

THE SMART CITY: ACHIEVING POSITIONS OF RELATIVE ADVANTAGE
DURING URBAN LARGE-SCALE COMBAT OPERATIONS

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE
Art of War Scholars

by

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Fort Leavenworth, Kansas
2019

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REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 14-06-2019		2. REPORT TYPE Master's Thesis		3. DATES COVERED (From - To) AUG 2018 – JUN 2019	
4. TITLE AND SUBTITLE The Smart City: Achieving Positions of Relative Advantage during Urban Large-Scale Combat Operations				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
				5d. PROJECT NUMBER	
6. AUTHOR(S) Caleb M. Ling				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
				8. PERFORMING ORG REPORT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD Fort Leavenworth, KS 66027-2301				10. SPONSOR/MONITOR'S ACRONYM(S)	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution is Unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT World urbanization trends and growing competition with peer adversaries demand clear-eyed attention to the increased possibility of Large-Scale Combat Operations (LSCO) in the urban environment. In recent years, the topic of megacities and urbanization gained attention within academia and the United States Department of Defense (DoD), due to the growing challenges associated with large cities. Despite the increased attention, military professionals struggle to conceptualize useful models and techniques for joint urban operations (JUOs) and LSCO in large cities. This deficiency exists due to city structural variances across regions, which limit the usefulness of traditional urban planning models. Nonetheless, the smart city, an increasingly popular design concept, provides urban planners and joint force command (JFC) planners a consistent model to meet urbanization challenges around the world, due to its analogous technology and functions. This study coalesces science, history, theory, and doctrine by using 32 primary source documents from the Battle of Manila to identify three operational challenges, including the protection of key infrastructure, fire as an obstacle to maneuver, and civilians on the battlefield. Furthermore, the study explains how JFCs may leverage the smart city by offering techniques including the Resilient Pocket and Flammability Corridors to gain positions of advantage.					
15. SUBJECT TERMS Smart City, Megacity, Large-Scale Combat Operations, Positions of Relative Advantage, Resiliency					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. PHONE NUMBER (include area code)
(U)	(U)	(U)	(U)	157	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

THE SMART CITY: ACHIEVING POSITIONS OF RELATIVE ADVANTAGE DURING URBAN LARGE-SCALE COMBAT OPERATIONS, by Major Caleb M. Ling, 157 pages.

World urbanization trends and growing competition with peer adversaries demand clear-eyed attention to the increased possibility of Large-Scale Combat Operations (LSCO) in the urban environment. In recent years, the topic of megacities and urbanization gained attention within academia and the United States Department of Defense (DoD), due to the growing challenges associated with large cities. Despite the increased attention, military professionals struggle to conceptualize useful models and techniques for joint urban operations (JUOs) and LSCO in large cities. This deficiency exists due to city structural variances across regions, which limit the usefulness of traditional urban planning models. Nonetheless, the smart city, an increasingly popular design concept, provides urban planners and joint force command (JFC) planners a consistent model to meet urbanization challenges around the world, due to its analogous technology and functions. This study coalesces science, history, theory, and doctrine by using 32 primary source documents from the Battle of Manila to identify three operational challenges, including the protection of key infrastructure, fire as an obstacle to maneuver, and civilians on the battlefield. Furthermore, the study explains how JFCs may leverage the smart city by offering techniques including the Resilient Pocket and Flammability Corridors to gain positions of advantage.

ACKNOWLEDGMENTS

My interest in cities and smart cities in particular comes from the experiences afforded to me prior to attending the Command and General Staff College. Consequently, I must acknowledge the Olmsted Foundation and Chiang Mai Smart City for the opportunity to learn about urban planning from 2015-2018. In addition to the foundation, I appreciate the encouragement from my thesis committee, Dr. Phillip Pattee, LTC Kenneth Rich, and Mr. Kurt Vandersteen. Their guidance throughout the process allowed me to narrow the scope of the research, while remaining sufficiently flexible to emerging conclusions.

Dr. Dean Nowowiejski and the Art of War Scholars program enabled a deeper level of analysis during the study. The scholars provided useful criticism that refined my ideas, while Dr. Nowowiejski encouraged and funded my trip to the National Archives and Records Administration in College Park, Maryland. Many of the critical primary source documents came from this unique opportunity for original research. Dr. Nowowiejski's mentorship throughout the Art of War Scholars program provided a source of confidence as an academic and encouragement to continued professional publication.

My family greatly contributed to the completion of this study, both through sacrifice and encouragement. As so often happens in our marriage, Ashley picked up the slack and allowed me to complete my goal. Furthermore, Harrison and Celia gave me the perfect balance of space and affection that kept me going through the evenings.

To each acknowledged party above, I hope this study lives up to your expectation and brings credit to you and your organization.

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ACRONYMS

A2AD	Anti-access/Area Denial
AG	Above Ground
BCSCW	Boyd Cohen Smart City Wheel
BCT	Brigade Combat Team
BRAC	Base Realignment and Closure
CBD	Central Business District
CCTV	Closed-Circuit Television
CMO	Civil Military Operations
COADEV	Course of Action Development
CTC	Combat Training Center
DATE	Decisive Action Training Exercise
DSA	Division Support Area
DoD	Department of Defense
DoS	Department of State
EAB	Echelons Above Brigade
EMA	Energy Market Authority of Singapore
EMS	Electromagnetic Spectrum
EPIRA	Electric Power Industry Reform Act
FLOT	Forward Line of Troops
GIS	Geographic Information Science
ICT	Information Communications Technology
IDP	Internally Displaced People
IMDA	Infocomm Media Development Authority

IoT	Internet of Things
JCS	Joint Chiefs of Staff
JFC	Joint Force Command
JRTC	Joint Readiness Training Center
JUO	Joint Urban Operation
JIUOC	Joint Interagency Operations Center
JLCCTC	Joint Land Component Constructive Training Capability
JUOL	Joint Urban Operations Laboratory
Kbps	Kilobits per second
LOC	Line of Communication
LOE	Lines of Effort
LoRaWAN	Low Power, Wide Area Network
LSCO	Large-Scale Combat Operations
LSOO	Large-Scale Offensive Operations
Mbps	Megabits per second
MCTP	Mission Command Training Program
Meralco	Manila Electric Company
MOUT	Military Operations on Urban Terrain
MRX	Mission Readiness Exercise
MW	Megawatt
NGO	Non-governmental Organization
NSC	National Simulations Center
NTC	National Training Center
OCO	Offensive Cyber Operations
PAA	Position Area for Artillery

PCAU	Philippine Civil Affairs Unit
POA	Pacific Operations Area
POV	Privately Owned Vehicle
POW	Prisoner of War
QTP	Qualified Third Party
RFID	Radio-Frequency Identification
SCOC	Smart City Operation Center
SIT	Singapore Institute of Technology
SNSP	Smart Nation Sensor Platform
SWPA	Southwest Pacific Area
TPS	Third Party Suppliers
TRANSCOM	US Transportation Command
VMS	Variable Message Sign
WFX	Warfighter Exercise
WiFi	Wireless Fidelity
WLAN	Wireless Local Area Network
WPAN	Wireless Personal Area Network
WSN	Wireless Sensor Network

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CHAPTER 1

INTRODUCTION

Research Purposes

Current US Army doctrine in FM 3-0 and ADRP 3-0 *Operations* (December 2017) make the assumption that Large-Scale Offensive Operations (LSCO) will occur in open terrain by describing and depicting the preponderance of offensive operations in linear, non-urban environments.¹ FM 3-0 provides only one paragraph about large-scale combat operations in urban areas, which simply claims that urban operations are resource intensive and require careful arrangement of forces.² However, this assumption forms an incongruence with claims in ATP 3-06 *Urban Operations* and the Chief of Staff Strategic Studies Group Report “Megacities and the US Army.” In 2014, “Megacities and the US Army” described a gap in doctrine between the world’s urbanization trends and the US Army’s conception of urban operations, particularly in large cities.³ Furthermore, ADRP 3-90 (Offense and Defense) claims that “the performance of offensive tasks in an urban environment is one of the most challenging mission that military forces can undertake.”⁴ Despite partial acknowledgement of the complexity of offensive urban operations, or joint urban operations (JUOs) in joint doctrine, current US Army doctrine only scantily acknowledges the increased likelihood of large-scale offensive operations (LSOO) in the urban environment. To that end, current doctrine claims that the defender generally has the advantage because complex urban terrain reduces technological superiority, weapons range, and firepower.⁵ Despite these claims, doctrine does not provide techniques, descriptions, or examples to achieve relative advantage during LSCO in the urban environment. Moreover, current doctrine does not completely accomplish LTG Michael

Lundy's charge found in his foreword of FM 3-0, which states, "the pace of modernization make(s) it imperative that we do everything possible to prepare for the worst-case scenarios. We must be ready to win with the forces we have, and having the right doctrine is a critical part of that readiness."⁶ As it pertains to the urban environment, the US Army and the joint force struggles to conceptualize JUOs, particularly urban LSOO.

For the reasons above, this study will bolster the small body of literature that focuses on this underappreciated and enormous predicament for the United States Army. Although this study cannot completely analyze nor solve the predicament with megacities, the "Smart City" urban design concept, which is common to nearly all megacities, provides a useful model for analysis. To that end, this study seeks to describe how forces can achieve positions of relative advantage during LSCO in smart cities. The study deliberately focuses on smart cities because the concept does not limit the scope by population size and can aptly apply to both small cities and megacities. Rather than using a hypothetical scenario such as those found in ATP 3-06 *Urban Operations*, the study examines an under-analyzed large-scale offensive urban operation, the Battle of Manila (1945).⁷ Although the study uses historical context, the analysis of the battle will not use historiography as a method, but rather a document analysis to determine operational-level challenges experienced by units and commanders during the battle. By identifying these challenges, the study will provide examples of how joint forces command (JFCs) may leverage existing smart city infrastructure gain positions of relative advantage.

Research Question

Research Question: How can JFCs use the smart city to gain positions of advantage during Large-Scale Offensive Operations in the urban environment?

1. What are the components of the smart city?
2. What operational challenges did US units and commanders experience at the Battle of Manila in 1945?
3. If the battle were to occur today, how could a JFC leverage smart city systems and infrastructure to gain positions of relative advantage during these operational challenges?

Background

At the 2015 Association of the United States Army Eisenhower Luncheon, GEN Mark A. Milley, Chief of Staff of the Army, claimed that the world is rapidly urbanizing in large cities and that the United States Army must be prepared to operate in the complex environments of megacities.⁸ Although the terms “urban” and “city” are quite un-descriptive, books, academic articles, and intergovernmental organization white papers in the fields of sociology, demographics, and urban planning ubiquitously use some variation of “50 percent of the world now lives in cities with projections of 70 percent by 2050.”⁹ Nearly three years after the conference, the United States Army still does not have doctrine or techniques for large-scale combat operations in large or megacities. Arguably, the United States Army moved in the opposite direction by implicitly assuming that LSCO will occur in advantageous, non-urban terrain. On October 10, 2017, LTG Michael Lundy unveiled the newest version of FM 3-0 *Operations* and ADRP 3-0, which in terms of US Army doctrinal history represents an enormous accomplishment

that will drive change within the Army. However, of the combined total of 449 pages of FM 3-0 and ADRP 3-0, one paragraph mentions urban operations. In Chapter 7 of FM 3-0 “Large-Scale Offensive Operations,” each of the descriptions and figures implicitly describe and depict relatively linear maneuver in non-urban environments, while referring the reader to ATP 3-06 *Urban Operations*. For example, Chapter 1 of FM 3-0 explains the competition in cyberspace and the electromagnetic spectrum by using an image depicting a hypothetical situation in Eastern Europe (Reference Figure 1). The image depicts three cities, highlighted in red, and a battlefield existing outside of the three cities.

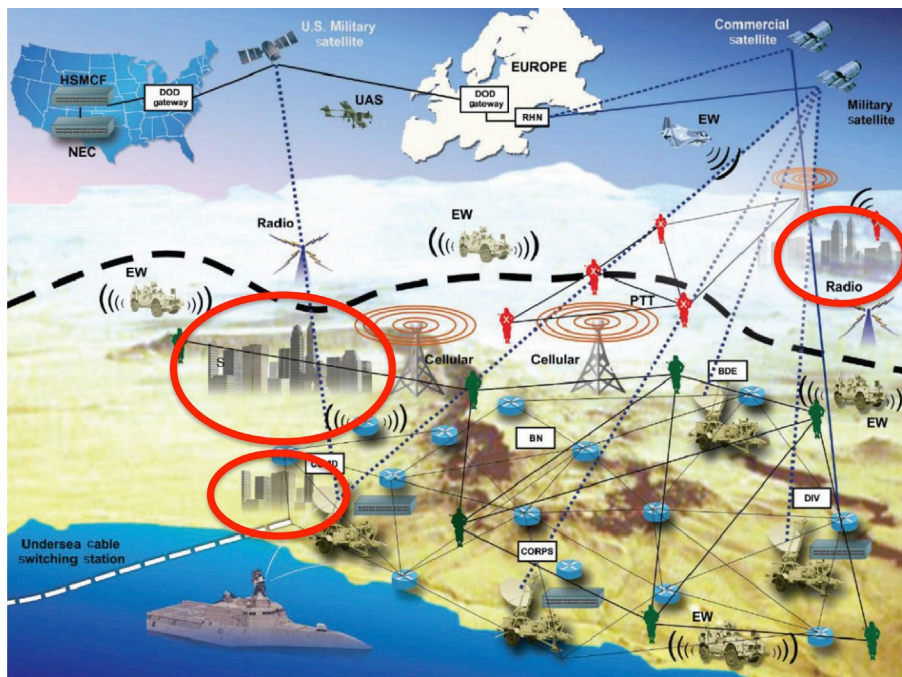


Figure 1. Cyberspace in the Multi-domain Extended Battlefield

Source: Headquarters, Department of the Army, Field Manual 3-0, *Operations* (Washington, DC: Government Publishing Directorate, December 6, 2017), 1-8.

In 2014, The Chief of Staff Strategic Studies Group paper “Megacities and the US Army” claimed that ATP 3-06 cautions against linear forms of maneuver in urban environments, but nevertheless presents traditional forms of maneuver.¹⁰ The report further claims, “the fundamental assumptions implicit to these approaches are the ability to isolate and shape the urban environment and to utilize ground approaches from the periphery into the city.”¹¹ The study claims that isolation of a megacity has a flaws because of the sprawl, population size, density, digital connections, etc.

Part of the problem with developing techniques for large cities comes from the vast variations in the urban environment and human terrain between each large city. Joint Publication 3-06, *Joint Urban Operations*, points out, “the challenges and solutions in one area may be greatly different from those in other areas of the city.”¹² “Megacities and the US Army” describe the immense differences between six megacity cases studies, including New York City, Bangkok, Rio de Janeiro, Sao Paulo, Lagos, and Dhaka. For the last 100 years, urban planners developed models, which describe general zones and components of cities in various regions of the world. Just as the “Megacities and the US Army” struggles to conceptualize an analogous framework, the 17 primary city models from urban planning, ranging from the Concentric Zone Model to the Chinese City Model, vary too drastically for conceptualizing techniques for urban LSCO.

Although the models may not be useful for a set of urban operation techniques, the models present various forms of urban functions. Despite being structurally different, cities all perform similar functions such as governance, security, distribution of resources, infrastructure development, etc.¹³ As technology advanced during the late 20th and early 21st century, cities used information communications technology (ICT) systems and the

Internet of Things (IoT) to collect large volumes of data, called big data, to help make smart decisions about urban functions, which later became known as the “Smart City.” Although not every megacity is a smart city, megacities tend to either be smart cities or plan to be smart cities in the near future due to their need for judicious use of resources. According to the UN World Cities Data, in 2018, the world had 31 megacities.¹⁴ Of those 31 megacities, only Mumbai and Bangkok, did not have current plans for becoming a smart city.

This study hypothesizes that because smart cities have similar functions and infrastructure, smart city theories provide a reasonably consistent framework, by which to analyze all smart cities, including smart megacities. Consequently, the United States Army may leverage the smart city infrastructure to gain positions of relative advantage in smart cities and begin to create techniques for offensive operations in the megacity.

Definitions

Although it may seem trivial, urban planners must clearly define the terms the “city” and “urban.” Surprisingly in the field, researchers use the terms without ever defining the terms. Neil Brenner, a leading urban theorist at the Harvard Graduate School of Design’s Urban Theory Lab, critiqued the field for making undescriptive statements such as “The world is half urban.” In a lecture in 2015, Brenner explained that the term city and urban have different meanings to different governments leading to serious questions about the validity of the world urban population and urbanization statistic.¹⁵ Similar questions arise in defining the megacity. Because countries determine the population size of their cities according their districting laws and census, the accuracy of the term megacity can be nebulous. For example, some cities conglomerate to enumerate

their population size, such as the Greater Tokyo Area. For this reason, this study will define a city, including the megacity, as an urban settlement and outlying areas, which are governed by a singular local government.

The term megacity received substantial attention in the last decade from international bodies, researchers in many fields, non-governmental organizations (NGOs) and even within the US Department of Defense. Each of the groups has their own reasons for studying the recent explosive growth of megacities. Nonetheless, the population size and density of the megacity form the heart of concern in most studies. Academia and government bodies alike accept the definition of megacities as urban areas with 10 million or more residents. Throughout the research, the study will reference both megacities and large cities because although a megacity contains 10 million or more people, a city with 9.5 or even 5 million people poses very similar challenges for JFCs. Furthermore, the study's analysis applies to all cities, including small cities, which rebuts the skeptic's question, "Why would the US Army fight in megacities?"

Urban design concepts of the 21st century have greatly benefited by associating themselves with trendy movements. For example, in the early 2000s, New Environmentalism led to the "Go Green Movement" and the "Green City" also known as the "Sustainable City." Similarly, the smart city has benefited from the idea of "smart" technology, which includes everything from the smartphone to smart-homes. Smart technologies are devices that generally connect to the internet, provide a degree of control, and provide forms of automation. To that end, from a technological perspective, the smart city includes a layer of sensors that perceives data, networks that transmit the data to servers for storage, and computer systems, which analyze the data in order for

humans or automation to make judicious decisions. However, the smart city also incorporates ideas from two previous design concepts the Creative City and the Sustainable City, which speak to leveraging collective human capital to make efficient decisions and environmentally cognizance and resiliency respectively. Therefore, the smart city combines resident creativity and participation with analyzed data from ICT to provide efficient services to citizens.

Information Communications Technology forms the networks of the Smart City that transmits data. ICT refers to a group of communication technologies that transmits information over communication mediums such as the internet, wireless, RFID, the cloud, and telephone lines. Consequently, ICT infrastructure provides the critical connections that allow the Smart City to receive data and facilitate automation.

The Internet of Things refers to the layer of devices that connects to the internet through the various forms of ICT. The smart city uses the IoT for a variety of tasks including government smartphone applications, integrated security systems, automated resource controls, pollution monitoring etc. Some of the tasks directly affect the individual resident by allowing them to receive assorted government services and messages ranging from a public transit pass to a visa application. Other tasks allow the government to judiciously regulate resource consumption, such as automated highway lights or leak-detection devices on water supply systems.

Scope

This study will limit the subject scope in four ways: urban concept, levels of war, type of combat operation, and a singular historical vignette. Although the Chief of Staff of the Army is concerned with megacities, this study will limit the scope of the megacity

by explaining how the smart city design concept, which is common to 94 percent of megacities, is a useful model for doctrine and planning. Furthermore, the smart city applies to cities of other sizes also. Although smart cities focus on two primary dynamics, technological and social, this study will not explore the human elements such as education, creativity, and inclusivity. Given the scope of the city size in question, this study will focus on the operational level of war, particularly when identifying challenges. Nonetheless, the study may reveal results and recommendations applicable to the upper tactical level of war (corps and divisions) through the theater-strategic level of war. Given the time constraints, the scope of the study will include only one vignette of a large-scale offensive operation, the Battle of Manila in 1945, as a means to make realistic recommendations for techniques to utilize smart city infrastructure to gain positions of relative advantage.

