living system allows Marines to once again change their perspective and view the city holistically and not just as another difficult operating area. This is not as easy as it may seem though. The Combat Studies Institute at Fort Leavenworth posited that the military is not prepared to think this way and that it is “in contrast to the little mock villages created at many US military installations as training sites...these are in no way adequate for teaching military operators and planners about large ‘living’ cities.”²⁸

Thinking about a city as a living system, and organism, requires an understanding of what makes it tick and how it works. Where is the brain -the legitimate civil and illegitimate criminal sources of power? Where is the heart that pumps the blood that keeps the system operating—the water, electricity, and media? Where are the veins that keep the flows going—the roads, bridge, wires, and pipes? Marines operating in a megacity will need to understand this in order to not upset the entire system and create additional enemies or a humanitarian crisis when the city collapses. In a city of 10-20 million people the number of adversaries is likely to be a small fraction and ensuring that the rest of the population can continue their day-to-day activities as much as possible is important. An IPB that views the city as an organism will allow forces to operate as an antibody, moving through the veins, lines of communication, creating as little disruption as possible to engage the enemy before flowing back out. Understanding the city as an organism informs the intelligence and planning cells to know where to plug in to download the information needed to use the city to their advantage. As already discussed, technology can assist in this process; an example of this is the new realm of cyber space.

New Technology—“New Means”

Cyber

The cyber environment is quickly being realized as a new domain that must be embraced in the fight of the future. America’s enemies are no longer confined to the physical domains but can have instant effects outside of their immediate area through a digitally connected city and world. The ability to raise a flash mob or call for reinforcements is now available at the click of a mouse, post on the internet, instant message, or tweet. Tactical units must have the ability to isolate the enemy not only physically but digitally. Forces must be able to control or at least influence the information that enters or leaves the battlespace requiring that cyber capabilities be integrated and pushed down to lower echelons. These capabilities must be tied in either through direct augmentation from higher command authority or a delegation of authority to organically integrated capabilities; if this is not possible a connection to joint or national level assets must be provided to fulfill these requirements.

Additionally, cyber operations will be directly tied to information operations. Information operations will be used to separate the enemy from their supporters, those who are neutral, and to empower our allies (official and unofficial). Information operations can be used to turn the city on the enemy. Those previously identified sources of power identified during design and through IPB can now be leveraged in an indirect approach to attack adversaries. Social media applications (Apps) can be developed for dissemination that will facilitate host nation/city reporting and communication. Cyber operations can provide some of the best situational awareness and assets for the information fight in the connected digital city of the future. The urban battlefield of the future will also provide unprecedented surveillance opportunities to tap into via closed circuit TV, full motion video, and other camera support,

increasing situational awareness to gauge the effectiveness and impact of operations. It is likely that in the future almost every item (light pole, stop light, car plan, cellphone, and even individuals) will be a collector able to receive and send information whether knowingly or not. This is a massive step forward in the concept of “every Marine a collector” where now, everything is a collector. Where the city was once seen as a place to hide, this connectivity and the ability to access it will reduce that advantage for the adversary. Those “internet-of-things” provide input to the necessary understanding of how the city works together just as another increasingly prolific technological advance, the unmanned aerial vehicle (UAV), will provide.

UAVs

Situational awareness within an urban environment is a premium and can best be achieved through locally controlled information, surveillance, and reconnaissance (ISR). ISR will need to be pushed down and available on a real time basis. This ISR will be available from a number of assets including hand held nano or micro-platforms,²⁹ medium sized drones such as commercial available vehicles similar to those created by 3D Robotics³⁰ and military developed drones. Drones from Group I (i.e., InstantEyes, Ravens, Pumas, BlackHornets, etc.) all the way up to the inclusion of Group IV and V (i.e., Predators, GreyEagles, Reapers, Etc.) should be available at the tactical level or augmented from Unmanned Aerial Vehicle Squadrons (VMU) elements for an urban assault.³¹ It is often hard to observe the multiple avenues of approach in a city with its maze of alleys, roads, and even footpaths. UAVs can be used to assist in the isolation of an objective area or observation on a unit’s flank or rear area. With UAVs providing real time information gathering and observation on the battlefield the warfighter will have eyes and ears around corners, in buildings, behind obstacles and in surrounding neighborhoods like never before, creating immense advantages. This will provide the ability to send a UAV asset

forward into the target area and gather an immediate estimate of the situation and instant mapping of the area without having to put boots on the ground until necessary. The ability to use those same assets to shape the objective also shows that it is not just ISR, but the potential for its use as a fire support asset that make advances in UAVs so important to operations in the urban environment.