Because the volume of material about the smart city vastly grew over the last decade, the study will delimit source publication dates to simplify data collection. The source scope includes four delimiting dates. Due to the rapidity of change in the urban planning field, the study will limit the dates for periodical sources about urban planning and cities to sources published from January 1, 2010 through January 1, 2019. The preponderance of primary and secondary sources about cities will come from government documents, press releases, and articles from January 1, 2015 through January 1, 2019. While the field of urban operations experienced changes in the last two decades, older sources provide valuable information about historical urban operations. Therefore, the study will limit the dates for urban operations publications from January 1, 1944 through December 31, 2018. By creating a larger scope for urban operations, the study may take

advantage of doctrine used at the Battle of Manila, such as the 1944 edition of FM 31-50, *Attack on a Fortified Position and Combat in Towns*. Finally, for the accounts of the Battle of Manila, the study will only include primary sources from December 1944-December 1950, with the majority of primary sources published in 1945. However, the extension to 1950 allows the study to include professional writings and accounts of officers in publications the Command and General Staff College. The heavy reliance on primary sources allows the study to identify frictions experienced by commanders during the Battle of Manila, which have not been written consolidated into a single text.

Why a Historical Vignette?

The study includes a historical vignette to provide real context that operational commanders faced, the use of real images, and the ability to emphasize the magnitude of the operational problems in 1945 in order to evoke thoughts of the scale of operational challenges today.

Throughout history military leaders struggled to determine how emerging and future technologies adopted by societies will impact the conduct of war. Williamson Murray describes these societal changes as military revolutions and explains that the revolutions are compounding.¹⁶ History offers no lessons, but allows readers to identify challenges that remain valid across time. For example, the greater totality provided by the Industrial Revolution applies to today as it did in 1914. Hence, researchers must acknowledge that some of the challenges of war will remain despite military revolutions. Consequently, as military leaders prepare for war in the future, they must understand the relationship between history and the emerging technological changes. To that end, a hallmark of the American way of war includes a tendency to search for overmatch

technological solutions without reflecting on the historical conditions of human dynamics and the challenges thereof.

A historical vignette offers realism to the magnitude of the operational challenges. A study that simply prophetically claims that certain challenges will exist in the future loses the nuance of historical experience with smaller problems. For example, the most recent large-scale urban conflict occurred in Mosul, a city with a population of 2.5 million. While 2.5 million people may sound large to Americans due to American suburban development, more than 548 cities around the world contain more than a million people, representing 23.3 percent of the world's population.¹⁷ Forty-eight cities contain 5-10 million people and 33 cities contain more than 10 million or more people.¹⁸ By comparison, Manila in 1942 contained less than one million people. Population represents just one aspect of magnitude. Cities grew in area and increased in density rates. Challenges identified in the study, such as the evacuation of internally displaced people (IDPs), should force readers to realize that not only will this challenge exist in the future, but the challenge could be 900-3,200 percent greater in magnitude by current population sizes alone.

¹ Headquarters, Department of the Army (HQDA), Field Manual (FM) 3-0, *Operations* (Washington, DC: Government Publishing Directorate, December 6, 2017), 7-1-7-7.

² Ibid., 5-5.

³ Chief of Staff of the Army Strategic Studies Group, *Megacities and the US Army: Preparing for a Complex and Uncertain Future*, June 2014, accessed January 13, 2019, <https://www.army.mil/e2/c/downloads/351235.pdf>, 8.

⁴ Headquarters, Department of the Army (HQDA), Field Manual (FM) 3-90-1, *Offense and Defense*. (Washington, DC: Government Publishing Directorate, April 13, 2015), 99.

⁵ Headquarters, Department of the Army (HQDA), Army Techniques Publication (ATP) 3-06, *Urban Operations* (Washington, DC: Government Publishing Directorate, December 7, 2017), 1-2.

⁶ HQDA, FM 3-0, foreword.

⁷ HQDA, ATP 3-06, 4-1.

⁸ Mark A. Milley, AUSA Eisenhower Luncheon Speech, AUSA Conference, (Washington, DC, October 4, 2016), accessed December 9, 2018, http://wpswps.org/wp-content/uploads/2016/11/20161004_CSA_AUSA_Eisenhower_Transcripts.pdf.

⁹ HQDA, ATP 3-06, 1-1.

¹⁰ Chief of Staff of the Army Strategic Studies Group, *Megacities and the US Army: Preparing for a Complex and Uncertain Future*, 8.

¹¹ Ibid.

¹² Joint Chiefs of Staff (JCS), Joint Publication (JP) 3-06, *Joint Urban Operations* (Washington, DC: Government Publishing Directorate, November 20, 2018), I-8.

¹³ Michael Pacione, *Urban Geography: A Global Perspective* (London: Routledge, 2009), 359.

¹⁴ United Nations DESA/Populations Division, *The World's Cities in 2018- Data Booklet*, 2018, accessed January 21, 2019, http://www.un.org/en/events/citiesdayassets/pdf/the_worlds_cities_in_2018_data_booklet.pdf.

¹⁵ Neil Brenner, "The 'Urban Age' in Question," Dean's Lecture Series 2015, Melbourne School of Design, accessed January 12, 2019, <https://www.youtube.com/watch?v=AXhwDwPzH2Y&t=3694s>.

¹⁶ MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution: 1300-2050* (New York: Cambridge University Press, 2003), 13.

¹⁷ United Nations DESA/Populations Division, *The World's Cities in 2018- Data Booklet*.

¹⁸ Ibid.

CHAPTER 2

LITERATURE REVIEW

The first human settlements emerged in Mesopotamia almost 10,000 years ago for various reasons including survival, social needs, and resource production and collection. Although major metropolitans of today may appear quite different than villages Mesopotamia, the purposes of human organization and the services provided to residents stayed categorically similar across history. Because basic human needs for sustenance, shelter, and security are common across the globe; human settlements across time and space developed varying methods to provide essential services. The difference between the environments of urban settlements across different centuries comes from the human applications of technology and the evolution of social constructs. Consequently, cities coalesce unique social characteristics with resources provided by specific physical and human geographies. As the site of the accumulation of resources and human interaction, cities provide immense opportunity for development, as well as exploitation from adversaries. As technology advanced, city structures supported larger populations, which grew in structural and social complexity. To control the complexity of cities and secure the population, cities and societies within the urban areas planned and developed both formal and informal systems to leverage more efficient control and security. However, in the search for greater efficiency, residents gave up or cities involuntarily took liberties. While some residents see the opportunity for greater municipal services, others see a militarization or securitization, colloquially referred to as a ‘police state’.

What is a Megacity?

While the concept of the megacity does not directly apply to the subject of this study, the concept frames a greater problem, of which smart city systems may help define an approach and techniques. The seminal white paper titled, “Megacities and the United States Army,” framed the discussion about megacities by presenting our current doctrine for urban operations and our flawed assumptions about the ability to isolate and shape the urban environment of megacities.¹ Although, population size plays a fundamental role in issues of the megacity, factors of human geography, formal and informal built structures, resource flows of the city dramatically increase the complexity of megacities. The Strategic Studies Group white paper further supported city variances by provided six case studies including New York City, Bangkok, Rio de Janeiro, Sao Paulo, Lagos, and Dhaka. From their study, the group provided a typology framework by grouping megacities in one of three categories: Highly integrated, moderately integrated, and loosely integrated. The group described the categories based on the reliability of systems, quality of infrastructure, and flow regulation. While perhaps useful in distinguishing between the sophistication, risks, and resilience of the city, the typology does little to address the US Army’s unrealistic doctrine for large urban environments.

The Problem with Traditional Urban Ecological Models

The field of urban morphology, a sub-field of urban planning, provides us with additional typologies in the form of urban ecological models. The first major ecological model produced in 1925 by Earnest Burgess used concentric zones to explain the development of Chicago. In 1939, Homer Hoyt criticized Burgess’s model and developed the sector model after the study of 142 American cities.² Six year later, Harris and

Ulman developed the third major model, the multiple-nuclei model, which posited that American cities develop along various functional areas distinguished by the local land-use organization of industry and residences.³ As with much of the field during the early to mid-19th Century, the majority of researchers came from and focused on Western Cities.

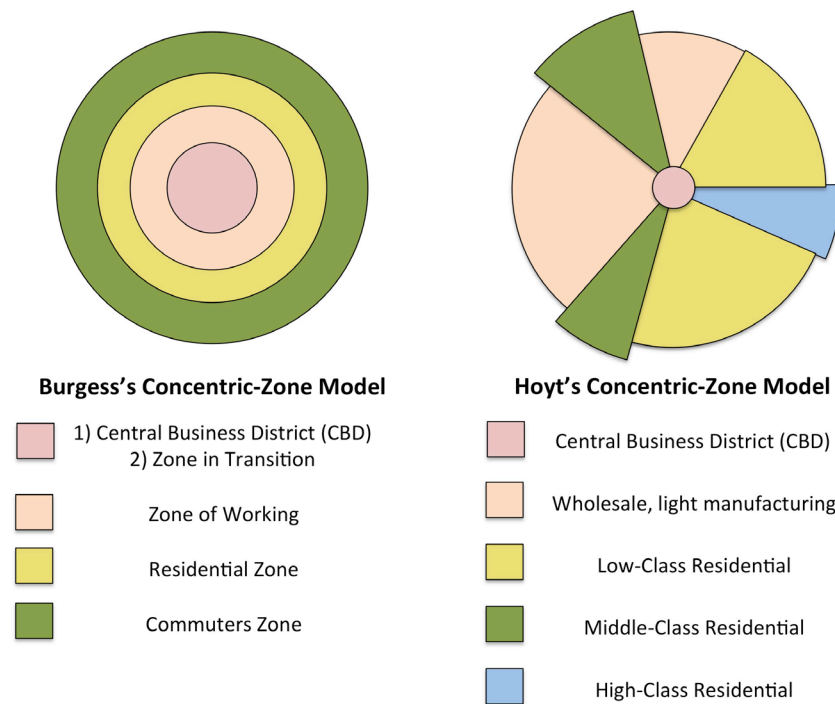


Figure 2. Urban Ecological Models

Source: Created by author using data from Michael Pacione, *Urban Geography: A Global Perspective* (London: Routledge, 2009), 64, 193.

However, In the latter half of the 20th century, a resurgence of models focused on the development of non-Western cities. In 1980, Griffin and Ford produced a model of Latin American Cities, which features concentric zones, an elite residential sector and a CBD

adjacent to the city market connected by public transport lines.⁴ Other prominent models of the era include the African City, the apartheid city, the Islamic city, the colonial-based city in South Asia, and the bazaar city model. In 1967, T. McGee produced the Southeast Asian City Model, which features ethnic diversity, high-class residential, squatter settlements, the *desakota* (extended metropolitan region), and *kampungs* (traditional neighborhoods or villages).⁵ Ford expanded upon McGee's Southeast Asian Model to describe the Indonesian City Model, which features nine major zones, with the notable inclusion of port-colonial city zone and the Chinese commercial zone.⁶ The 2017 edition of ATP 3-06 nods to urban ecological models in its description of urban functional areas, but only offers a hypothetical model that does not demonstrate spatial or structural relationships within the city.⁷

The ecological models, like all models, help make sense of complexity. However, the models are not particularly helpful for the joint force and the US Army in addressing the problem of techniques underscored in the Strategic Studies Group white paper. First, as the urban morphology shows, the structures of cities in various regions of the world are far too dissimilar. Second, even the cities within specific regions do not necessarily follow the models provided. In Southeast Asia, cities have a multitude of deep-rooted factors for development including colonial occupation, religion, long-existing Chinese settlement and trade, squatter settlements, and environment and geography. For example, Jakarta, Singapore, and Bangkok have vast structural differences despite their relative close proximity. In comparison to Southeast Asia, the North American cities of Vancouver, Los Angeles, and New York City have relatively minor differences, despite

much greater distances apart. Hence, the complexity produced by human geography greatly impacts the structural diversity of cities.

On the surface, ATP 3-06's description of urban functional areas offers possibilities for the development of techniques. Moreover, nearly all urban ecological models contain basic functional areas, such as the Central Business District (CBD), industrial zones, and residential zones. However, the importance of each component varies widely across cities. For example, every urban ecological model features a CBD. However, some cities, especially megacities, may have two or more CBDs. Some cities may have historic, cultural cores, which hold greater significance than the CBD. From the perspective of military operations, some residential areas may be important. Industrial sectors of cities change in importance, especially as mid-tiered cities begin to focus on the service sector. Finally, the differences between high-income/high-class residential areas may vary from single-family villas in South American cities to luxury apartments in dense high-rises in a Southeast Asian City.

While developing techniques based on urban ecological components may be problematic due to large variances, functional properties (not to be confused with functional areas) of the city are common to nearly all cities. Some of the functional properties include governance, safety and security, power, water, waste management, transportation, and infrastructure maintenance. To assist with these functions, cities have turned to technological solutions to gain efficiencies through a smarter approach.

What is a Smart City?

Researchers and urban planners use the term "Smart City" widely in city planning, journal publications, and news articles. However, the academic fields and

practitioners have not accepted a single definition of the smart city, which causes ambiguity in understanding. Part of the reason for discord over the definition comes from the varying purposes for which cities adopt smart city initiatives. As practitioners and stakeholders in the term “Smart City,” cities that developed smart city programs use some or all of the smart city’s theoretical concepts to redefine their own meaning of the smart city. Researchers across multiple fields also provided definitions of the smart city. In 2007, Rudolf Giffinger et al. contributed a popular definition by describing the smart city as, “A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living built on the smart combination of endowments and activities of self-decisive, independent, and aware citizens.”⁸ In addition to defining the Smart City, Rudolf Giffinger et al. were the first research team to create a methodology for evaluating smart cities.⁹ In 2013, Colin Harrison et al. more concisely described it as “Cities that seek to make the best use of knowledge and intelligent citizens, administrators, and service providers to improve the design, construction, and operation of the city in various ways.”¹⁰ Later in 2015, Maria-Luisa Marsal Llacuna, a Spanish architect, et al. expanded the definition to include citizen services when they defined smart cities as,

Smart City initiatives try to improve urban performance by using data, information and information technologies to provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration among different economic actors, and to encourage innovative business models in both the private and public sectors.¹¹

What Do Smart Cities Do?

Boyd Cohen, a renowned urban strategist, developed a model called the Boyd Cohen Smart City Wheel (BCSCW), which describes what smart cities strive to achieve.

Boyd Cohen established six dimensions including: Smart Economy, Smart Governance, Smart People, Smart Living, Smart Mobility, and Smart Environment. These dimensions may be thought of as similar to Lines of Effort (LOEs), because they link multiple goal-oriented objectives in each dimension, which focus efforts toward establishing desired conditions. Cities may select all or some of the components from the model, generally with small variations in wording. For example, Smart City Hong Kong uses the BCSCW as an inspiration for its Smart City Plan by focusing on all six of the dimensions.¹² While some cities do not specifically use the BCSCW as inspiration for their plan, in 2014 and 2015, cities in Europe, North America, and South America voluntarily evaluated their city functions using the BCSCW in order to compete in smart city rankings.¹³ To date, Boyd Cohen's methodology remains the most extensively used benchmark criteria and still influences how cities think about smart city design.

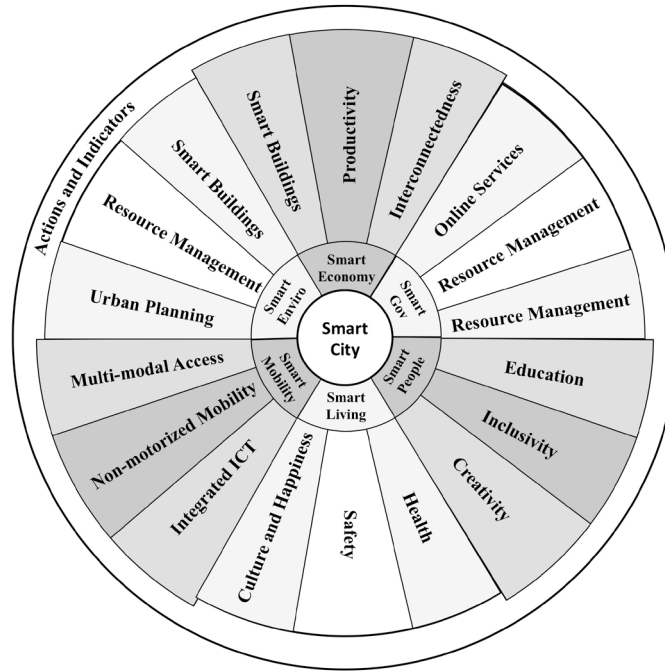


Figure 3. Boyd Cohen Smart City Wheel

Source: Created by author using model from Boyd Cohen, *The Smartest Cities in the World 2015: Methodology*, Fast Company, November 20, 2014, accessed March 15, 2017, <https://www.fastcompany.com/3038818/the-smartest-cities-in-the-world-2015-methodology>.

The Genesis and Evolution of Smart Cities

Cities adopt the smart city concept in different ways. In 2015, Boyd Cohen proposed a model to describe the maturation of smart cities. He explained that some smart city programs move between three phases of the smart city, while others remain fixed in a single phase for various reasons.¹⁴ Cohen believes that cities exist in the following three generations: Smart City 1.0: Technology Driven, Smart City 2.0: Technology Enabled, City-Led, and Smart City 3.0: Citizen Co-Creation.¹⁵ Cohen characterized Smart City 1.0 as cities led by service providers, such as CISCO, IBM, or Huawei. Usually, city managers are keen on adopting the smart city concept, but city

administration, residents, and physical environment may not have the ability to fully understand the implications and benefits of the Smart City; therefore, they require assistance from service providers.¹⁶ Smart City 2.0 includes city programs that led by forward-thinking administrators or leaders, who have a vision for how technology can help them achieve an endstate for the city.¹⁷ Finally, Smart City 3.0 includes cities that allow citizens to participate and lead city development decisions through a process known as co-creation.¹⁸ This maturation model provides insight into the level of citizen participation, ownership, and reliance on the smart city, its infrastructure, and processes. For example, leveraging the infrastructure in a 1.0 Smart City during offensive urban operations will provide useful data; however, leveraging a 3.0 Smart City will likely have greater influence over the civilian population, given their participation.

The Digital Infrastructural Layers of the Smart City

The smart city digital infrastructure layers of the smart city act as a model to understand how the smart city detects and transmits data, collects and stores big data, elucidates raw data into useable information, and forms automated techniques to gain efficiencies. The UN report to the Secretary-General titled “Smart cities and infrastructure” lists five layers including:

1. Urban: the layer where physical and digital infrastructures meet.
2. Sensor: The layer that includes smart devices that measure and monitor different parameters of the city and its environment.
3. Connectivity: The layer that involves the transport of data and information from the sensor level to storage and to data aggregators for further analysis.

4. Data analytics: The layer that involves the analysis of data collected by different smart infrastructure systems, to help predict some events such as traffic congestion.
5. Automation: The digital enabling interface layer that enables automation and scalability for a large number of devices across multiple domains and verticals.¹⁹

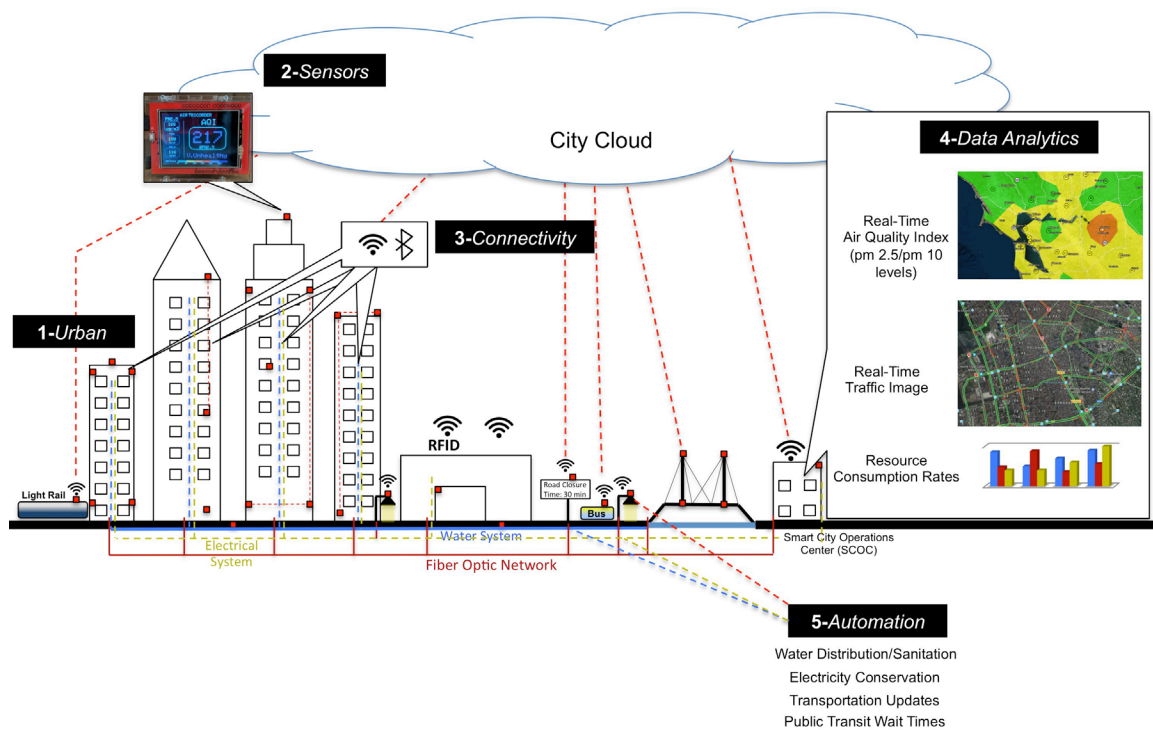


Figure 4. Digital Infrastructure of the Smart City

Source: Created by author.

New Military Urbanism

Stephen Graham, a leading urban researcher, coalesced urban planning concepts with military operations to form a seminal work, “Cities Under Siege.” Stephen Graham predicates his core argument on the concept, which he terms, “New Military Urbanism.” New Military Urbanism builds from the concept of “militarization” originally explored by the military sociologist, Michael Geyer.²⁰ Geyer defines militarization as “the contradictory and tense social process in which civil society organizes itself for the production of violence.”²¹ Graham adds seven new dimensions to militarization to form the concept of New Military Urbanism, which includes:

1. Rural Soldiers, Urban War. Professional armies consisting of soldiers from rural backgrounds executing urban warfare.
2. Tracking: Citizen, Consumer, Soldier. The blurring of civilian and military applications of technologies for control, surveillance, communications, simulation and targeting.
3. Camera-Weapon: Spectacles of Urban Violence. Military Urbanism and its wars are overwhelmingly performed and consumed from the spectacle of electronic imagery.
4. Security Surge. The surge in security focus through preemptive and ubiquitous surveillance within and beyond the borders.
5. Colonizing Transnational Urbanism. The attempt to construct a mutually exclusive binary- a secure urban environment in the homeland and an exploitable urban environment abroad to preemptively attack terrorism.

6. Cosmopolitanism and Homeland. The contradiction of 1) stressing powerful differences between US cities and those elsewhere and 2) the rural myth and American sub-urbanization.
7. New State Spaces of Violence. Urbicide and the destruction of urban spaces for the purposes of security and to displace dissent and resistance.²²

Simply put, New Military Urbanism combines the social process, dynamics, and technological implements, which blur the distinctions of civilian life with the military objective of security. The Smart City unequivocally enables the dimensions of New Military Urbanism. Although not all of Graham's dimensions apply to this study, 1-Rural Soldiers, Urban Warfare, 2-Tracking: Citizen, Consumer, Soldier, 3-Camera-Weapon: Spectacles of Urban Violence, and 4-Security Surge apply to the context of this study. The military urbanism dynamic will play an integral role in the JFC's ability to influence the population to gain positions of advantage in urban LSCO.

Large-Scale Offensive Operations in the Urban Environment

As Stephen Graham points out in "Cities Under Siege," urban warfare has existed since pre-modern times and often cities were main targets of war, presumably for their resources.²³ To that end, urban operations have not changed much since pre-modern times. Today, joint force doctrine explains that the joint force relies upon the establishment of lodgments, such as ports and airfields, which almost always coincide with urban areas.²⁴ ADRP 3-0 supports the strategic importance of cities by stating "Physical centers of gravity, such as a capital city or military force, are tangible and typically easier to identify, assess, and account for than moral centers of gravity." On the operational or tactical level, the destruction or capture of key industrial and commercial

cities may provide an economic advantage by denying the production and distribution of equipment and supplies strikes at the enemy's future ability to wage war.²⁵ Finally, ATP 3-06 explains that the cities control key routes of commerce and may provide a tactical advantage.²⁶ The importance held by cities at all three levels of war underscores why the joint force cannot repudiate urban LSCO altogether.

As discussed in the background of this study, the Army has an incongruence between rapid urbanization and the emphasis placed on large-scale urban combat in doctrine. Logically, a description of large scale urban operations might fit in FM 3-0's chapter, "Large-Scale Offensive Operations." The primary differences for large-scale offensive operations in the newest version of FM 3-0 and previous versions of FM 100-5 from the 1990s include 1) the roles that various echelons assume, 2) the additional focus on electromagnetic spectrum (EMS) and cyberspace 3) gaining positions of relative advantage 4) the consolidation of gains obtained from offensive maneuver. Although reestablishing the corps as a tactical headquarters impacts LSCO in general, it deeply affects the description of offensive operations because it makes divisions the principal tactical formation. This change accounts for the increased importance and presence of EMS and cyberspace threats, which divisions have more capability to address. Due to the central importance of the idea of "positions of relative advantage," the concept will receive its own section in the literature review. Though consolidation of gains receives minor attention at the end of "Chapter 7: Large-Scale Offensive Operations", Chapter 8 focuses solely on the consolidation of gains. The field manual states "Consolidate gains are the activities to make enduring any temporary operational successes and set the conditions for a stable environment allowing for a transition of control to legitimate

authorities.” Although conceivably gains could be made in the defense or wide area security, US doctrine claims that the initiative is won through the offensive. Hence, victory requires successful consolidation gains after an offensive operation. Chapter 8 further explains that the consolidation of gains include activities that secure the advances made by preventing the enemy from affecting progress made by the US forces. FM 3-0 envisions that US forces must continue offensive tasks in other forms by simultaneously exploiting existing advantages and pursuing the remaining means of resistance.²⁷ Arguably, all of these factors play a more critical role in large-scale offensive operations in the urban environment.

Positions of Relative Advantage

Due to the complexity of the modern urban environment, many writers including the Strategic Studies Group, assume that cities offer an advantage to the defender by nullifying technological advantages, slowing the tempo of the attacker, and requiring greater offensive mass. For this reason, the attacker must aggressively seek advantages.

US Army doctrine has used the term “positions of advantage” for many years and the concept applies to warfare throughout history. The 2008 edition of FM 3-0 speaks of multiple types of advantages including positional advantage, relational advantage, asymmetric advantage, and informational advantage. While the 2008 edition does not define any of these advantages, it does state, “movement and maneuver warfighting function is the related tasks and systems that move forces to achieve a position of advantage in relation to the enemy.” Moreover, JP 3-0 speaks of positional advantage and offers a few examples of how to achieve advantage, but likewise does not specifically define nor distinguish between various types of positional advantage. However, US Army

FM 3-0 defines positions of relative advantage as, “A position of relative advantage is a location or the establishment of a favorable condition within the area of operations that provides the commander with temporary freedom of action to enhance combat power over an enemy or influence the enemy to accept risk and move to a position of disadvantage.” FM 3-0 points out that “the Army must both recognize and exploit positions of relative advantage because they are generally temporary, which is a critical assumption that bears importance to the problem statement.”²⁸ Thorough analysis of potential positions of relative advantage gives the joint force the initiative to seize small opportunities. To that end, FM 3-0 provides examples of positional advantage, which include:

1. Physical and geographical advantages
2. Combat power and warfighting function overmatch
3. Relationships and influence,
4. Legitimacy, ideas, and popular perception
5. Time
6. Freedom of action
7. Moral
8. Will²⁹

In urban LSCO, the attacker will likely experience initial disadvantage in some positions, such as combat power and warfighting function overmatch or freedom of action due to the density and complexity of the urban environment. However, many of the other examples of positional advantage do not necessarily benefit the attacker or the

defender due to city complexity. Hence, either force can gain positions of relative advantage throughout the urban operation.

The Battle of Manila

Military historians largely overlook the Battle of Manila, with far fewer historiographies of the battle than its European counterparts. Before the 1990s, the primary publications about the Battle of Manila include primary sources from officers who experienced the battle. Books like *From Down Under to Nippon: The Story of the Sixth Army in World War II* by General Walter Krueger and *Our Jungle Road to Tokyo* by General Robert Eichelberger briefly mention the Battle of Manila as one event among many in the Southwest Pacific Area (SWPA). After the war, some of the junior officers wrote about their experiences in Command and General Staff College monographs and other publications. In 1995, Richard Connaughton et al.'s *The Battle of Manila* provided the first deeper historical analysis of the battle. More recently, James M. Scott wrote a popular military history account of the battle in his book *Rampage*.

Like the field of military history books of the European theatre, military historians tend to focus on either the strategic setting facing military and political leadership or the tactical setting describing the human dynamics of soldiers and tactical units in particular battles. This characterization mostly rings true of the primary works about the Battle of Manila. Connaughton et al. set the strategic scene and introduce the readers to operational leaders. However, much of the book focuses on personal accounts of tactical leadership and civilian experiences. Additionally, *The Battle of Manila* includes a surprisingly limited number of sources, many of which are secondary sources.

James M. Scott's book *Rampage*, as the name suggests, provides a fascinating experience about the destruction of Manila. Similar to Connaughton et al., Scott sets the strategic scene by introducing us to the strategic political and military leaders and the American history with Manila. However, Scott remains focused on the deeply human experience of the battle using primary accounts from Filipino civilians, prisoners of war, American soldiers, and Japanese commanders. Unlike Connaughton et al., Scott provides extensive research using a seemingly endless list of primary sources. His research, methodically categorized and cited, provided extensive research notes for this study at the National Archives and Records Administration at College Park, Maryland and the US Army Heritage and Education Center at Carlisle, Pennsylvania. Despite indirectly describing the situations facing operational level units in the book, Scott does not specifically address the conditions as operational challenges faced by Sixth Army and XIV Corps; rather, he focuses on the conditions that contribute to the personal experiences of the battle and the total destruction of the city. Nonetheless, the meticulous descriptions provided considerable guidance to understanding the operational challenges during the document analysis of this study.

¹ Chief of Staff of the Army Strategic Studies Group, *Megacities and the US Army: Preparing for a Complex and Uncertain Future*, 8.

² Pacione, *Urban Geography: A Global Perspective*, 193-194.

³ Ibid., 194.

⁴ Ibid., 642-643.

⁵ Ibid.

⁶ Ibid.

⁷ HQDA, ATP 3-06, 1-13-1-19.

⁸ Rudolph Giffinger, Christian Fertner, Hans Kramar, Robert Kalasek, Natasa Pichler-Milanovic, Evert Meijers, “Smart Cities Ranking of European Medium-Sized Cities.” October 2007, 10-11, accessed March 18, 2019, http://www.smartcities.eu/download/smart_cities_final_report.pdf.

⁹ Ibid., 13-15.

¹⁰ Colin Harrison, “Smart Cities and Quality of Life,” Point of View based on the Urban Systems Collaborative meeting, London, 10-11 September 2013, Urban Systems Collaborative, April 8, 2014, accessed June 5, 2018, <http://urbansystemscollaborative.org/wp-content/uploads/2014/04/Smart-Cities-and-the-Quality-of-Life.pdf>.

¹¹ Maria Marsal-Llacuna, Joan Colomer-Llinàs, and Joaquim Meléndez-Frigola, “Lessons in Urban Monitoring Taken from Sustainable and Livable Cities to Better Address the Smart Cities Initiative,” *Technological Forecasting and Social Change* 90 (2015): 611-22, accessed May 28, 2018, doi:10.1016/j.techfore.2014.01.012.

¹² Innovation and Technology Bureau, Office of the Government Chief Information Officer, *Hong Kong Smart City Blueprint*, 2-3, accessed March 8, 2018, [https://www.smartcity.gov.hk/doc/HongKongSmartCityBlueprint\(EN\).pdf](https://www.smartcity.gov.hk/doc/HongKongSmartCityBlueprint(EN).pdf).

¹³ Boyd Cohen, “The Smartest Cities in the World 2015: Methodology,” Fast Company, November 20, 2014, accessed March 15, 2017, <https://www.fastcompany.com/3038818/the-smartest-cities-in-the-world-2015-methodology>.

¹⁴ Boyd Cohen, “The 3 Generations of Smart Cities,” Fast Company, August 10, 2015, accessed March 15, 2017, <https://www.fastcompany.com/3047795/the-3-generations-of-smart-cities>.

¹⁵ Ibid.

¹⁶ Ibid.

¹⁷ Ibid.

¹⁸ Ibid.

¹⁹ United Nations Economic and Social Council, *Smart Cities and Infrastructure*, Geneva, May 9-16, 2016, 7, accessed January 21, 2019, https://unctad.org/meetings/en/SessionalDocuments/ecn162016d2_en.pdf.

²⁰ Stephen Graham, *Cities Under Siege: The New Military Urbanism*, (New York: Verso, 2010), 60.

²¹ Ibid.

²² Ibid., pg 61-88.

²³ Ibid., pg 10.

²⁴ JCS, JP 3-06, III-16.

²⁵ Ibid.

²⁶ HQDA, ATP 3-06, 2-2.

²⁷ HQDA, FM 3-0, 8-2.

²⁸ Ibid., 1-18.

²⁹ Ibid., 1-18-1-19.

CHAPTER 3

RESEARCH METHODOLOGY

This study primarily relied upon qualitative data received from document review along two lines: 1) smart cities and 2) large-scale offensive operations in urban environments (reference Figure 5). The document review for line 1 answered research question 1. Meanwhile, the document review for line 2 answered questions 2 and 3.

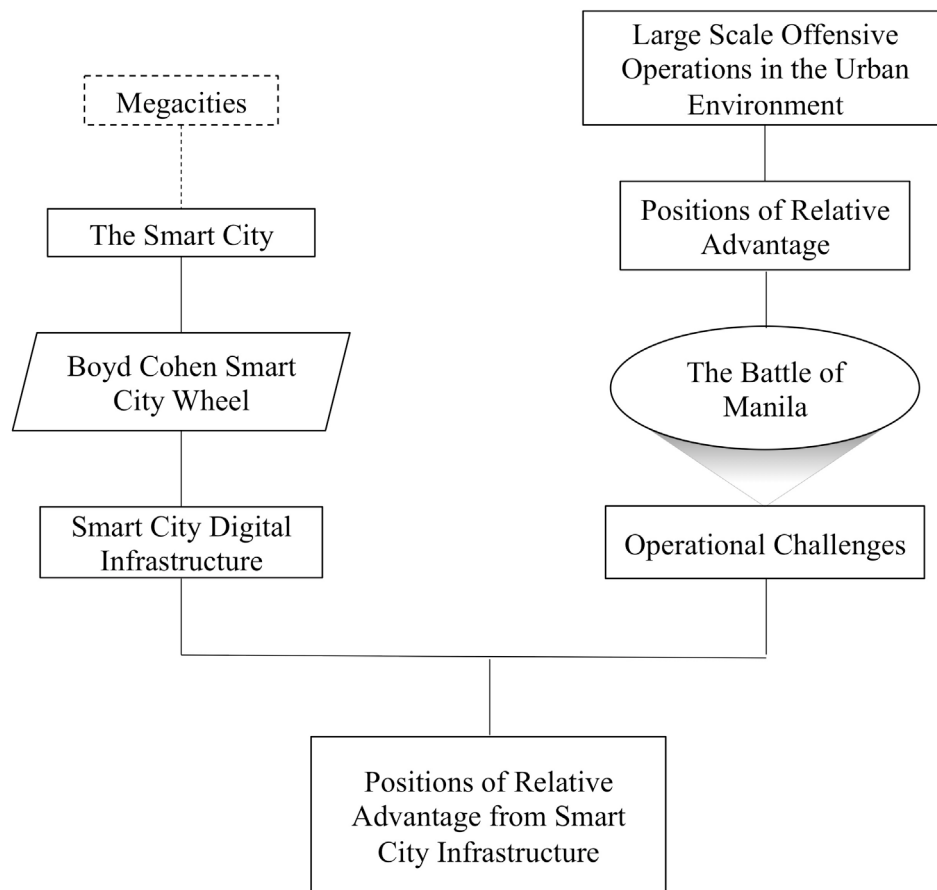


Figure 5. Conceptual Framework

Source: Created by author.

To analyze the components of the smart city, the study included a document analysis relating to each of the layers of the digital infrastructure of the Smart City, with the exception of the urban layer. The study intentionally placed less focus on the urban layer, because the research primarily focuses on the utility of the other layers. Therefore, the study analyzed documents pertaining to the other four layers to describe the existing hardware and software components and functions that each layer provides. The sources documents included journal publications, service provider white papers, Smart Nation Singapore government documents, and government documents from the Republic of the Philippines. The study supplemented the government documents from the Philippines with government documents from Smart Nation Singapore for two reasons. First, Manila's smart city program, New Clark City, served as the logical choice for smart city documents. However, since the program began in late 2018, the smart city did not have robust online, open-government document access. The researcher contacted the New Clark City administration and received permission to view government documents at their headquarters in the Philippines only. Conversely, Smart Nation Singapore, a world leader in open-governance, provided extensive open access to online government documents, plans, and collected data. Second, the Philippine's Duterte administration contracted Singapore-based consulting firm Surbana Jurong to develop the New Clark City, which makes Singapore a natural inspiration for the Philippine's first smart city.¹

As mentioned in the introduction, rather than use hypothetical combat scenarios, the study uses the Battle of Manila as a relevant historical example of LSOO in a large urban environment. Although other battles could have been chosen, the Battle of Manila is perhaps the largest-scale offensive operation undertaken by the United States Army.

Although the Japanese decisively lost the battle, the United States considered Japan a peer adversary, who experienced considerable victories prior to 1945. Third, the size of the forces are unrivaled by other US Army LSOOs, with the Japanese forces totaling 200,000 men. Discovering and examining the challenges experienced by commanders at the Battle of Manila will provide insightful examples of friction. To identify the operational challenges of the battle, the research included a thorough document review of primary source material including after action reports, unit histories, interrogation data, personal accounts and memoirs, and professional publications from first-hand accounts. Although the document review relied heavily from primary sources, the researcher did not conduct a historiography. To that end, the analysis included an abbreviated account of the events of the battle for context. Hence, Chapter 5 focused primarily on key events and the emergent themes from the analysis.

Coding Procedures

To analyze the data received from the document review, the study used the coding method. Although quite intensive and time-consuming due to the iterative nature of coding, this method provided the greatest analytical integrity. For each source, the researcher conducted a cursory examination of all of the document texts to identify critical passages that pertain to the concepts listed in the conceptual framework. After the cursory search, the researcher analyzed the critical passage text line-by-line to determine common themes. Typically, during the textual analysis, a singular theme emerged from sentences, sections, or paragraphs. The researcher then placed the identified themes into a spreadsheet that meticulously captures the source details.

After a complete analysis of all of the texts, the researcher organized the themes into primary and sub-themes known as codes. After re-grouping the themes, the researcher initiated the second cycle of textual analysis by re-reading the text and identifying the relationships with the established codes. The researcher entered important quotes and data from the text into the spreadsheet in relation to the associated code. For example, after identifying the sentence “A serious interference with progress was the advent of approximately 2,000 refugees who came streaming out of the first floor of Del Monico Church on to Gral Luna,” the researcher added the quote to the “IDPs as an obstruction of Maneuver” code. During the second cycle, the research evaluated and modified the codes as required.

At the completion of the analysis, the researcher compared and contrasted the codes and the associated text in the spreadsheet to glean salient information to include in Chapter 4: Analysis. Although the coding instrument exceeded a sensible size to include with the results, Appendix A captures the entire coding instrument and the 196 quotes.