Beyond ISR, another increasingly advantageous aspect of UAVs is their ability to provide persistent close in and timely, accurate, and scalable fires. Persistent Close Air Support (P-CAS) can be provided by loitering UAVs, on either MQ-1C Grey Eagles or MQ-9 Reapers, linked directly to the warfighter utilizing digital applications such as the Kinetics Integrated Lightweight Software Individual Tactical Combat Handheld (KILSWITCH), Android Precision Assault Strike Suite (APASS), or Android Tactical Assault Kit (ATAK).³² This type of tablet-based software allows a user to tap a target on the map and send the data directly to a drone or air support platform to quickly and precisely attack targets with weapons ranging from precision guided munitions (PGM), joint directed attack munitions (JDAMS), or even surface to surface fires like High Mobility Artillery Rockets Systems (HIMARS) or artillery. These same fires should also be scalable fires where the projectile can be selectable to reduce a building or just clear a room, giving Marines the ability to adapt to changing situations and avoid collateral damage. Additionally, UAVs can be used to deliver munitions by dropping them or, in the case of Switchblade,³³ Terminator,³⁴ or DJI Phantoms,³⁵ becoming kamikaze drones that are flown to the target much as the remote controlled bombs developed by the Germans during WWII.

Some of these same capabilities should be assumed for potential adversaries. In order for a concept of embracing the city to be effective, parities such as these must be overcome. Recreational UAVs easily purchased on-line or at the local Radio Shack can and are already

quickly being militarized or converted for surveillance purposes. This new capability creates a new dimension to the classical air-power paradigm. Air superiority will also consist of controlling an adversary's ability to utilize his UAVs. Currently, the ability to defeat adversary drones is in its infant stage. Tests have been conducted to defeat enemy drones using low tech methods such as nets or even bald eagles as well as high tech methods like radar and laser technology. While further testing and advances will be necessary to defeat enemy UAVs, commercial, off-the-shelf products available to our adversaries are still out matched by the military Block I-V assets earlier discussed.

Robotics

Manned and unmanned systems should be incorporated to the lowest tactical level to effectively operate in the urban environment. While the urban environment has often been characterized as a "meat-grinder" with high casualty levels, this should not be our first thought when considering a new concept. A concept that seeks to understand the city and embrace new technology such as robotics will never completely avoid casualties but it can certainly reduce them. In referring to the use of robots, Deputy Secretary of Defense Bob Work said, "10 years from now if the first person through a breach isn't a fucking robot, shame on us."³⁶

When people think about robots they often envision something like the Terminator, R2D2, C3P0 or our newest hero, BayMax while overlooking the robots that have been tried and tested since the Second World War. Both the Germans and Russians employed a limited number of robots in the form of radio controlled tank type vehicles to tracked smaller demolition mines.³⁷ Robots began to be recognized during Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) in the form of Explosive Ordinance Disposal (EOD) robots, yet have not been fully exploited to their potential. Current technology already offers the ability to