Table 1. Example Coding Instrument

Theme	Sub-Theme	Quotation	Source
Civilian Presence	IDPs as Obstruction to Maneuver	“A serious interference with progress was the advent of approximately 2,000 refugees who came streaming out of the first floor of Del Monico Church on to Gral Luna.	XIV Corps M-1 Operation, 29 July 1945, pg 123
		“Civilian Control. The problems of controlling and administering the civilian inhabitants will nearly always arise, and may be complicated by a flow of refugees into built-up areas.	FM 31-50 <i>Attack on a Fortified Position and Combat in Towns</i> , 31 January 1944, pg 66
		“Among the obstacles encountered by the Division’s advance in Manila was the presence of swarms of the native population who crowded the streets cheering the American Troops.” (Entry-5 February 1945)	37 th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Part II, 1945
		“Immediately following our initial penetration into this enemy stronghold, a steady stream of civilian refugees and patients, long held virtually captive by the Japanese in the hospital, began to pour into our lines, greatly hindering military operations. By the end of the afternoon over 2,000 civilians had been channelized into an emergency assembly area east of Taft Avenue. The evacuation continued throughout the night and an estimated total of 7000 were eventually rescued.” (Entry-17 February 1945)	37 th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Part II, 1945
		“A considerable amount of confusion was encountered at the bridge across the Pasig River, by the clamor of frightened civilians trying to get to the north side of the river. This was soon placed under control by the assignment of ambulances and cargo trucks to assist in the evacuation of these people.”	37 th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V, 1945

Source: Created by author.

¹ Bases Conversion and Development Agency. “BCDA, Japan Team Up with Surbana Jurong Singapore for Development of New Clark City.” accessed March 18, 2019. <https://bcda.gov.ph/bcda-japan-team-surbana-jurong-singapore-development-new-clark-city-0>.

CHAPTER 4

ANALYSIS

As Boyd Cohen described in his Smart City 1.0, many cities see utility in the smart city, but do not have the expertise or resources to create a smart city themselves.¹ For this reason, city managers may contract service providers to assist with an entire program or outsource specific functions of the smart city to service providers. According to Markets and Market's "Smart Cities Market" report, the market for smart city providers will grow from "308.0 billion USD in 2018 to 717.2 billion USD by 2023, at a compound annual growth rate (CAGR) of 18.4 percent"² Service providers provide everything from hardware installation, software development, and personnel training. Given the expanding market, many companies such as Sprint are beginning to create niches for themselves. IBM, CISCO, and Microsoft were the first major companies to provide Smart City services. For example, IBM powers the service-oriented architecture for Honolulu³ and Jakarta Smart City⁴, while CISCO powers Smart Dubai.⁵ Many cities have grave concerns about large contracts with service providers. From personal experience as a city planner for Chiang Mai Smart City, municipal and provincial government worry about future flexibility of the system. If services providers design and install the city network hardware and software, cities become habitually committed to that company and system. Often cities cannot change Cservice providers, because an ecosystem may not be completely compatible with a new service provider, resulting in a loss in service. Any loss in service of major cities could result in catastrophic resource expenses and loss of investment. Consequently, large service providers dominate cities. These factors imply that the joint force may have greater continuity between smart cities

around the world, if only several large international companies dominate the service provider market. Although cities specify individual needs based on municipal objectives, a service provider will likely use similar techniques and hardware in the smart city layers among its smart city clients.

The framework and philosophy of smart cities inform the smart city digital infrastructure. Because cities establish dimensions, analogous to LOEs, in their smart city plan, the digital infrastructure supports data collection and decision-making along those dimensions. For example, if the city wants to focus on Smart Environment, the city may establish a network of air quality sensors, a new tram system, create a smartphone-enabled ride-share program, and build bicycle lanes. Hence the philosophy and framework initially drive the construction of the digital infrastructure layers. However, eventually the collected data from the digital infrastructure may complete a feedback loop that drives changes within the digital infrastructure itself. Because the infrastructure intrinsically links to the municipality and decision-makers, understanding the smart city allows JFCs to understand the relationship between the human and emerging urban geographies.

Smart City Digital Infrastructure Layers

The literature review provided the five layers of the Smart City, which included the urban layer, sensor layer, connectivity layer, data analytics layer, and the automation layer. Each layer, with the exception of the urban layer, consists of hardware and software components.

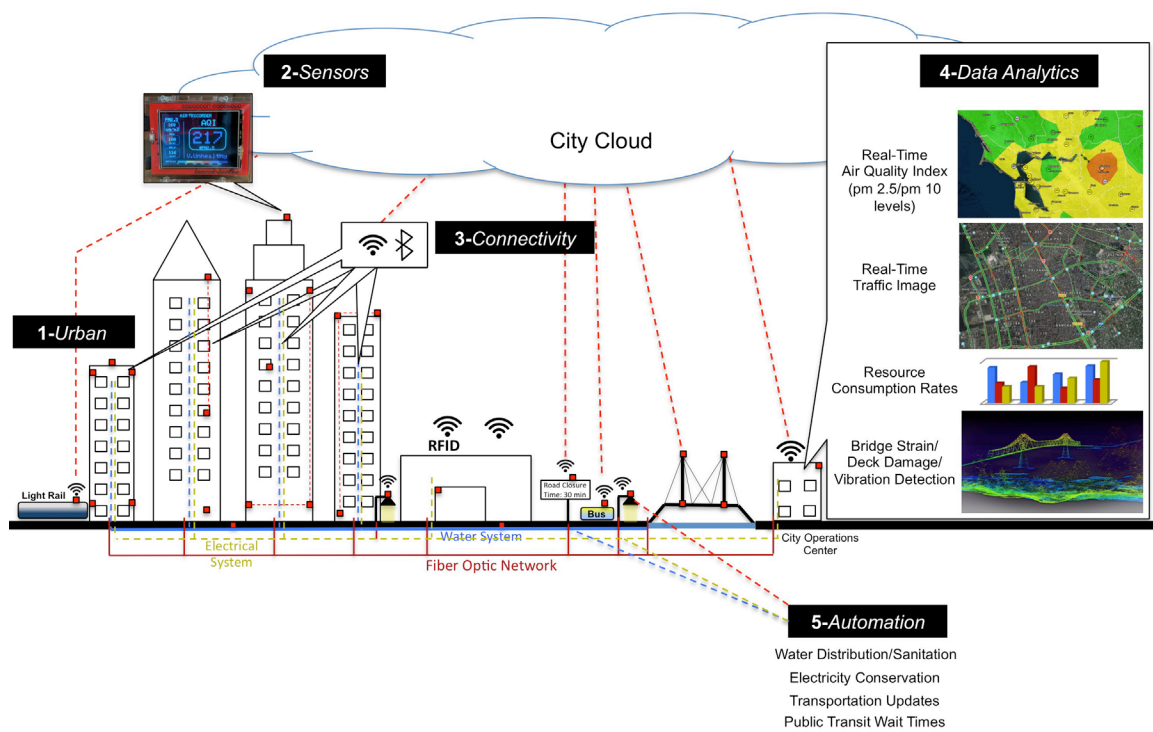


Figure 6. Digital Infrastructure of the Smart City

Source: Created by author.

Urban Layer

Of all five of the layers, average residents likely have the greatest familiarity with the urban layer, since it existed long before the other four layers. The urban layer consists of the built structures including buildings, roads, parks, subways, etc. Though this study does not concern architecture and engineering, the resilience of smart cities plays an integral role LSCO, explained in Chapter 5.

Cynics of the utilization of city infrastructure in LSOO often cite that Aachen, Manila, and Mosul, as examples, which destroyed the majority of infrastructure of the

city causing large power outages, water supply complications, and wastewater backhaul problems. In these conflicts, the relationship between the ferocity of the battle, size of the city, and the resilience of the urban infrastructure will determine the condition of smart city digital infrastructure. City resilience and sustainability, covered by both the smart living and smart environment in the BCSCW dimensions, emphasize the physical resilience of the buildings and the resilience of essential services, particularly in disaster prone regions. In Asia, engineers design cities to withstand large earthquakes, tsunamis, and floods. Perhaps, Smart City Tokyo serves as the best example of resilient buildings. On March 11, 2011, Tokyo experienced a 9.0 magnitude earthquake resulting in a tall tsunami.⁶ Although cities in other parts of the Japan did not fair well, Tokyo successfully notified residents. Due to automation, the Shinkansen bullet trains automatically stopped during the tremors, which prevented the trains from derailing.⁷ Additionally, other typically vulnerable infrastructure, such as elevated bridges suffered no damage. Smart cities throughout the world have systems that provide additional resiliency and sustainability to built structures.

Arguably, the most crucial developments for urban infrastructure resilience include the “microgrid” and other alternative energy developments. The microgrid consists of a small, local power grid that can operate independently or connect to larger power grids. In cities like Manila that are subject to earthquakes, tsunamis, and floods, governments install microgrids to mitigate the damage and ensure services during crises. According to a national press release, each of the microgrids installed by the Philippine government has a two megawatt (MW) received from solar panels, 2MWh of batteries, and 2MW of diesel backup.⁸ The Energy Market Authority of Singapore (EMA) is

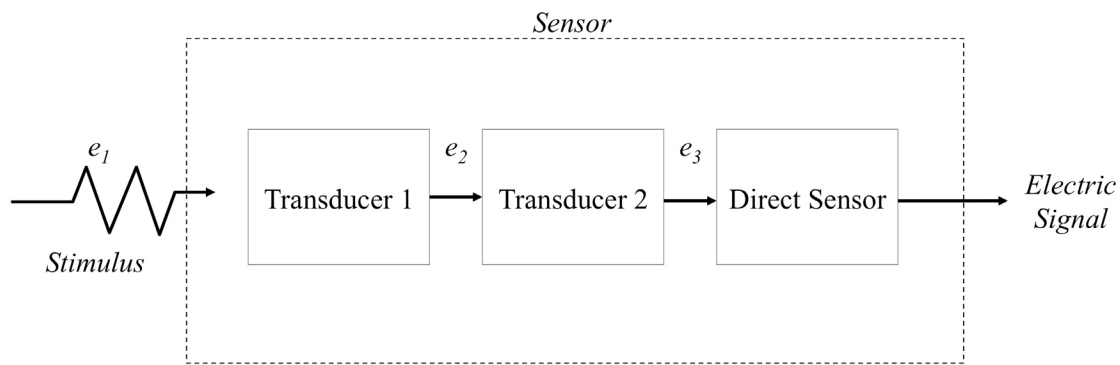
currently researching the efficacy of microgrids in Singapore.⁹ The Singapore Institute of Technology (SIT) designed the first experimental microgrid, which is largely energy self-sufficient and can be connected and disconnected from the main power grid of Singapore. The university plans to scale-up the project to create a grid for the entire university campus by 2023.¹⁰ In addition to providing electricity and the ability to pump water, microgrids can power the other layers of the smart city that transmit big data back to the smart city operations center (SCOC). The Philippines enacted another concept that contributes to city resiliency called Qualified Third Parties (QTP), commonly known in some US states as third party suppliers (TPS). Starting with the enactment of the “Electric Power Industry Reform Act of 2001” (EPIRA), the Philippines authorized qualified third parties (QTPs) to establish electrical services in un-serviced locations throughout the country.¹¹ While QTPs mostly apply to rural areas, EPIRA served as a springboard for smaller electrical service providers and the further emergence of modern microgrids. Unlike TPSs in the United States, the QTPs of the Philippines offer alternative sources of power using their own grids.

Because cities face greater concerns of air pollution and resource consumption, smart cities offer vast solutions across multiple dimensions of the BCSCW. Many smart cities choose to focus on smart mobility as an early initiative because traffic congestion and pollution have very visible impacts on the residents of the city. This study specifically focuses on two small aspects of smart mobility including multimodal transportation access and variable message signs (VMS). Although the smart technology and automation play an important role, multimodal transportation speaks to smart city philosophy by diversifying options for citizens. As opposed to mid-sized US cities, smart

cities that focus on multimodal transportation do not strictly rely on privately owned vehicles (POVs) and provides options and layers of resiliency for a city's transportation system. Multimodal transportation can include various combinations of light rail, trams, buses, vans, cars, rickshaws, motorbikes, bicycles, electric scooters, walking, etc. A resident that uses multimodal transportation may use a car, subway, and bicycle to get to work and a different combination on the way home. Multimodal transportation often changes the landscape of the city with tram lanes, narrower streets with less cars, more bicycle lanes, and larger sidewalks and pedestrian overpasses. Smart cities encourage multimodal strategies because it often requires fewer resources from the city, reduces traffic congestion, and reduces air pollution. Arguably, cities with multimodal strategies are more resilient because in the event of crisis the roads contain less congestion from single-occupancy vehicles and residents have access to more public and high occupancy forms of transportation. Variable message signs serve as the second critical piece of infrastructure that enables a smart city's disaster management system, as well as daily messaging for other information alerts. The information displayed on VMS ranges from simple welcome messages of real-time time-distance predictions for traffic. Although technicians must manually program some VMS such as the trailer-based signs, many VMS may be changed remotely via Zigbee nodes (described in the connectivity layer). SCOC personnel can change the smart VMS message remotely or automation can change the VMS message automatically based on algorithms and data received from sensors. For example, if sensors detect severe congestions three kilometers down the highway from the VMS, an automated sign will recommend speed reduction, wait times, and alternative routes automatically.

Sensor Layer

The sensor layer has the most function diversity, because cities, private companies, and private citizens employ a multitude of types of sensors for various reasons. In the *Handbook of Modern Sensors*, Jacob Fraden broadly defines a sensor as “a device that receives and responds to a signal or stimulus,” which he says includes almost everything including the human eye.¹² More specific for the purpose of this study, sensors are devices that detect, collect, and measure data about a variety of properties, which is transduced into an electric signal.



Note: A sensor may incorporate several transducers.
 e_1, e_2 and so on are various type so energy.

Figure 7. Sensor Composition

Source: Created by author using data from Jacob Fraden, *Handbook of Modern Sensors: Physics, Designs, and Applications*, 3rd ed. (New York: Springer, 2010), 4.

Cities, private companies, and private citizens use sensors for a variety of purposes and consumers can obtain basic sensors for as cheap as 1 USD per device. In

their paper about integrating contextual sensing in the journal *Sensing*, Sagl et al. produced possibly the best categorization of sensors (reference Table 2).

Table 2. Sensor Categorization

Term	Characteristic and Applications
Environmental Sensors	Meteorology and Weather
	Air Pollution
	Flood Monitoring
Mobile Sensors	Disaster Management
	Embedded Mobile Sensor Web
Pervasive Sensing	Smart Environment and Homes
	RFID-based Tracking
People as Sensors	Participatory Sensing
	Noise Mapping
Collective Sensing	Disaster and Incident Management
	Mobility Patterns and Transportation

Source: Created by author using data from Gunther Sagl, Bernd Resch, and Thomas Blaschke, “Contextual Sensing: Integrating Contextual Information with Human and Technical Geo-Sensor Information for Smart Cities,” *Sensors*, 15 (29 July 2015): 17013-17035.

Though cities have less control over remote sensors, *in situ* (static) sensors and human sensors comprise the majority of sensors in the Smart City. Of particular importance, Sagl et al. provide a list of applicable fields, which are both synonymous with the type of data transmitted to the smart cities network and the type service that the smart city can provide. For example, environmental sensors placed on buildings at various heights and within different districts of the city provide the city with a picture of the air quality. Large cities have interest in these environmental sensors, because many of the world’s largest cities have unhealthy levels of PM2.5 and PM10 air particulates. Other examples of

common environmental sensors include vibration and structural damage sensors, which provide particularly useful data for high-rise buildings, bridges, pipelines, etc. that may receive earthquake and tsunami damage.

Smart cities and private companies commonly use collective sensors, which typically have a crowd-sourced feature. For example, smartphone application companies like Waze can provide real-time traffic data using reports from application users. To that end, smart cities tend to use smart city infrastructure for traffic management because congestion limits business and provides a tangible and visible representation of government efficiency. For example, in a 2015 TEDx Talk, Dr. Cheong K. Hean, the director for Housing and Development Board of Singapore, showed a real-time traffic flow image, obtained from collective sensors located in each Singaporean taxi.¹³

Often cities and large companies will assemble many sensors together in a single network. In a white paper produced by the American multinational automated systems company, National Instruments, the company defines a wireless sensor network (WSN) as “a wireless network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions.”¹⁴ For example, on May 3, 2017, Singapore’s Government Technology Agency announced the development of the Smart Nation Sensor Platform (SNSP) at the annual Digital Government Exchange.¹⁵ The press release described a nation-wide platform will use all 110,000 lampposts as the physical connection of the nation’s WSN. Two years later, Singapore envisions the SNSP to provide consumers with water use data, leak-detection, an elderly emergency alert system, and lampposts that perform multiple functions such as measuring air quality and rainfall and facial recognition.¹⁶

Connectivity Layer

Readers can simply think of the connectivity layer as the way that the sensors transmit data through the internet to storage servers. Smart Cities and consumers employ various types of connectivity technology called protocols, including WiFi (Wireless Local Area Network WLAN, 802.11) and Bluetooth (Wireless Personal Area Network WPAN, 802.12.1), as the most commonly consumer recognized protocols. Many consumers interact with WiFi daily when using devices such as a computer, smartphone, or wireless keyboard. However, smart cities also employ other protocols for their sensor networks such as Zigbee (802.15.4) and LoRaWAN (Low Power, Wide Area Networks; 802.15.4g), which offer different capabilities than WiFi.

Connectivity technology has three factors to consider: power, distance, and bit rate for transferring data. Power refers to the battery supplied to the device, which can vary between 24 hours with Wi-Fi to more than 10 years with LoRa.¹⁷ Distance refers to the distance which the device can transmit data. For example, LoRaWAN currently provides the greatest distance of 2-5 kilometers in urban areas and 20 kilometers in rural areas.¹⁸ Finally, the bit rate refers to the maximum transference rate of data, which is 50 Kbps for LoRaWAN, 250 Kbps for Zigbee, and 54 Mbps for WiFi.¹⁹

All of the protocols require a source of internet provided through an ethernet or optical fiber cable. However, WiFi, Zigbee, and LoRaWAN have the ability to conduct mesh networking, which allows two or more nodes to connect and relay data to other nodes. Mesh networks provide greater reliability because if the signal is blocked from one node, another node may provide the signal to the device. For cities, particularly dense cities, mesh networks provide redundancy, greater performance, and resiliency.

Of course, cities have a multitude of configurations for protocol nodes connected to sensors. In Singapore, a leading smart city, the Infocomm Media Development Authority (IMDA) installed base nodes along streets that connect to sensors in the area. In an online media release, IMDA announced that the agency plans to install above ground (AG) boxes, which serve as an all-in-one container with power, 100Mbps fiber connectivity, and multiple computer servers to provide connectivity to sensor nodes and collect data for various government agencies.²⁰ Because of mesh networking, the sensors, which may be located on rooftops, lampposts, or streets signs, provide redundancy and may connect to other AG boxes in the area. Once the sensor layer collects data, the AG boxes can transmit the data to various government agencies and SCOCs for analysis.

Data Analytics Layer

The data analytics layer receives the data from the sensor layer through a connection protocol, such as Zigbee and LoRa. After the data analytics layer receives the information, the layer coalesces the data, often called big data, and stores it onto either servers located within a facility in the city or cloud-based servers elsewhere. After the layer coalesces the information, smart city employees use software to turn the data into useable information. From there, the information takes two main routes, either an SCOC monitors the data and makes informed decisions or automation software automatically transmits commands to nodes for various actions. Although every smart city displays information and makes decisions differently, generally smart cities either have a singular SCOC or multiple SCOCs for various agencies. For example, small smart cities like Chiang Mai, Thailand have an SCOC consisting of 25-30 analysts that work for the mayor and provincial governor. However, each of the large Singapore government

agencies, such as Land Transport Authority and the National Environment Agency, likely has their own SCOCs. Regardless of one or more SCOCs, decision-makers use the analyzed information to make decisions. Often, SCOCs can make immediate inputs similar to the automated system. For example, if real-time traffic data suggests congestion in one part of the city, the SCOC may have the ability to manually change the traffic lights and VMS to alleviate congestion.

Automation Layer

Smart cities routinely employ automation to gain efficiencies. Automation occurs when computer software analyzes collected data and automatically initiates a command based on codes and algorithms. Similar to the hardware in the sensor layer and connectivity layer, smart cities usually do not program their own automations, but rather outsource their applications to a third party. Large software companies like CISCO, Siemens, Microsoft, Oracle, and Huawei dominate the market for the automation layer. Although cities use automation for a multitude of tasks, cities often apply automation to judiciously use resources. Common applications of smart city automation include lighting, parking spaces, and security features. Because cities incur heavy electrical power generation costs, some cities now use smart lighting, which uses a sensor to detect the presence of a vehicle or pedestrian. If the sensor does not detect a moving object, the light automatically turns off. Space also comes at a premium in the city. Consequently some smart cities attempt to manage parking spaces using smart parking. Sensors installed above parking spots detect the presence of a vehicle and automatically relay the information to VMS to display quantity of parking spots available. Many owners of new computers and smartphones have familiarity with automated smart security software such

as facial recognition and biometrics software. When applied to building security, facial recognition software can automatically grant an authorized person access to an otherwise locked building. Automation offers city planners and, perhaps, JFC planners the ability to manipulate the environment automatically.

Conclusion

Upon an initial glance, JFC staffs may view the digital infrastructure as a less important byproduct of the built environment of the city. However, the smart city currently serves as a useful framework for understanding cities throughout the globe. From a philosophical standpoint, the smart city undeniably links to municipal governance. In fact, the philosophy claims to provide citizen greater ability to participate in governance decisions, implying that the concept of the smart city may offer the joint force a greater understanding of the relationship between the human and urban geography. Furthermore, the smart city accounts for the built environment in the urban layer. However, rather than simply focusing on urban modeling, such as the Hoyt, Burgess, or Latin American city model, the smart city focuses on the relationship of the urban, sensor, and connectivity layers with the residents and municipal government decision-makers. Data collection throughout the city informs decision processes and allows municipal decision-makers to manipulate both the built environment and human behavior. Consequently, using the smart city framework can help JFC staffs understand the operational environment of the city and develop potential methods to manipulate the city processes and the behavior of civilians to provide relative positions of advantage in urban LSCO.

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- ² Markets and Markets Research, “Smart Cities Market by Smart Transportation, Smart Buildings, Smart Utilities, Smart Citizen Services, and Region-Global Forecast to 2023,” accessed January 25, 2018, <https://www.marketsandmarkets.com/Market-Reports/smart-cities-market-542.html>.
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- ⁴ IBM, “Jakarta Smart City,” accessed March 18, 2019, <https://www.ibm.com/case-studies/jakartasmartcity>.
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- ⁷ Ibid.
- ⁸ Republic of the Philippines, Department of Energy, *Solar to Put Up More Microgrid Projects*, June 11, 2018, accessed March 10, 2019, <https://www.doe.gov.ph/energist/solar-put-more-microgrid-projects>.
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- ¹¹ Republic of the Philippines, Department of Energy, “Expanded Rural Electrification Program Implementation Strategies,” accessed March 15, 2019, <https://www.doe.gov.ph/expanded-rural-electrification-program-implementation-strategies>.
- ¹² Jacob Fraden, *Handbook of Modern Sensors: Physics, Designs, and Applications*, 3rd ed. (New York: Springer, 2010), 1.
- ¹³ Cheong K. Hean, “How We Design and Build a Smart City and Nation,” December 15, 2015, accessed March 10, 2019, <https://www.youtube.com/watch?v=m45SshJqOP4&t=678s>.

¹⁴ Texas Instruments, “What is a Wireless Sensor Network?” accessed January 24, 2019, ftp://ftp.ni.com/pub/devzone/pdf/tut_7142.pdf.

¹⁵ Smart Nation Singapore, “Digital Government Exchange 2017,” Opening Speech by Head of Civil Service at DGI 2017, May 3, 2017, accessed January 27, 2019, <https://www.smartnation.sg/whats-new/speeches/digital-government-exchange-2017>.

¹⁶ Smart Nation Singapore, “Smart Nation Sensor Platform,” accessed April 20, 2019, <https://www.smartnation.sg/what-is-smart-nation/initiatives/Strategic-National-Projects/smart-nation-sensor-platform>.

¹⁷ Kais Mekki, Eddy Bajic, Frederic Chaxel, and Fernand Meyer, “A Comparative Study of LPWAN technologies for Large-Scale IoT Deployment,” *ICT Express*, 5, no. 1 (March 2019): 1-7.

¹⁸ Ibid.

¹⁹ Ibid.

²⁰ Infocom Media Development Authority, *Singapore Lays Foundation for Smart Nation*, November 03, 2017, accessed February 21, 2019, <https://www.imda.gov.sg/infocomm-and-media-news/buzz-central/2014/6/singapore-lays-foundation-for-smart-nation>.

CHAPTER 5

THE BATTLE OF MANILA AS A LSCO VIGNETTE

Context of the Battle of Manila (February 1945)

After the surrender of Major General Jonathan W. Wainwright at Bataan in 1942, Manila held a deep symbolic significance to American forces of the Southwest Pacific Area (SWPA) theater and General Douglass MacArthur, in particular. Aside from the American internees and symbolism, the Philippine capital city, offered key infrastructure such as harbors and airfields, necessary for supporting a future Japan Campaign. In 1945, SWPA forces began the Luzon campaign, known as M-1, and the subsequent liberation of Manila with an amphibious landing in the Lingayen Gulf. Sixth Army, under General Walter Krueger, received the task to liberate Manila and the American internees.

General Tomoyuki Yamashita, the famed Japanese commander who defeated the Allied forces during the Malaya Campaign in 1942, commanded the Japanese imperial forces on Luzon. General Yamashita organized his forces into three groups under his operational plan, completed on December 19, 1945.¹ Yamashita assigned the Shobu Group the sector of Northern Luzon, the Kembu Group Central Luzon, and the Shimbu Group Manila and Southern Luzon. Although the operational plan called for defensive positions outside of Manila, the eventual American envelopment forced Shimbu Group to retreat into Manila. Tasked to delay American forces, Rear Admiral Sanji Iwabuchi, commander of Shimbu Group's Manila Naval Defense Force (MNDF), violated Yamashita's orders and fought to the death in Manila.

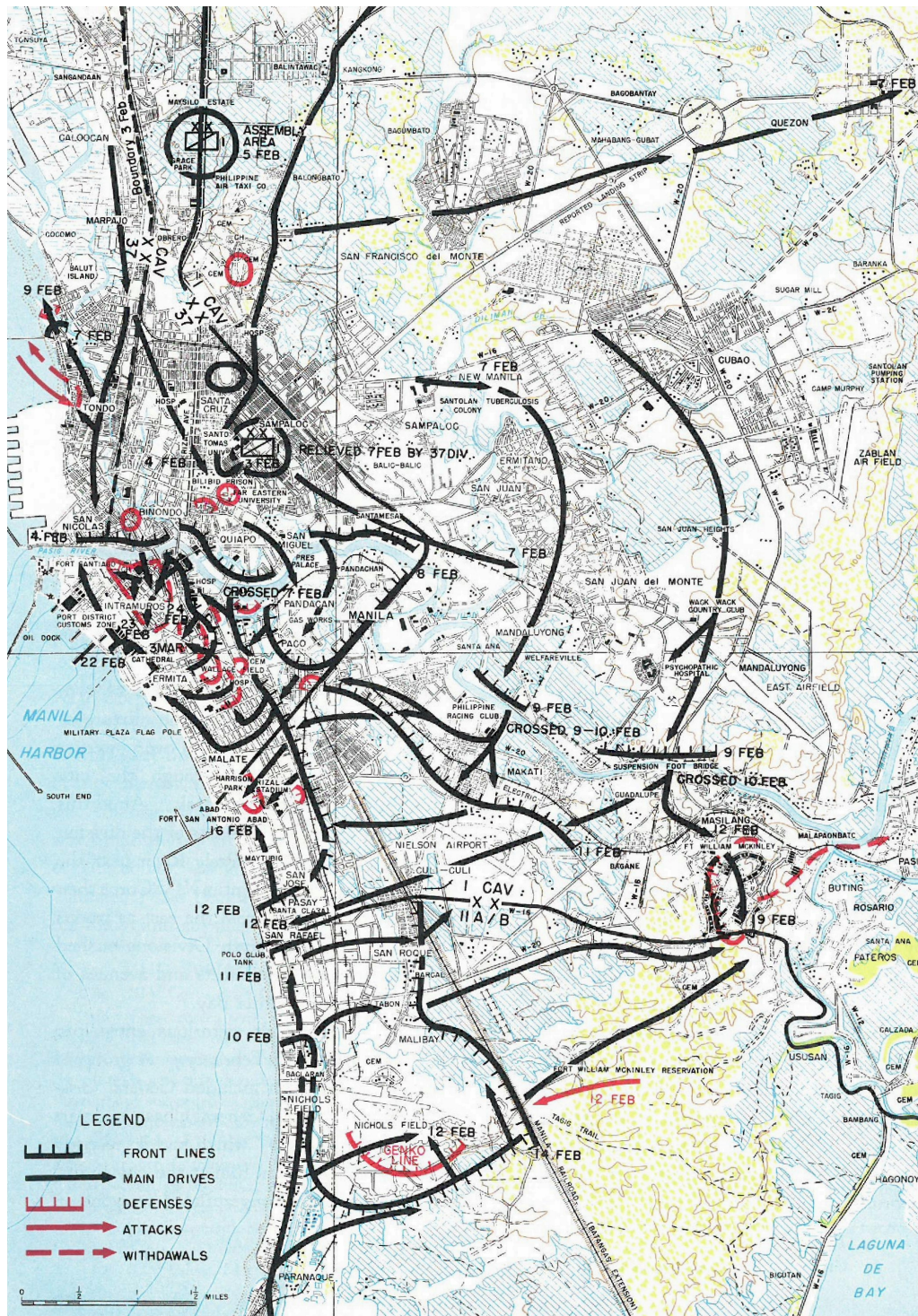


Figure 8. The Battle of Manila, February 3- March 3, 1945

Source: Douglas MacArthur, *Reports of General MacArthur: The Campaigns of MacArthur in the Pacific*, vol. 1 (Washington, DC: U.S. Government Printing Office, 1966), 254.

On January 9, 1945, American forces landed relatively unopposed at the Lingayen Gulf, 175 kilometers north of Manila.² During its movement south, XIV Corps, under the leadership of Major General Oscar Griswold, fought major battles at Clark Field and Fort Stotsenburg in the latter half of January 1945. On January 30th, General Krueger issued Field Order 46 to Sixth Army, which initiated the final movement to Manila.³ As elements of Sixth Army slowly maneuvered through the difficult terrain, elements of General Robert Eichleberger's Eighth Army began to envelop Manila from the south. On February 3rd, XIV Corps, consisting of the 37th Infantry Division, 1st Cavalry Division, and the 11th Airborne Division (attached), began the attack on Manila.⁴ For the purpose of context, the study will divide the Battle of Manila into the following four critical events: the liberation of POWs at Santo Tomas University and Bilibid Prison, the seizure of Nichols Field and Fort McKinley, the crossing the Pasig River, and the final attack at the Intramuros.

Critical Event 1: Liberation of Internees at Bilibid Prison and Santo Tomas University

MacArthur's renowned slogan "I will return" speaks to his loss of the Philippines and his deep commitment to liberate American internees from 1942. With the Japanese propensity for atrocities and desperation, MacArthur saw securing the internees as a primary factor for speed in the attack. On February 2, the 1st Cavalry Division, under command of Major General Verne Mudge, conducted its famous "flying column" that penetrated into Manila to quickly liberate the internees at Santo Tomas University. Nearly a kilometer to the southwest, the 37th Infantry Division liberated the prisoners at the Bilibid Prison. Afterwards, the 37th Infantry Division relieved the 1st Cavalry

Division at Santo Tomas University, so that the cavalry could backtrack northeast to seize key infrastructure, including the Novaliches Dam and Balara Filters. The 37th Infantry Division established Santo Tomas University as the division support area (DSA), which housed a field hospital to treat internees and IDPs, and a position area for artillery (PAA). Due to fierce fighting, fires set by the Japanese, Japanese counter-fire, and a lack of an evacuation plan, many internees, IDPs, and soldiers died on the grounds of Santo Tomas University.

Critical Event 2: Crossing the Pasig River

Before American forces arrived to Manila, the MNDF destroyed nearly all of the major bridges across the Pasig River and the San Juan River. Realizing that the Japanese forces destroyed the bridges, the 37th Infantry Division conducted a deliberate wet gap crossing across the Pasig River. Seizing key terrain along their drive south, the 37th Infantry Division used the Malacanang Palace to establish a staging area in San Miguel District. At the crossing areas between the palace and the Paco District, the river ranged from 120-180 meters across. The 37th Infantry Division's 145th and 148th Infantry Regiments seized far-side objectives in Paco and Pandacan Districts, while the 129th Infantry Regiment seized another piece of key infrastructure, the Manila Electric Company's (Meralco) Steam Plant on Provisor Island. Although the 37th Infantry Division's attack across the Pasig River met fierce resistance, Japanese forces withdrew west towards to the Intramuros.

Critical Event 3: Seizing Nichols Field and Fort McKinley

On January 31, 1945, Eighth Army landed troops from the 11th Airborne Division south of Manila and along Tagatay Ridge, before being attached to General Krueger and the Sixth Army. Admiral Iwabuchi did not intend to fight in Manila and decided that General MacArthur's forces would likely come from the south and attempt to seize the major airfield, Nichols Field. Consequently, Iwabuchi established a strong defensive belt near airfield called the Genko Line. On February 5, as the 11th Airborne Division closed the pincer from the south, the division met stiff resistance at the Genko Line. After nearly a week of fighting, the 11th Airborne Division destroyed the Japanese forces and seized Nichols field. By this point in the battle, the 37th Infantry Division gained ground quickly and had already seized much of the southern side of the Pasig. Meanwhile, the 1st Cavalry Division secured the Novaliches Dam and began moving south to Quezon City. Well south of the 1st Cavalry Division and in reach of the 11th Airborne Division, Admiral Iwabuchi tightly defended Fort McKinley, an old American fort from the Philippine-American War, which he used as his headquarters. XIV Corps tasked the 11th Airborne Division to seize the fort and by February 17th, the 11th Airborne Division controlled the key terrain.

Critical Event 4: Seizing the Intramuros

By the third week of February, XIV Corps controlled nearly all of Manila with only small pockets of Japanese forces remaining in the city. However, a sizeable Japanese force withdrew to the Intramuros, a 16th century fort with high, thick walls. The 1st Cavalry Division mopped up small Japanese pockets and secured a large portion of the city while the 37th Infantry Division attacked the citadel. Because the fort's

impressive walls, the 37th Infantry Division fired thousands of artillery and mortar rounds before a daylight assault. As had occurred throughout the city, many Filipino residents could not escape before the fight, resulting in many civilian casualties. After the long barrage, the 37th Infantry Division's regiments assaulted the fort and like the preceding days, the Japanese fought to the death.



Figure 9. Razed Manila along the Pasig River (February 23, 1945)

Source: US Army Signal Corps. *Philippine Islands – Luzon – Manila*. Records Group: 111, Album 2903, Image 87 (College Park, MD: National Archives and Records Administration).

Operational Challenges at the Battle of Manila

The study used 32 primary source documents to identify three operational challenges for Sixth Army and XIV Corps including the protection of key infrastructure, obstacles for maneuver, and civilians on the battlefield (reference Appendix A). General Krueger and the Sixth Army staff identified the protection of water and electrical systems and the evacuation of POWs during the initial order. While the impact of fire and smoke were not an anomaly to war in the Pacific Oceans Area (POA) and the Southwest Pacific Area (SWPA), the SWPA forces first experienced major urban conflict and urban fire in at Manila. Though US forces could not have specifically known that the Japanese would intentionally raze the city to create obstacles for maneuver, the SWPA forces should have anticipated fire as an obstacle, due to its use throughout history and its consistent role in the nature of urban and siege warfare. The combination of limited essential services infrastructure, fire, and indirect fire, compelled civilian populations to congregate, which resulted in major operational challenges for the Sixth Army and XIV Corps.

Operational Challenge 1: The Protection of Key Infrastructure

Prior to the M-1 Operation, General Douglass MacArthur had every intention of limiting collateral damage to Manila. He forbade the use of aerial bombing and restricted the use of artillery, until February 10th, when he clearly understood that battle would destroy the city and many more Americans may die without indirect fire support.⁵ MacArthur had many reasons for enacting restrictions, not least of which include his personal connections to Manila. Aside from personal reasons, General Douglass MacArthur had strategic reasons to protect the infrastructure, which included the intention to use of Manila's airfields and port for the potential invasion of the Japan. On

February 3rd 1945, the first day of the battle, General MacArthur could not envision the total destruction of Manila that would come in the following days.

Sub-Theme 1-1: Protection of the Municipal Water Supply System

Prior to the start of the operation, General Krueger and the Sixth Army staff identified the municipal water system as both key terrain and a critical vulnerability to the to operation.⁶ The municipal water system posed both immediate implications to the success of the operation, but also challenges for the consolidation of gains after the operations.

Intelligence received from Filipino guerillas correctly claimed that Japanese sappers wired the Novaliches Dam with explosives with the intent to slow XIV Corp's mobility. The Sixth Army report stated, "Intelligence reports indicated that the enemy intended to destroy or possibly pollute the source of water for the Manila area."⁷ Iwabuchi's MNDF Order 43 corroborates the Japanese intent by stating, "A special order will be issued concerning the demolition of the water system and the electrical installations."⁸ The destruction of the Novaliches dam posed an immediate concern because its destruction could release 56 megaliters of water, which could produce a considerable obstacle to mobility in the eastern part of Manila , contributing to the Japanese delay.⁹ Hence, XIV Corps tasked the 1st Cavalry Division and subsequently the 7th Cavalry Regiment to "seize and secure the Manila Water Supply System extending from Novaliches Dam to San Juan Reservoir" on February 6th.¹⁰ In anticipation of the orders the 7th Cavalry Regiment seized the Novaliches Dam before the Japanese sappers could detonate the explosives to flood American lines of communication (LOCs). The following day, the 2nd Squadron secured the Balara Filter System and Filter Plant, which

was “the backbone of the Manila water supply system.”¹¹ After securing their objectives, the 7th Cavalry Regiment began the tedious task of defusing over one ton of explosives throughout the facility.¹² The regiment’s 2nd Squadron continued their mission and seized the San Juan Reservoir mostly intact. However, shortly after their success, a Japanese artillery attack destroyed the main outlet valves. Recognizing the importance of the facilities, XIV Corps’ Field Order 7, tasked the 1st Cavalry Division to continue to “Protect the vital installations of the Manila water supply system within its zone of action.”¹³ While securing the facilities the 7th Cavalry Regiment mapped the primary Manila water supply system and continued to seize important infrastructure nodes, such as the artesian wells (reference Figure 10). During the protection of the key infrastructure, Japanese forces repeatedly attacked the facilities to flood the LOCs.



Figure 10. 7th Cavalry Regiment's Sketch of the Metropolitan Water District

Source: 7th Cavalry Regiment, 7th Cavalry Historical Report: Luzon Campaign 27 Jan to 30 June 45, vol 1, Records Group: 401, Box 13371 (College Park, MD: National Archives and Records Administration).

Although the troops described the temperature as a reprieve from the sweltering and steamy fight on Leyte, the temperature in Manila during February, the middle of the hot season, usually remains between 27-33 degrees Celsius, with little to no rain.

Traditionally, farmers on Luzon and outside the Manila City limits planted and flooded their rice fields, further exacerbating the requirement for water.¹⁴ Consequently, the preservation of the municipal water system provided Sixth Army and XIV Corps with access to a source of fresh water.

In addition to having access to water for XIV Corps, Major General Griswold and General Krueger understood the implications for the civilian population if the municipal water system was destroyed. A Sixth Army report stated, “Early seizure of these sources of water supply [Novaliches Dam, Balara Water Filters, San Juan Reservoir] was therefore vital to the health and even to the existence if the city’s population.”¹⁵ Despite concerted efforts to protect the water system, much of the city did not have access to water due to the destruction of the municipal electrical grid and power plants. Marcial Lichauco, a Filipino who ran a makeshift aid station for wounded IDPs, described in his diary that the only water came from wells.¹⁶

After the battle, the Novaliches dam and some of the nodes remained intact; however, the US and Japanese forces damaged the pressurized water system throughout the city. As the Sixth Army surgeon’s report explained about the consolidation of gains in Manila, a chief concern included providing water to the local population and restoring the water mains. For the first months after the battle, US forces established and controlled water points throughout the city, where residents filled containers for daily consumption. The surgeon reported, “The rehabilitation of the water system was carried out by the army engineers. Water was furnished to civilians first by the use of army water supply points and later through the regular water mains. At the beginning of March, the water supply was partially restored.”¹⁷ The rationing of water unequivocally lessened the exasperation of residents and allowed follow-on forces to focus on reconstruction.