employ robots more effectively than just within EOD operations. The potential for ISR, remotely delivered explosives, and attachable weapons has already been demonstrated.³⁸ Deputy Secretary of Defense Work has stated that “Russia and China are already developing highly autonomous weapons, more commonly referred to as killer robots.”³⁹ Canalized urban terrain can first be cleared by automated systems with Marines following closely behind safely outside of bomb or direct fire weapons range. A robot can breach a door or building providing the initial entrance while transmitting a video feed back to the remaining elements of the team. Once the room is cleared or situational awareness and observation is achieved the human element of the team can continue the mission. If an enemy is identified via robotic observation and that robot is armed it can then engage without ever putting a person at risk. Additionally, those same robots could be armed with less than lethal measures such as tear gas or a stun gun. All robotic devices should be equipped with a remote detonation device making them capable of delivering explosive effects. Just as UAVs were noted as providing the ability to assist in observation and isolation in the difficult LOCs of the city, robotics can do the same. Small robots such as those used in EOD units can be dropped in sewers, down manholes, or just stationed on the corner to provide observation and sensing. The ability to collect using these assets also assists in the situation awareness and feeds back into that essential understanding of the situation.

What should also be imagined is what has been termed “human-machine collaboration and combat teaming.”⁴⁰ This is more about a machine assisting in the human decision making process in order to make faster and better decisions. The Defense Advanced Research Projects Agency (DARPA) has begun testing ways to link individual soldiers to that technology to support the decision making cycle and exploit unmanned systems by working together.⁴¹ Mechanical assist and monitoring technology will allow every soldier and Marine to act as a

sensor and to receive input from other feeds. This ability for marines to serve as a sensor is a natural evolution of the “every Marine a collector” concept. Robotics will not only assist in force protection and in the decision making process but they are force multipliers that are all the more important to a smaller and lighter force.

SPMAGTF-CRs, while smaller than a normal MEU construct, may be the perfect size for one of those smaller missions if manned, equipped, and trained correctly. Appropriately manning these smaller units with UAVs and robotics increase their combat power incrementally. Imagine one Marine controlling numerous autonomous robots and UAVs; that one Marine may now have the fire power and C2 that once was only imagined at squad, platoon, or even higher level units. Over the past 10 years, the Marine Corps has gained valuable experience in disaggregated operations and small unit tactics. Companies and platoons have operated in small outposts in both Iraq and Afghanistan. *Expeditionary Force 21* (EF 21) envisions disaggregated company landing teams (CLTs) “taking on a larger role in crisis response and may form the GCE of the SPMAGTF.”⁴² Aggregating multiple CLTs may be necessary for larger scale operations in mega or secondary cities. While the lack of initial mass can be seen as a disadvantage it can also be used to create an advantage. Smaller units can more effectively infiltrate an urban environment, provide less disruption, and when combined with the ability to aggregate, can come together to mass combat power as a large force.

Conclusion

A new approach that embraces the city emerges from new circumstances (smaller units in a much larger urban environment), a new design methodology (city as a system), and technological advances that provide new means for urban operations. Doctrinal changes should incorporate new design concepts such as those suggested by David Kilcullen that help the

Marine Corps to understand the city from a holistic approach. This methodology needs to be written into the MCWP 3-35.3 and referenced in the MCWP 5-1, Marine Corps Planning Process (MCPPE). Cyber operations should be incorporated down to lower tactical units through attachments or organic units. These cyber warriors will assist in the intelligence effort, deception operations, and offensive/defensive operations and can assist in isolating the battlefield. Technological advances in UAVs and robotics need to be prioritized and fielded before the Marines' next urban battle. Group I through Group V UAVs should be prioritized, with the latter providing persistent close air support; electronic warfare; information, surveillance, and reconnaissance; and communication extension capabilities. Other UAVs at the squad level need to provide close in observation, local communication extension capabilities, and kinetic fires. These small UAVs can be part of the manned/unmanned system and can be the eyes and ears for squad leaders while being quickly converted to flying explosives or provide other kinetic effects when needed. Robotics should provide force protection and augmentation by being the "first through the breach" and being able to provide observation as well as lethal and non-lethal fires. Using the company landing team as the base of this unit will require augmentation or organizational changes to include UAV operators, cyber forces, signals and radio intelligence, and robotic controllers.