Figure 11. Filipino Children Use a Division Water Point. (February 7, 1945).

Source: 37th Infantry Division, 37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Operations Narrative, Part II, Records Group: 401, Box 8603 (College Park, MD: National Archives and Records Administration).

Sub-Theme 1-2: Protection of the Municipal Electrical System

Almost simultaneously as the 7th Cavalry Regiment rapidly seized the municipal water facilities, the XIV Corps Field Order 6 (February 7, 1945), tasked the 37th Infantry Division to cross the Pasig River seize the Manila Electrical Company's (Meralco) electrical facilities on Provisor Island, which augmented the Botocan Hydro Station to provide power to Manila.¹⁸ In 1930, Meralco completed the regions largest hydroelectric dam, the Botocan Hydro Station, nearly 75 kilometers to the southeast of Manila.¹⁹

However in February 1945, the Botocan Hydro Station remained securely in the Japanese

Shimbu Group's control. Consequently, XIV Corps viewed the Meralco facilities on Provisor Island as an alternative source of electricity after the US forces seized the capital.

The Provisor Island facility consisted of five large buildings and many smaller structures. Perhaps the most critical piece to the Meralco plant included the large steam turbine plant, which consisted of six generators. On February 9th, as other elements of the 37th ID attacked across the Pasig River, the 129th Infantry Regiment fought the Japanese 1st Naval Battalion for Provisor Island. The 129th Infantry Regiment made multiple attempts to seize a foothold through the smoke of oil fires and burning buildings to the South. Because the resistance of Japanese machine and mortars was so strong, the 37th ID conducted several rounds of preparatory fires with artillery and mortars. Once the 129th Infantry Regiment reached the island, the machinery and buildings created a labyrinth of ambushes. Throughout the next days, the 37th ID continued to fire artillery onto the Island in support of the regiment's assault. By the evening of the 10th, the 129th Infantry Regiment controlled the island, but all of the major components of the Provisor Steam Plant lay in ruin.²⁰

Due to the destruction of the Meralco steam plant, much of Manila lost power during the battle. Without electricity, the city lost the ability to provide other functions such as pump water and backhaul sewage. In his diary, Lichauco summarized the desperate situation for the civilian populace by saying the situation by saying, "With no electricity, running water, food, or even fuel for cooking, the challenge proved daunting."²¹ Hence, civilians moved to locations of available water.

Sub-Theme 1-3: Municipal Sewage System and Sanitation

Because Manila had been a colonial capital for hundreds of years in 1945, Manila possessed a modern sewage system and buildings often had toilets. However, after the damage to Meralco steam plant, the sewage system lacked electricity for the backhaul of waste. Unsurprisingly, Manila, a relatively dense city in a tropical environment, quickly experienced sanitation issues. On February 5th, Tressa Cates, an American internee at Santo Tomas University, wrote in her diary, “There was no electricity and very little water. Fortunately, the Army had dug many latrines.”²² Because of the large quantity of wounded Soldiers, IDPs, and former internees, the Sixth Army established hospitals in elementary schools, college buildings, and a former slaughterhouse, which use pit latrines in lieu of bathrooms.²³ However, for the huddled groups of IDPs seeking shelter from the dangers of the battle, the makeshift shelters simply did not have a place to dispose of waste. For example, feces littered the sanctuary of the Church of San Agustin, which provided refuge inside the Walled City.²⁴ After the battle as the XIV Corps attempted to consolidate their gains, the Sixth Army surgeon wrote that many of the private wells, including the artesian wells showed bacteriological evidence of fecal contamination.²⁵

Discussion for Leveraging the Smart City Infrastructure

Critics of the idea of leveraging components of the smart city quickly point out that electricity plays a critical role in the smart city systems, which may result in reduced effectiveness of the smart city infrastructure. While much of the smart city undeniably requires electricity, the concept’s philosophy of sustainability and resilience may affect its ability to provide electricity during duress. Consequently, JFCs may have opportunities to leverage the smart city both prior to and during urban LSOO.

Prior to an operation, the JFC may leverage the smart city in many ways. Because the philosophy of the smart city encourages open governance, many smart cities freely share vast amounts of government documents, analysis, and real-time data, which would inform the Joint Intelligence Preparation of the Operational Environment (JIPOE). Common open data found on government websites include population reports, urban plans, and transportation assessments. Many smart city websites use in situ CCTVs to provide residents with real-time views of road congestion. Through diplomacy from the US Department of State (DoS), the joint force may gain access to the smart city's automation layer controlled by the SCOC. Alternatively, offensive cyber operations (OCO) conducted by the US Department of Defense (DoD), other US government agencies, or leveraging backdoors from service providers to gain access to the SCOC, which will provide analysts and planners access to the city's big data and analytic software. Nonetheless, JFCs should leverage the tools of the smart city long before launching an operation and the inevitable damage caused by urban LSOO.

After the JFC begins an urban LSOO, damage will undoubtedly degrade the smart city's infrastructure. However, emerging resiliency and sustainability technology, increase the survivability of affected city districts. As addressed in Chapter 4, smart cities around the globe prepare for natural disasters ranging from tsunami and earthquake events in Southeast Asia to flooding in South Asia and Sub-Saharan Africa. Boyd Cohen's Smart City model reflects the trend of sustainability and resilience. For example, Makati City, a constituent city located in the heart of Metro Manila, has an advanced resiliency program which links disaster management systems, health services, and transportation.²⁶ On April 22, 2019, during the analysis of this chapter, Makati city

experienced a 6.3 magnitude earthquake resulting in only minor damage and sixteen deaths, which can be attributed to the city's focus on resilience. As suggested in Chapter 4, cities recognize the vulnerability of their electrical grid and look for solutions to build redundancy. Hence, as the concept of microgrids mature, cities will likely adopt microgrids both for sustainability and resiliency purposes. For example, microgrids in New York City have the ability to connect to the municipal electric grid, but also power residential complexes during power outages.²⁷ Slightly smaller than the microgrid, larger buildings now augment power with both solar powered batteries and large diesel generators during periods of power outages. Whereas in 1945, the Botocan Hydro Station and the Meralco Steam Plant on Provisor Island provided the source of power for the Manila, today the city has a myriad of power sources making the city more resilient to natural disasters and the damage associated with large-scale urban conflict.

For LSOO in smart cities, alternative power options require US forces to consider that the operational environment in the city may have power sources ranging from smaller QTPs to microgrids and individual power generation through solar batteries and diesel generators. Through JIPOE, joint force planners can identify corridors of microgrids and QTPs, which will form zones resistant to power outages caused by shutting off power or the destruction of main power plants. Similar to the IDPs of the Battle of Manila, IDPs in future battles will likely seek essential services such as water in these zones, which may be termed "Resilient Pockets."

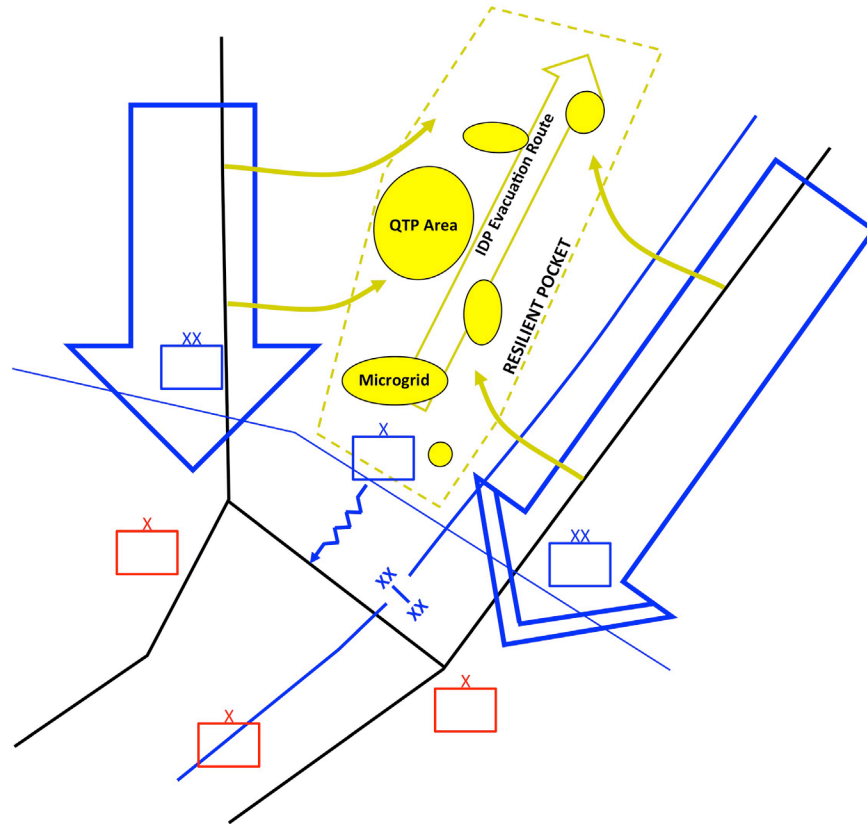


Figure 12. The Resilient Pocket

Source: Created by author.

Once the urban LSCO begins, the SCOC could be the operational center of gravity (COG) for the JUO due to its ability to enable freedom of action for the joint force. As the singular location for big data, the information acquired at the SCOC could answer the joint force commander's information requirements. Again to provide resiliency and efficiency, many smart cities collect and store big data in servers in the city via new cloud-based operations center software offered by service providers such as AT&T, CISCO, and Huawei. Alternatively, smart cities may opt to store the data via in service provider servers, which may be located thousands of kilometers from the

conflict.²⁸ Nonetheless, the real-time data obtained from the sensor layer can inform decision points and branch and sequel plans.

In the urban layers of the smart city, resilient pockets powered by alternative energy such as QTPs, microgrids, solar cells, and generators can power the connectivity and sensor layers of the smart city. Mesh LoRa and Zigbee networks provide additional resilience to data transmission in the smart city network. First, both protocols consume far less power than their WiFi counterparts with batteries that last more than 10 years. Although base nodes must receive internet connection via Ethernet or fiber optic line, cities and private companies, which focus on resilience to damage, increasingly bury their wires under the ground. Second, when enabled by mesh networks, sensor nodes that are destroyed or blocked by the destruction of battle can still connect to other functioning nodes in the mesh. These factors will play an important role in the resilient pocket because it will increase the likelihood that the city can provide essential services to civilians waiting to be evacuated.

Despite the 7th Cavalry Regiment preserving vital nodes of the water supply system such as the Novaliches Dam, after the initial days of the Battle of Manila, the city did not have access to running water. However, the destruction of water mains without the ability to shut off or divert water to avoid leaks likely contributed to the lack of running water in Manila. The lack of water heightened the panic and desperation of congregated pockets of civilians subsisting from small wells throughout the city. Furthermore, the untreated well water increased the risk of waterborne diseases originating from contaminants such as oil, dead bodies, and feces.

Presuming that QTPs and microgrids provide pockets of alternative power, smart water systems may survive the damage caused by urban LSCO. Smart water systems manage the treatment, storage, and the distribution of water efficiently through data analytics. Starting with the treatment, smart cities around the world use sensors to monitor the water-borne microbes and chemicals present in the water both at filtration facilities and within the pipes throughout the city. Access to this information, may provide valuable information about the condition of water sources throughout the city that may particularly valuable to the joint force during the consolidation of gains. To date, smart cities have not dramatically shifted the ways cities store water. Reservoirs often provide large quantities of water prior to filtration and water towers provide storage post-filtration. With increased flooding around the world, cities now carefully manage and divert runoff to reservoirs or other bodies of water. Similar to the intent to destroy Novaliches Dam to restrict mobility corridors for US forces in Manila, enemy forces may manipulate runoff systems and water towers to provide obstacles to canalize mobility. While cities likely do not have flood data for hypothetical rerouting of runoff or damage to water towers, the locations of such infrastructure can assist JFC planners in determining vulnerable areas during JIPOE. Perhaps, the most important implications for the smart water systems exist in the realm of distribution. Cities, increasingly concerned about drought and population growth, monitor the water distribution system for pipe leakages. Pervasive sensors across the system can detect leaks that may not be observable to the human eye. Both during the JUO and the consolidation of gains, detecting water supply system leaks and patching pipes will provide US forces positions of relative advantage, such as legitimacy and freedom of action.

When considering the magnitude and ferocity of the Battle of Manila, one must conclude that future LSCO in the smart city may resemble similar destruction levels to its predecessors. Perhaps, by some metrics the destruction will have greater effects due to the increased total area, population, and density of cities. However, in the case of large cities and megacities, likely neither force will have enough force to occupy all parts of the city. Consequently, forces will likely fight in zones of the city that contain key terrain until one the forces achieves their objective. This dynamic may indicate that some parts of the city will remain untouched. Undamaged zones of the city coupled with resilient pockets may provide JFCs the opportunity to provide areas of safe haven for IDPs, where they may receive shelter, potable water, and have access to proper sewage. By identifying intended undamaged zones, the joint force can task subordinate units to protect protected zones to enable IDP collection and evacuation.



Figure 13. Bilibid Prison and Santa Mesa Scorched, Facing South towards the Intramuros (February 7, 1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2902, Image 170 (College Park, MD: National Archives and Records Administration).

Operational Challenge 2: Fire as an Obstacle to Maneuver

With the brutality of modern weapons, increased urban density, and frequent poor building codes, fire will undoubtedly exist in urban LSCO. In 1945, Manila did not resemble anything like it does today. The average building did not stand higher than four floors, with only some apartment buildings reaching heights of 10 floors. Today where two story buildings once stood, high-rises of forty floors or more exist. Despite the low density by today's standards, much of Manila burned to the ground in 1945. Due to

practices of both the Shimbu Group and XIV Corps, hundreds of primary source documents, such as diaries, letters, unit reports, war-crime trial documents, interviews, etc., report the devastation of the fire. Personal accounts and unit reports describe fire as the horrendous hallmark of the Battle of Manila. Unsurprisingly, the intense walls of fire and the toxic smoke challenged the maneuver of the XIV Corps and the movement of civilians. Entire districts burned to the ground and the 11th Airborne Division could see the flames far south of Manila. Although the Japanese played the most notable role in the inferno of Manila by destroying buildings and structures that might offer XIV Corps a positional advantage, the XIV Corps owned some of the responsibility and the internally displaced Filipinos suffered the cost. Consequently, the study divides the effects from fire into three categories, including fire as an obstacle to XIV Corps maneuver, an obstacle for escaping IDPs, and the potential for self-induced disruption.

The most documented sub-theme code that emerged from the document analysis supports the idea that the Japanese used fire as an obstacle in their defensive plan to delay American forces. This conception divides further into three techniques employed by the Japanese Manila Naval Defense Force, including the destruction of key infrastructure using demolitions, the destruction of unused or unsalvageable resources, and deliberate torching of buildings. On February 3rd, prior to the arrival of 1st Cavalry Division's flying column toward Santo Tomas University, Rear Admiral Iwabuchi issued Manila Naval Defense Force No. 43 (MNDF), which authorized forces to begin secretly demolishing unnecessary installations and material.²⁹ That evening, Marcial Lichauco wrote, "From every section of the city we hear the detonations of tremendous explosions and the skies around us are aglow with fire."³⁰ What Iwabuchi intended to be discrete so

as to not disturb the local populace turned into a murderous, fiery orgy. When 1st Cavalry Division arrived at Santo Tomas University on February 5th, the fires swept from the south of the university near the Bilibid Prison 3.5 kilometers towards 5th Avenue. In his testimony, Vicente Arias said clouds of smoke covered the city and all of the surrounding buildings were ablaze.³¹ The senior commanders echoed the experiences of local Filipinos. General Eichleberger, commander of 8th Army, could see the fires 80 kilometers to the south stating, “The view of Manila last night was a terrible thing as the whole part of one side of the city seemed to be on fire. Smoke and flames were going way up in the air.”³² Major General Beightler, commander of the 37th Infantry Division, was just north of the Pasig River when he said, “The sky was a copper-burnished dome of thick clouds...Great sheets of flame swept across roof-tops sometimes spanning several city blocks in their consuming flight.” The fires continued through the 37th Infantry Division crossed the Pasig River. To disrupt the 129th Infantry Regiment’s attack, Japanese soldiers on Provisor Island set the oil tank on fire.³³ As the Japanese retreated south and west towards the Intramuros, they fulfilled MNDF order 43. On February 9th, as the 37th slowly gained ground along the south side of the Pasig River, Japanese forces continued their demolitions dousing buildings in gasoline along the river in Makati (central Manila). By the 14th of February, the original fires set by the Japanese to slow XIV Corp’s advance south to the Pasig River completely destroyed entire districts and slowly burned out leaving crumbled remains.³⁴

Not only did the fire present challenges for XIV Corps and the 37th Infantry Division in particular, but also the inferno prevented IDPs from escaping the conflict. Because the Japanese prevented IDPs from evacuating the city and the Sixth Army and

XIV Corps did not have the ability to evacuate the civilian population, most of the city's population remained in the city during the battle. Consequently, when the Japanese retrograded from the periphery of the city and set fires to delay the XIV Corps, the city from North to East burned along the Pasig River, forming a double obstacle for civilians. For that reason, many families congregated in large courtyards to avoid injury.³⁵

Of course, many historical accounts from the Battle of Manila blame the Japanese for the fires and demolitions. However, the XIV Corps undoubtedly had a role in the fiery blaze that swept across the city, due to their urban warfare techniques and weapon systems employed. Many of the units claimed in their reports that the 1944 version of FM 31-50 *Attack on a Fortified Position and Combat in Towns* played an important role in how they prosecuted the first urban battle in the Pacific Theater. The manual explains the effective but dubious nature of incendiary weapon systems by stating "Use of Incendiaries. Incendiaries will often be a potent factor in town fighting. Frequently the quickest, surest, and most economical way of dislodging an enemy from a building will be to burn it...The use of incendiaries must be carefully controlled since flame is a double-edged weapon which may affect either side."³⁶ In the early days of the battle, the 37th Infantry Division tried to curb the fire by making firebreaks using demolitions. In fact the 37th Infantry Division Commander, Major General Beightler, instructed the division engineer to supply all demolitions to the effort.³⁷ However, the attempt ultimately proved to be unsuccessful and the attempt to curb the fire only aggravated it further.³⁸ Personal accounts of the Battle of Manila reflect the effectiveness of incendiary techniques during the attack. Major Henne of 3rd Battalion, 148th Infantry Regiment, said that Japanese soldiers occupied the upper floors of buildings to gain fields of fire.

Henne explained, “The preferred solution was to use cannon to blast the upper floors to rubble and then move in. An equally favorable solution was to burn the building.”³⁹ Aside from techniques, US forces in the Pacific regularly used incendiary weapon systems in both rural and urban environments. In the unit after action reports for the Battle of Manila, units consistently listed the use of flame-throwers as an effective tool to flush out Japanese soldiers in makeshift bunkers and buildings.⁴⁰ Not only did special equipment contribute to the blaze, but the munitions played a role also. Major Henne said that on the evening of February 13th, one mortar platoon fired more than 4,000 81mm mortars high explosive rounds with time-delayed fuses and white phosphorous rounds designed to burn the buildings.⁴¹ On February 23, to soften the formidable Intramuros, the 37th Infantry Division artillery fired white phosphorus rounds, which burned the buildings in the old fort.⁴² The XIV Corps subordinate units did not limit the incendiary tools to just supplied equipment. During the assault on the Intramuros, soldiers of the 37th Infantry Division employed every possible method to flush out resisting Japanese soldiers, including the use of gasoline and oil.⁴³ While subordinate units of the 37th Infantry Division thought fire presented a reasonable solution to avoid additional casualties, historians cannot rule out the XIV Corp’s involvement in collateral damage and civilian deaths due to fire, which impacted their moral position of advantage in 1945 and remains a controversial subject today.

Discussion for Leveraging the Smart City

Joint force planners and tactical units must conceive of fire as nearly inseparable from urban LSCO. As in the case of Manila, but also more recent battles such as in Mosul and Marawi, fire invariably exists on the urban battlefield. Although smart cities

often do not specifically address fire in their overarching smart city plans, cities do consider fire as part of resiliency strategies. Consequently, JFC planners may utilize existing data intended for the Smart City to identify flammability corridors, firebreaks, and obstacles and obscuration caused by smoke.

Part of the philosophy behind the smart city includes an emphasis on efficiency and the judicious use of resources. For this reason, most urban planners shun the idea of suburbanization, because it increases the surface area to which cities must provide electrical and water grids. Therefore, the planners of smart cities often advocate some degree of density, though not necessarily cities that contain seemingly endless skyscrapers. In fact, conversations throughout urban planning circles debate the optimum height of buildings, with some popular ideas ranging from 4-6 floors, similar to the urban form of Paris. Nonetheless, the achievement of density and mixed-use development allows cities to provide more efficient services. Despite the benefits, urban density leads to a paradox, because taller urban structures and higher population densities increase the fire fuel density. Of course, cities attempt to control the urban fire risk by using building materials that have higher flash points and a myriad of fire control systems linked in the sensor and automation layers. Despite advancements, fire risk control measures cannot reduce fire risk altogether, especially when challenged with the use of military incendiary devices. Increased urban density also creates urban wind corridors, which amplify and manipulate natural wind patterns and may impact the spread of urban fire. Although urban planners specialize and study in urban climatology and wind engineering, many city pedestrians also have experience with the Venturi effect, the channelization and intensification of wind speed caused by converging urban structures. In some cases, the

Venturi effect may cause damage to other urban structures such as windows. However, in other cases, smart cities such as Singapore intentionally design parts of the city to cool their tropical city while monitoring the wind speeds from sensors placed on buildings.⁴⁴

The collation of fire detection and the collection of wind data via the sensor layer collation at the SCOC, may provide JFC planners the ability to determine flammability corridors that pose a risk to maneuver. Through wind channelization imaging, JFC planners can conduct JIPOE to determine flammability corridors that may be suited to the enemy's use of a fire as an obstacle belt. Other considerations include the building density and the general building composition. Greater urban density may increase the risk for fire, but mid-density low-income areas that use less fire retardant building materials may have a greater urban fire risk. Furthermore, informal settlements, such as squatter settlements and slums, likely do not have multi-storied buildings; however, by their nature, informal settlements lack safety regulations and often have high densities. Unlike establishing blocking obstacles in rural environments or forested environments, urban fires offer the enemy a timely and low-resource opportunity to block an opponent's maneuver. In the early days of the Battle of Manila, the Japanese successfully created a temporary blocking obstacle using demolitions, gasoline, and incendiary devices to burn buildings. With greater fuel densities and stronger urban wind effects, defending forces in future LSCO may choose to leverage fire as an obstacle. Aside from determining areas of higher risk during JIPOE, flammability corridors may allow planners to determine the locations of firebreaks and project their resourcing requirements. Again, the Battle of Manila provides instruction about sustainment requirements. Despite the 37th Infantry Division's best efforts, the unexpected collection and resourcing of demolitions further

stressed the sustainment forces, which were already busy moving internees. Finally, real-time wind effects data within the urban corridors may provide information necessary to predict the spread of fire and the locations in which forces may maneuver. An understanding of potential flammability corridors may ultimately inform the JFC decision points that may achieve positions of relative advantage.

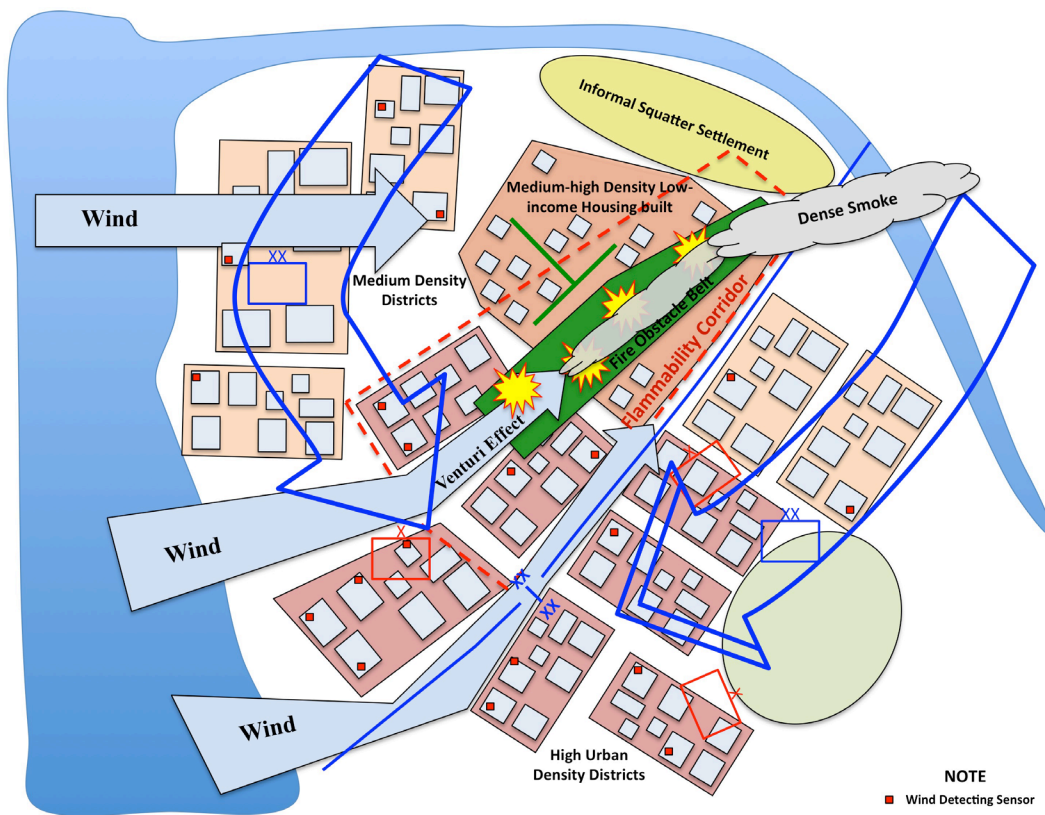


Figure 14. The Flammability Corridor

Source: Created by author.

Though fire directly contributes to air effects and hazards of smoke, JFC planners must distinguish between the two hazards because fire and smoke may cause different

effects in different areas of the city (reference Figure 14). Large urban fires such as in the Battle of Manila, reduced visibility both at ground level and from above. Smoke obscuration, much like fire itself, acts as a double-edged sword that may impact both forces. On one hand smoke may obscure a retrograde, on the other it may make it complicate targeting, which will impact the use of aerial based platforms such as aircraft and UAVs. At the ground level, the toxic gases contained in smoke pose the greatest concern to maneuvering units. Large urban fires typically produce harmful gases and small air particulates (PM2.5 and PM10), while depleting the air of oxygen. Studies since the 1960s vary in smoke inhalation deaths as a percentage of all fire related deaths. Nonetheless, the studies find that fire victims die at higher percentages due to respiratory failure caused by the inhalation of carbon monoxide, carbon dioxide, and hydrogen cyanide or the depletion of oxygen.⁴⁵ Planners may find it difficult to predict the concentration, effects, and dissipation rate of smoke caused by urban fires due to various factors such as atmospheric effects, fire temperature, and fuel sources. However, common applications in the smart city may provide critical information to determine risks. For example, undamaged air pollution sensors at various points on buildings may provide analysis of PM2.5 and carbon dioxide levels at various heights, while functioning CCTVs may provide a real-time view of ground level visibility.

Similar to how planners analyze the enemy's use of rural terrain and associated risks during JIPOE, planners must analyze seemingly unexpected uses of the urban terrain. In the case of Manila, the Japanese attempted to leverage fire to gain geographic, combat power overmatch, temporal positions of relative advantage. Given its low-resource cost, desperate defenders will likely use fire in future urban LSCO. To gain

favorable conditions prior to the operation, a thorough mission analysis and JIPOE using smart city systems to identify potential flammability corridors, firebreaks, and resource calculations can give the JFC temporary freedom of action.



Figure 15. 37th Infantry Division Guides IDPs Across the Pasig River (1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2902, Image 33 (College Park, MD: National Archives and Records Administration).

Operational Challenge 3: Civilians on the Battlefield

In the Battle of Manila the civilian population could not escape on their own for a variety of reasons including Japanese disruption, fire, and potential crossfire. However, primary source documents do not indicate any prior planning for civilian control and

evacuation during the battle. Moreover, due to the poor relationship between the Japanese and local Filipinos, Japanese commanders believed that they could not risk IDPs providing intelligence to the American forces. In addition to the risk posed by IDPs, the main road networks and intersections contained mines and obstacles that prevented Filipino locals from escaping easily. Nonetheless, US commanders identified the liberation of American internees in the heart of Manila as a key task for the operation. Consequently, the civilians in the Battle of Manila must include a bifurcation into two sub-themes: the obstruction of maneuver caused by IDPs and the evacuation of internees.

Theme 3-1: IDPs and the Obstruction of Maneuver

During the Battle of Manila, nearly one million civilians lived in Manila, making it one of the largest cities in the world at the time. Unlike Manila today, the city did not have many buildings greater than ten floors. Nonetheless, the civilian density posed challenges for the XIV Corps. As mentioned in previous sections, XIV Corps units had familiarity with the 1944 version of FM 31-50, *Attack on a Fortified Position and Combat in Towns*. The urban doctrine acknowledged the challenges that IDPs posed by stating “Civilian Control. The problems of controlling and administering the civilian inhabitants will nearly always arise, and may be complicated by a flow of refugees into built-up areas.”⁴⁶ This line of doctrine rang true across the XIV Corps, 37th Infantry Division, and civilian diaries, which explained that the large presence of IDPs inside Manila posed an operational challenge for Sixth Army and XIV Corps because it obstructed maneuver, inundated forces with the challenge of protecting them, and limited targeting of indirect fire.



Figure 16. Swarms of Civilians Obstructing Movement Corridors (February 4, 1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2903, Image 123 (College Park, MD: National Archives and Records Administration).

The 37th Infantry Division faced most of the obstruction from civilians due to the XIV Corps boundaries, with 1st Cavalry Division in the eastern suburbs and 11th Airborne Division to the south near Nichols Field. When the 37th Infantry Division entered the city on February 5, 1945, the 37th Infantry Division reported that one of the major obstacles encountered included swarms of natives who crowded the streets.⁴⁷ After the XIV Corps crossed the Pasig River, the division experienced similar problems with pockets of civilians. For example, on the 17th, the division described their penetration into the heart of the city by saying,

Immediately following our initial penetration into this enemy stronghold, a steady stream of civilian refugees and patients, long held virtually captive by the

Japanese in the hospital, began to pour into our lines, greatly hindering military operations. By the end of the afternoon over 2,000 civilians had been channelized into an emergency assembly area east of Taft Avenue. The evacuation continued throughout the night and an estimated total of 7,000 were eventually rescued.⁴⁸

Similarly the XIV Corps M-1 AAR says that the Corps experienced serious interference with progress, when a pocket of 2,000 IDPs poured out of the Del Monico Church.⁴⁹ As explain before, the lack of basic essential services, fire, and persecution from the Japanese caused large congregations of IDPs. Without a deliberate plan for the evacuation IDPs, the XIV Corps handled the challenges as its subordinate units encountered the pockets. Because the subordinate units often discovered the pockets of IDPs unexpectedly, friction easily overwhelmed unit maneuver as additional tasks quickly emerged.

Once divisions and regiments discovered pockets of IDPs, the XIV Corps and divisions reacted to the operational challenge by creating emergency branch plans. Planners, logisticians, and military police quickly coordinated the evacuation of IDPS found in these pockets. The 37th Infantry Division Logistics After Action Report from the M-1 Operation described the challenge by stating, “A considerable amount of confusion was encountered at the bridge across the Pasig River, by the clamor of frightened civilians trying to get to the north side of the river. This was soon placed under control by the assignment of ambulances and cargo trucks to assist in the evacuation of these people.” The reallocation of mobility assets exasperated the XIV Corps, which struggled with mobility throughout the M-1 Operation. Unlike the 1st Cavalry Division, the 37th Infantry Division did not have organic trucks, resulting in the 37th Infantry Division slogging through the countryside of Luzon by foot to reach Manila from the Lingayen Gulf. With long LOCs and demands for trucks, the XIV Corps and 37th

Infantry Division scrambled to gather trucks to move IDPs to safety. Undoubtedly, the lift demands required to evacuate civilians stressed other sustainment functions required for future actions, such as moving bridging material, casualty evacuation and replacement, and resupply. In addition to the challenge of evacuating IDPs from the battlefield, rear areas and assembly areas experienced a continuous flow of IDPs seeking refuge and medical attention. The Sixth Army surgeon's report claimed a "great numbers of civilian casualties were received by Sixth Army hospitals."⁵⁰ In diaries, internees of Santo Tomas University described the large influx of wounded IDPs seeking medical attention.⁵¹ Not only were the Sixth Army hospitals overwhelmed with wounded civilians, but also the damaged civilian hospitals required the Sixth Army supply Philippine Civil Affairs Unity (PCAU) surgeons with medical supplies taken from Army stocks.⁵²



Figure 17. Women and Children Killed in the Walled City (February 23, 1945).

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2903, Image 8 (College Park, MD: National Archives and Records Administration).

From the beginning of the operation, Sixth Army and XIV Corps demonstrated considerable concern for collateral damage resulting in the deaths of civilians. The rules of engagement (ROE) established by General MacArthur and General Krueger restricted bombing and aerial fires and limited indirect fire to only observed targets.⁵³ The 37th Infantry Division AAR entry for February 7, 1945 states, “Large numbers of civilians, both white and native, were known to be in the area South of the Pasig River, and particularly in the Walled City, and of course it was desired to spare them if possible. To that end artillery fire was restricted to observed fire upon known targets.” However as casualties mounted in the subsequent days, commanders loosened the ROE to allow unobserved indirect fire.⁵⁴ Nonetheless, civilian deaths remained a consideration. The 37th Infantry Division AAR entry for February 10, 1945 states, “Every effort had been made to spare the civilian population known to be held in captivity somewhere in the area, but as the tactical need for heavy fire power increased permission was sought and obtained to place area artillery fire in front of our advancing lines without regard to pinpoint targets.”⁵⁵ The Japanese Manila Naval Defense Force recognized the opportunity and exploited the US sensitivity to civilian casualties by often using civilian populations as shields.⁵⁶ The concern for civilian deaths gave the Japanese Manila Naval Defense force freedom of action by presenting multiple dilemmas that limited maneuver options along the XIV Corps forward line of troops (FLOT), while inundating in the rear areas with additional civil-military tasks.

Theme 3-2: The Evacuation of Internees

Among other reasons, General MacArthur launched the attack on Luzon and subsequently Manila to secure the American internees kept at Santo Tomas University and Bilibid Prison. As Sixth Army headed south from Lingayen Gulf, General MacArthur spurred Major General Mudge's flying column by demanding, "Go to Manila! Go around the Nips, bounce off the Nips, but go to Manila! Free the internees at Santo Tomas! Take Malacan Place! Take the Legislative Building!"⁵⁷ The two internment camps held approximately 4,000 internees, who had been starved and tortured by the Japanese since arriving from the Bataan Death March in April 1942.⁵⁸ Before the arrival of XIV Corps, the prison guards of Bilibid fled the prison; however, three years of privation, made many of these men, women, and children often incapable of walking and escaping the fires set by the Japanese on North of the Pasig approached the prison.⁵⁹ Robert Kentner, a prisoner of Bilibid Prison, noted, "The fires are spreading and coming towards the camp."⁶⁰ Due to their feeble state, when the 1st Cavalry Division and 37th Infantry Division liberated the internees, the internees required immediate medical attention. Consequently, the XIV Corps established a series of field hospitals, with the first field hospital on the campus of Santo Tomas. Over the course of the first week, hundreds of nurses arrived to treat both internees and IDPs that managed to congregate on the campus.⁶¹ Although Sixth Army and XIV Corps apparently did not have the resources to evacuate all of the internees until after the battle concluded, on February 5, 1945, the 37th Infantry Division used all of their vehicles and borrowed some from 1st Cavalry to evacuate the internees from Bilibid Prison.⁶² Nonetheless, Sixth Army and XIV Corps received harsh criticism from the journalists present during the battle. Because Santo

Tomas served as a PAA and DSA, the campus received large amounts of indirect fire, which killed 22 people in one day.⁶³ One journalist said complained, “Why the hell couldn’t they have gotten those people out of Santo Tomas instead of leaving them there to be blown to pieces with shells?”⁶⁴

Discussion for Leveraging the Smart City

With 548 cities containing a million or more people, future urban LSCO must contend with populations that range from the same size to nearly 40 times larger than Manila in 1945. For this reason, the enormous operational challenge of IDPs that XIV Corps experienced must inform how JFCs approach urban LSCO in the future. Although the presence of American internees, as a subset of the civilian population, may initially appear as a historical detail unique to Manila, the case offers important considerations that may apply to future considerations of urban LSCO. Future battles in cities will likely include larger civilian populations that will magnify the operational challenges associated with IDPs. Consequently, JFCs must develop techniques that leverage existing systems within the Smart City to shape the environment in order to provide maneuver space for tactical elements.

While a few cities experience exurbanization and decreasing densities, city densities tend to increase over time due to development, employment opportunities, and demographic trends such as urban migration. Although, Manila population statistics from after the Battle of Manila do not exist, recent density trends effectively demonstrate that IDP concentrations will likely be larger than 1945. In 2010, the greater Manila area, known as the National Capital Region, had a density of 19,137 people square kilometer. Just five years later, the population density soared to 20,785 people per square kilometer,

an 8.6 percent increase.⁶⁵ Whereas large pockets of IDPs in the Battle of Manila ranged from 2,000-7,000 people, today two city blocks may have upwards of 21,000 people.

Fortunately, the smart city infrastructure can provide positions of relative advantage to provide maneuver space and reduce the risk of civilian deaths. Through diplomacy from the DoS, the joint force may gain access to the smart city's automation layer controlled by the SCOC in order to influence civilian actions throughout the smart city. Alternatively, OCO conducted by the DoD and other US government agencies may manipulate the smart city to create favorable conditions in pre-identified resilient pockets and adjacent districts. With alternative sources of energy such as solar batteries and diesel generators, these areas may pump water through the municipal water system to sustain congregated IDPs. During course of action development (COADEV) planners can link the resilient pocket to civil military operations (CMO), such as evacuation and sheltering IDPs. By designating a resilient pocket, the JFC can encourage civilians in adjacent districts to move to established civilian collection points and evacuation routes within the resilient pocket. Due to its features and multi-domain protection by elements of joint force, the pocket may have increased probabilities for the use mixed-modal transportation such as trains, trams, or buses, which may more efficiently evacuate civilians.

In addition to the designation of resilient pockets, the joint force, either through host nation cooperation in the SCOC or through OCO, can target adjacent districts by shutting off electricity and water. Similar to the civilians in Manila in 1945, the lack of electricity and water will force populations to move in order to sustain themselves (reference Figure 16). Simultaneously, the JFC can leverage the Smart City emergency response systems including variable message signs in the automation layer to provide

evacuation instructions to civilians. Additionally, the JFC can use emergency notification messaging via text, government smartphone applications, and third party crowd-sourced applications to provide redundant evacuation instructions. Of course, procedures will not completely remove civilian presence from intended mobility corridors to the resilient pocket. However, the relative absence of civilians may provide the JFC and subordinate commanders with temporary freedom of action.



Figure 18. Shaping Adjacent Districts via Targeted Essential Services

Source: Created by author.

Although American internees may seemingly represent a unique historical detail of Manila in 1945, XIV Corps' experience with internees provide insight into similar challenges that JFCs may experience in future urban LSCO such as the consideration of aging populations' physical limitations. First, American planning and conceptualization must not rule out the possibility of American internees in the future. Arguably, the Multi-Domain Operations 2.0 concept of prepositioned forces within the competition space and during the early stages of establishing lodgments in anti-access/area denial (A2AD) environments will increase the risk of encirclement and captured US forces. Nonetheless, the more important challenge to civilian evacuation that JFCs planners must consider comes from the assumption that civilians can physically move themselves to a resilient pocket. Smart cities, around the world, struggle with complications of an aging society. Although the population of Manila today remains relatively young with a median age of 23.4 years, cities like Singapore have a median age of 40.8 years with long life expectancies.⁶⁶ For this reason, smart cities consider measures to provide support to the aging population. Consequently, JFC planners should expect a larger population of physically challenged citizens compared to the experience of 1945. This reality may have two important manifestations. First, due to filial relationships, families may be unwilling to abandon elderly relatives and will look for shelter pockets nearby. Second, once aged populations reach the resilient pocket and the civilian collection points, many elderly populations will require vehicle movement. Yet again the smart city offers a potential advantage. In keeping with smart city philosophy, planners often attempt to provide mixed-modal transportation. This may provide additional options for planners to utilize

mass transit systems such as trains, trams, buses, and vans to evacuate healthy and feeble civilians from the resilient pocket.