By adapting these advances in technology to the changes in the operational environment, and understanding the "city as a system" a new operational art can be derived. The Marines may not be able to isolate a mega-city, but properly equipped and trained they can capitalize on UAVs for ISR and fire support, manned/unmanned systems for force protections and lethality, and offensive/defensive cyber operations to isolate a small portion or an objective area. The new paradigm of a smaller Marine Corps' operating unit, in a dense urban environment, can be

daunting and scary but Marines will more likely find success if they adopt a new approach that employs a holistic design methodology and emergent technology before they enter the middle or mega city of tomorrow's operating environment.

Endnotes:

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- ¹ United States Marine Corps, Marine Corps Concept Development Command, *Concept Paper for Future Military Operations on Urbanized Terrain*. Quantico, Virginia, July 25, 1997.
- ² URBAN WARRIOR was an exercise executed in conjunction with the Marine Corps Warfighting Laboratory in 1997-99.
- ³ PROJECT METROPOLIS replaced URBAN WARRIOR in 1999 and continued until 2002. An article by Book, Elizabeth G. Book "Project Metropolis Brings Urban Wars to U.S. Cities." *National Defense*, April 1, 2002 has a summary of the 2002 exercise, accessed December 20, 2015, http://www.nationaldefensemagazine.org/ARCHIVE/2002/APRIL/Pages/Project_Metropolis4104.aspx.
- ⁴ Clear, Hold, Build is from MCWP 3-33.5 Insurgencies and Counter-Insurgencies but incorporated MOUT from MCWP 3-35.3 in the clearing phase.
- ⁵ *Sun Tzu on the Art of War*, Translated from the Chinese by Lionel Giles, M.A. (1910), accessed February 20, 2016, <http://www.au.af.mil/au/awc/awcgate/artofwar.htm>.
- ⁶ This may be an apocryphal quotation to Moltke as a reference cannot be found but the point remains valid.
- ⁷ Chief of Staff of the Army, Strategic Studies Group Cohort III, "Mega-Cities and the United States Army: Replicating the Home Field Advantage," July 2015. p. 63.
- ⁸ Littoralization is a separate topic that the Marine Corps is currently struggling with in regards to anti-access, area-denial, amphibious shipping, and ship-to-shore connectors and is not dealt with in this paper.
- ⁹ Marine Corps Futures Directorate, "2015 Marine Corps Security Environment Forecast: Futures 2030-2045" referred to as the MCSEF and the Marine Corps Intelligence Agency "Future Operating Environment 2015-2025: Implications for the Marine Corps" draw on "common patterns and trends identified by a variety of national and multinational institutions and organizations" as well as independent research and analysis." (MCSEF p. 3). Their forecasted operational environment is consistent with other respected forecasts around the globe.
- ¹⁰ MCSEF p. 58 while the "National Intelligence Council's Global Trends 2030" available for download at http://www.dni.gov/files/documents/GlobalTrends_2030.pdf, reports 60% will live in cities by 2030.
- ¹¹ United Nations, "World Urbanization Prospects: the 1999 Revision," accessed January 2, 2016 at <http://www.un.org/esa/population/publications/wup1999/urbanization.pdf>, p. 4.
- ¹² MCSEF, p. 56-57.
- ¹³ A middle weight or secondary city is usually defined as having 500,000 to 9.9 million. That wide range can also explain the 30% more figure.
- ¹⁴ COHERT III, p. 277
- ¹⁵ World Food Bank, "Africa Can End Poverty" blog, Accessed January 2, 2016, <http://blogs.worldbank.org/africacan/more-cell-phones-than-toilets>. David Kilcullen also covers this extensively in his book *Out of the Mountains*, p. 33-34.
- ¹⁶ David Kilcullen, *Out of the Mountains: The Coming Age of the Urban Guerrilla*. New York: Oxford University Press, 2013. p. 181-184 and 208-218.
- ¹⁷ IBID, p. 206-208.
- ¹⁸ David Wolman, "Facebook, Twitter Help the Arab Spring Blossom," *Wired*, Accessed on December 26, 2015 at <http://www.wired.com/2013/04/arabspring/>.
- ¹⁹ Kilcullen, "City as a System."
- ²⁰ CAERUS Associates, "City as a System Analytical Framework," presentation handout, May 2015. I was able to sit through a brief CAERUS had provided to MCWL in August of 2015.
- ²¹ Cohert III, p. 30.
- ²² CAERUS, "City as a System" p. 27.
- ²³ *Marine Corps Intelligence Activity, Urban Generic Information Handbook (UGIHR)*, Quantico, VA: 2003.
- ²⁴ CAERUS, "City as a System" p. 27.
- ²⁵ MCIA, UGIHR, p. 3.
- ²⁶ Flow consists of how water, sewage, traffic, money, people, information, electricity, etc. move.
- ²⁷ A simplified definition of a Smart City is networked and connected city connecting and monitoring the "Internet of Things" to maximize efficiency.

²⁸ William Robertson and Lawrence A. Yates. *Block by Block: The Challenges of Urban Operations*. Fort Leavenworth, Kan.: U.S. Army Command and General Staff College Press, 2003.

²⁹ Walter Christian Haland, Black, "Flying Robotic Binocular," *Small Arms Defense Journal*, Volume 7, num 5, p. 31 other options include the BCB Internationals SQ-4 Recon Micro UAS reported by David Crane on *Defense Review*, June 2, 2012, <http://www.defensereview.com/bcbaai-sq-4-recon-nano-uasuv-nuasnuav-bat-like-unmanned-spy-copter-drone-aircraft-for-over-the-hill-observation-and-reconnaissance-special-operations-forces-sof-get-a-new-small-backpack/>, Accessed December 27, 2016.

³⁰ <https://3drobotics.com/>, QuadCopter like this are also available from Amazon, Bestbuy and cheaper versions at the local big box store.

³¹ Block 1: less than 20 lbs and operates less than 1,200 AGL, Group 2: 21-55lbs and less than 3,500 AGL, Group 3: less than 1,320lbs, Group 4: over 1,320 lbs and operates lower than 18,000 MSL, Group 5: over 1,320lbs and over operates 18,000 MSL. Group 4 is also known as medium altitude, long endurance and group 5 as high altitude, long endurance. Block 4/5 are also multi-mission capable of providing fires, EW, communication, and ISR support. Information provided by Maj Scott Cuomo, HQMC Aviation MAGTF Planner and GCE Integration Officer.

³² Daniel Patt, "PCAS: Precise, Persistent, Prompt Close Air Support," DARPA Briefing Slides, March 2, 2015.

³³ <http://www.avinc.com/uas/adc/switchblade>.

³⁴ <http://www.wired.co.uk/news/archive/2014-05/01/terminator>.

³⁵ <https://www.wired.com/2015/02/white-house-drone/>.

³⁶ Bob Work, "Reagan Defense Forum: The Third Offset Strategy," accessed at <http://www.defense.gov/News/Speeches/Speech-View/Article/628246/reagan-defense-forum-the-third-offset-strategy>, Nov 7, 2015.

³⁷ The Russians and Germans both used small radio controlled tanks (Teletank and Goliath, respectively). Very little writing (in English) seems to have been devoted to their use. Multiple Youtube videos such as an US Army produced video accessed at <https://www.youtube.com/watch?v=zhK8LOPgPdA> or a British produced video accessed at https://www.youtube.com/watch?v=l_dr0arBlU can be viewed offering insight into their employment.

³⁸ Quintex North America, "Modular Advanced Armed Robotic System," Accessed January 2, 2016 at <https://www.qinetiq-na.com/products/unmanned-systems/maars/>.

³⁹ Danielle Muoio, "Russia and China are Building Highly Autonomous Killer Robots," *Business Insider*, Accessed January 2, 2016 at <http://www.businessinsider.com/russia-and-china-are-building-highly-autonomous-killer-robots-2015-12/>.

⁴⁰ Work, "Third Offset."

⁴¹ Allison Barrie, "DARPA Squad X Core Brings Tech Innovations to Infantry Squads," *FoxNews*, February 20, 2015 accessed on December 27, 2015 at <http://www.foxnews.com/tech/2015/02/20/darpa-squad-x-core-brings-tech-innovations-to-infantry-squads.html>.

⁴² EF21, p.14.

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