After the battle, the concerted effort to limit civilian casualties and damage to infrastructure may contribute to legitimacy and moral positional advantage during the consolidation of gains as the JFC suppresses partisan movements. FM 3-0's section titled "Paths to Victory" speaks to moral positional advantage by stating "Ensuring that enemies cannot transition a conventional military defeat into a protracted conflict that negates initial successes is foundational to victory."⁶⁷ As the offensive JUO transitions to stability operations, the moral advantage will enable the legitimacy and transference of responsibilities to civil authorities, thereby presumably reaching the JUOs military endstate.

Conclusion

The Battle of Manila, the largest US conventional urban LSOO, serves as a useful vignette to make realistic recommendations for techniques to address operational challenges. Although nearly 75 years ago, the operational challenges of protecting of key infrastructure, negotiating obstructions to maneuver, and preparing for displaced civilians on the battlefield undoubtedly apply today. In fact, JFCs in future urban LSOO will experience greater complexity in the identified operational challenges. Without techniques to leverage the urban environment, a defending enemy in urban terrain will likely have greater positional advantage, particularly in large cities or megacities. Fortunately, the smart city offers an analogous framework that may be leveraged in various regions of the world to develop techniques. The study's analysis indicates that JFCs may identify parts of the smart city infrastructure, such as SCOC, as operational

decisive points, if not the operational COG. Regardless of whether JFCs gain access to the entire smart city or only portions of the infrastructure, the development of techniques, such as the resilient pocket and the identification of flammability corridors, will offer positions of relative advantage in urban LSOO.

¹ Douglas MacArthur, *Reports of General MacArthur: The Campaigns of MacArthur in the Pacific*, vol. 1 (Washington, DC: U.S. Government Printing Office, 1966), 451.

² *Ibid.*, 254-256.

³ *Ibid.*, 270.

⁴ *Ibid.*, 275.

⁵ 37th Infantry Division, *37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Operations Narrative, Part II*, Records Group: 401, Box 8603 (College Park, MD: National Archives and Records Administration), 32.

⁶ Sixth Army, *Report of the Luzon Campaign: January 9-June 30, 1945*, vol. 1, 36.

⁷ *Ibid.*

⁸ XIV Corps, *Japanese Defense of Cities: As Exemplified by the Battle for Manila*, Manila Naval Defense Force Order no. 43, February 3, 1945 (Headquarters Sixth Army, July 1, 1945), 7.

⁹ Maynilad Water Services Inc., “Environmental Performance Report and Management Plan: Water Supply Services Recovery Project,” October 2006, accessed March 19, 2019, <http://documents.worldbank.org/curated/en/643931468293720991/pdf/E14900EAP1RI1P071119.pdf>.

¹⁰ 7th Cavalry Regiment, *7th Cavalry Historical Report: Luzon Campaign 27 Jan to 30 June 45*, vol. 1, Records Group: 401, Box 13371 (College Park, MD: National Archives and Records Administration).

¹¹ *Ibid.*

¹² *Ibid.*

¹³ XIV Corps, *XIV Corps Field Orders #2-24: 18 Jan-30 Nov 45*, Field Order 7, February 17, 1945, Record Group: 401, Box 4111 (College Park, MD: National Archives and Records Administration).

¹⁴ 7th Cavalry Regiment, *7th Cavalry Historical Report: Luzon Campaign 27 Jan to 30 June 45*, vol. 2, Records Group: 401, Box 13372 (College Park, MD: National Archives and Records Administration).

¹⁵ Sixth Army, *Report of the Luzon Campaign: January 9-June 30, 1945*, vol. 1, 36.

¹⁶ Marcial Lichauco, *Dear Mother Putnam: Life & Death in Manila During the Japanese Occupation 1941-1945* (Hong Kong: Paddyfield Ltd., 2015), 213.

¹⁷ Sixth Army, *Report of the Luzon Campaign: Report of the Surgeon*, Staff Sections, 161.

¹⁸ 7th Cavalry Regiment, *7th Cavalry Historical Report: Luzon Campaign 27 Jan to 30 June 45*, vol. 2.

¹⁹ National Power Corporation, Philippine Government, *Botocan Hydroelectric Plant*, accessed March 12, 2019, <https://www.napocor.gov.ph/index.php/16-dams/99-botocan-hydroelectric-plant>.

²⁰ Robert R. Smith, *Triumph in the Philippines* (Washington, DC: US Army Center for Military History, 1993), 261-263.

²¹ Lichauco, *Dear Mother Putnam: Life & Death in Manila during the Japanese Occupation 1941-1945*, 213.

²² Tressa R. Cates, *The Drainpipe Diary* (New York: Vantage Press, 1957), 249.

²³ James M. Scott, *Rampage* (New York: W.W. Norton & Company, 2018), 312-313.

²⁴ *Ibid.*, 377.

²⁵ Sixth Army, *Report of the Luzon Campaign: Report of the Surgeon*, 161.

²⁶ World Bank, Sustainable Development East Asia and Pacific Region, *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters* (Washington DC: The World Bank), accessed January 21, 2019, http://siteresources.worldbank.org/INTEAPREGTOPURBDEV/Resources/573631-1233613121646/makati_extop.pdf.

²⁷ Microgrid Knowledge, "Demand Energy Brings Pioneering Solar Plus Storage Microgrid to New York City," April 12, 2017, accessed March 21, 2019, <https://microgridknowledge.com/solar-plus-storage-microgrid-demand-energy/>.

²⁸ Ibid.

²⁹ XIV Corps, *Japanese Defense of Cities: As Exemplified by the Battle for Manila*, 7-8.

³⁰ Lichauco, *Dear Mother Putnam: Life & Death in Manila during the Japanese Occupation 1941-1945*, 204.

³¹ Report No. 80, *Investigation of Burning of Downtown Manila by the Japanese between 3 February and 7 February 1945*, Vicente Arias testimony, October 18, 1945, August 21, 1946, Records Group: 331, Box 1116 (College Park, MD: National Archives and Records Administration).

³² Robert Eichelberger, *Dear Miss Em: General Eichelberger's War in the Pacific, 1942-1945* (Westport, CN: Greenwood Press, Inc., 1972), February 6th, 1945.

³³ Scott, *Rampage*, 245.

³⁴ Ibid., 319.

³⁵ Ibid., 345.

³⁶ War Department, Field Manual (FM) 31-50, *Attack on a Fortified Position and Combat in Towns* (Washington, DC: War Department. January 31, 1944), 66.

³⁷ 37th Infantry Division, *37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V*, Records Group: 401, Box 8603 (College Park, MD: National Archives and Records Administration).

³⁸ Ibid.

³⁹ Charles Henne, *Battle History of the 3d Battalion, 148th Infantry, Manila, The Unwanted Battle (4 February through 7 March)* (Carlisle, PA: Military History Institute), 72.

⁴⁰ XIV Corps, *XIV Corps M-1 Operation, Part I*, February 13, 1946, Record Group: 401, Box 4111 (College Park, MD: National Archives and Records Administration), 123.

⁴¹ Scott, *Rampage*, 342.

⁴² Archibald M. Rodgers, *Artillery Ammunition Expenditure for Preparation for Attack on Intramuros. February 23, 1945*, Records Group: 401, Box 13372 (College Park, MD: National Archives and Records Administration).

⁴³ 37th Infantry Division, *37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V*.

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⁴⁵ Marshal S. Levine and Edward P. Radford, "Fire Victims: Medical Outcomes and Demographic Characteristics," *American Journal of Public Health*, 67, no. 11 (1977): 1077-1070.

⁴⁶ War Department, Field Manual 31-50, 66.

⁴⁷ 37th Infantry Division, *37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Operations Narrative, Part II*, 26.

⁴⁸ Ibid.

⁴⁹ XIV Corps, *XIV Corps M-1 Operation*.

⁵⁰ Sixth Army, *Report of the Luzon Campaign: Report of the Surgeon*, 157.

⁵¹ Cates, *The Drainpipe Diary*, 254-255.

⁵² Sixth Army, *Report of the Luzon Campaign: Report of the Surgeon*, 161.

⁵³ XIV Corps, *Japanese Defense of Cities: As Exemplified by the Battle for Manila*, 20.

⁵⁴ Ibid.

⁵⁵ 37th Infantry Division, *37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Operations Narrative, Part II*, 32.

⁵⁶ Ibid.

⁵⁷ Scott, *Rampage*, 128.

⁵⁸ Sixth Army, *Report of the Luzon Campaign: Report of the Surgeon*, 157.

⁵⁹ 37th Infantry Division, *37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Operations Narrative, Part II*, 26.

⁶⁰ Scott, *Rampage*, 196.

⁶¹ Cates, *The Drainpipe Diary*, 252.

⁶² 37th Infantry Division, *37th Infantry Division After Action Report, The Luzon Campaign (M-1 Operation) Operations Narrative, Part II*, 26.

⁶³ Scott, *Rampage*, 236.

⁶⁴ *Ibid.*, 301.

⁶⁵ Republic of the Philippines, Philippine Statistics Authority, *Philippine Population Density (Based on the 2015 Census of Population)*, September 1, 2016, accessed April 2, 2019, <https://psa.gov.ph/content/philippine-population-density-based-2015-census-population>.

⁶⁶ Department of Statistics Singapore, Singapore Government, *Population Infographic*, accessed April 2, 2019, <https://www.singstat.gov.sg/modules/infographics/population>.

⁶⁷ HQDA, FM 3-0, 1-39.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Since the 1905 Field Service Regulations, US Army doctrine recognized the defense as the stronger form of war, but emphasized the importance of the offense as the form of war that leads to victory.¹ Even today, FM 3-0 Operations uses Clausewitzian lexicon to describe the offense as actions that compel the enemy to react thereby providing positions of relative advantage and initiative. Consequently, the US Army views the defense as only a temporary state to enable the resumption of the offense. A careful study of history reveals that countries often prepare for the war that they want. However, in preparing for a particular war, their adversary looks for an asymmetric advantage. If the United States prepares for offensive operations by avoiding cities completely, our adversaries may look for asymmetric advantages in terrain that offers them a position of advantage until they can resume the offense. Therefore, with increasing urbanization trending towards 70 percent of the world living in urban areas, even if the United States can avoid operations in large cities and megacities, the United States will unlikely avoid LSCO in urban environments altogether.

As doctrine writers, planners, and commanders consider models for urban operations in large cities, traditional urban ecological models fail to bridge the gap between urban form, city functions, and human geography. The smart city, as a philosophy and model, attempts to unify form, function, and geography and serves as an excellent framework for modernizing cities. Though the term smart city and the evolution of smart cities tend to be loosely interpreted, the digital infrastructure required to run the

smart city remains relatively consistent across the globe for technological and economic reasons. All smart cities have an urban, sensor, connectivity, data analytic and automation layer that allow them to collect, collate, and analyze data to make judicious management decisions. Moreover, the technology used in those layers, such as sensors and connectivity protocols, remain analogous across the world.

As the United States joint force refocuses on large-scale combat operations against peer competitors, the joint force must search for positions of relative advantage that provide commanders options and opportunities. Arguably, the urban environment of large cities makes achieving positions of relative advantages more important than in any other terrain. Consequently, planners must look for unorthodox means to gain physical advantages, overmatch at the decisive point, freedom of action, and legitimacy. The smart city already provides many of those advantages to city managers such as freedom of action through greater efficiency and legitimacy through open governance and participation. Ergo, the smart city philosophy and infrastructure offers opportunities that may also enable positions of relative advantage in urban LSOO.

The smart city's trend of sustainability and resiliency could also dramatically affect the prosecution of LSOO. Planners cannot assume that LSCO in urban areas results in the complete destruction of the city for two reasons. First, the world's superpowers currently do not have enough forces to occupy, defend, or attack the entire breadth of megacities, which will result in greater emphasis on key terrain and infrastructure that contribute achieving their endstate. Given the increased sprawl, some areas of the city will likely remained undamaged. Therefore, the connectivity layer enabled by mesh network protocols such as LoRa, which can transmit signals at distances of two to five

kilometers, will likely ensure that parts of the smart city infrastructure will function. With greater concern for natural disaster resiliency, new building practices and resilient essential service systems may result in serviceable electricity, water, and wastewater systems in some districts. Thus, JFC may leverage the smart city infrastructure throughout the operation and can exploit the systems to consolidate gains after the battle.

The operational challenges of protecting of key infrastructure, negotiating obstructions to maneuver, and preparing for displaced civilians on the battlefield that the study identified remain valid considerations today. To that end, the growing challenges of increased urbanization warrants attention from the joint force, doctrine writers, and JFC planners to carefully consider how to achieve positions of relative advantage in an environment, which favors the enemy. With indications of increased rapidity and ferocity of battle short of nuclear warfare, conflict durations will likely preclude nations from building forces for long durations, such as the experience in World War II. Therefore, the force available at the commencement of conflict and the ability to project power will limit the size of the force available. Given our current capabilities to project power, the land component will likely have only one corps with enablers to fight an urban LSCO. Though certainly the SWPA and Sixth Army had more resources at their disposal, the Battle of Manila again offers insight for the land component size. Moreover, the analysis of the unit reports, personal accounts, and pictures, provides an opportunity to identify challenges and develop techniques for future urban LSCO enabled by DOTMLPF-P solutions.

Recommendations

Perhaps, the greatest obstacle to the preparation for urban LSCO comes from a pervasive assumption that the joint force will not fight in large cities or megacities due to their complexity, resource requirements, and advantage to the defender. However, as explained in previous sections, typically an adversary seeks an asymmetric advantage over his opponent. Adversary calculations aside, JP 3-06 explains that historically our operational reach relies upon ports, airfields, and railheads, which often exist near large urban areas.² In potential LSCO with our two current peer competitors, China and Russia, the joint force must seize lodgments to extend our operational reach. Again, the Battle of Manila offers insights into operational art in Asia, given that Manila served as a lodgment for an expected campaign in Japan. Since 1945, the geographical distance between adversaries and the United States' ability to project mass did not change dramatically. Hence, emerging concepts found within Multi-Domain Operations (MDO) 2.0 still require a lodgment and infrastructure that can support sustainment. Consequently, it seems unlikely that the United States can avoid large urban areas altogether if an operation requires significant mass. To that end, the DOTMLPF-P recommendations hereafter require an acknowledgement of the potentiality of urban LSCO.

Doctrine

The joint staff published JP 3-06, *Joint Urban Operations*, in 2013, prior to much of the popularity and attention of urban megacities and smart cities. The publication offers useful thoughts on understanding the urban layer of cities. Understandably the publication does not speak about smart cities because the design concept really only gained popularity in academia a few years prior to publication of JP 3-06. Nonetheless,

the joint publication does explain the critical role of digital infrastructure and ICT in JUOs. While the joint force should consider the rate of change of US doctrinal publications as a critical component to shared understanding across the force, the pace at which cities change must drive timely updates to Joint Publication 3-06 and Field Manual 3-06. In addition to increased urbanization, the necessity of timely updates comes increasingly faster technological advancements. The differences between commonplace technology from 2013 and 2019 underscores the necessity of biennial or annual doctrinal updates. Besides the frequency of publication updates, the bureaucratic doctrinal publication process often prevents timely updates. Hence, the joint force may require an abbreviated process for updates, in conjunction with delegated approval authorities.

Organization

Given the necessary integration of operations and capabilities across the instruments of national power required for successful JUOs, the DoD needs a Joint Interagency Urban Operations Center (JIUOC). The JIUOC could coalesce capabilities and expertise that enable and assist geographic combatant commanders (GCCs) and JFCs in preparing and executing JUOs. As an entity responsible for supporting GCCs, the DoD could establish the JIUOC as a subordinate command of United States Transportation Command's (USTRANSCOM) Joint Enabling Capabilities Command (JECC). Since JECC already liaises with and enables GCCs, it provides a suitable headquarters that can flexibly apply strategic capabilities to any region of the world. With unity of command under a single headquarters, the JIUOC could leverage the interagency capabilities necessary for planning and assisting in the execution all forms of JUOs. Similar to existing JECC subordinate commands, the JIUOC could provide tailored teams of joint

force planners to augment JFC staffs in the planning of JUOs. For example, in the case of urban LSCO in the smart city, the JIUOC augmentation team should have a DoS team that can work with the embassy country teams to gain access to SCOCs. If diplomacy should fail, the JIUOC augmentation team could link to the NSA and USCYBERCOM to conduct OCO to gain access to the smart city digital infrastructure. Furthermore, links to DoS, USAID, and NGOs could provide synchronization of civil military operations such as IDP evacuation, engineering, medical support, etc., which would enable positions of relative advantage for JFCs.

While the JIUOC offers capabilities and expertise to GCCs and JFCs, the DoD would greatly benefit from a Joint Urban Operations Laboratory (JUOL) that meticulously studies urban operations, develops relationships with academia, and links to future technology acquisition, while testing JUO techniques and strategies through modeling and simulations. In the example of flammability corridors, through simulations the JUOL could determine techniques and materiel gaps, which could link to US Army Futures Command and the Army Capabilities Integration Center (ARCIC). Moreover, the JUOL may have a critical role in education and training solutions.

Leadership and Education

As Stephen Graham explains with his concept of New Military Urbanism, the “rural soldiers, urban war” dynamic caused by American suburbanization and Department of Defense recruitment trends produces a military that generally has little to no experience or understanding of cities. The development model of the United States does not reflect the urbanization trends in South America, Africa, and Asia. For example, the United States’ tenth largest city, Santa Monica, contains just over one million people

with a population density of 2,252 people per square kilometer.³ Similar to the densities of Manila explained above, the densities of cities throughout other regions of the world dwarf the densities in the United States. Because of American suburbanization and subsequent low densities, American local suburb governments likely do not have the same motivation for efficiency-gaining systems offered by the smart city. Though many of the United States' mid-sized cities, such as Kansas City and Austin, adopted smart city initiatives, the DoD's recruitment tends to come from rural and suburb communities where smart cities do not exist. In short, the average American service member's experience with cities, if they have experience at all, will not prepare them for experiences with smart cities in other regions of the world.

Aside from the gap in passive learning, professional military education and training rarely, if ever, emphasizes urban studies or an appreciation for the complexity of cities. Consequently, the joint force relies upon experts drawn to the subject while studying in undergraduate and graduate programs. This study demonstrated that the subject of urban operations requires deep study and discourse about complex issues just to understand the basics of city functions. Therefore, the joint force needs to develop both generalists and experts in urban studies. If the DoD establishes a JUOL, the relationships with academia could cultivate a short-term education seminar specifically focused on urban studies, preferably at a university in a major city. The 3-4 week urban studies seminar could make urban generalists from selected mid-grade officers.

Developing urban experts will require considerable effort. Urban studies represent a multitude of academic fields such as urban planning, engineering, urban geography, sociology, etc. While rudimentary multidisciplinary understanding would greatly benefit

urban military experts, gaining a thorough holistic understanding takes years of experience and self-study. From personal experience as a smart city planning team, expertise in urban geography and geographic information science (GIS) does not lend holistic understanding to engineering or computer programming concepts of the smart city. Barring unique opportunities to work on urban planning teams afforded by broadening opportunities, military professionals will struggle to gain a sufficient holistic understanding of cities. Given the limitations of time, the JUOL should develop experts in particular fields based on organizational needs and personal interests. Scholarships can offer career-enhancing opportunities that directly apply a mid-grade officer's specialty. For example, urban GIS can enhance a US Air Force space operations officer's understanding of remote sensing, urban wind engineering enhances a US Army pilots understanding wind effects unique to the urban environment, and urban geography strengthens a US Army/Marine infantry officer's appreciation for urban terrain. Once the JUOL creates experts, the laboratory can use the officers for research, strategy development, planning teams, etc. However, for the health of the joint force, the experts must return to their career specialty without penalty, so that officers with an appreciation for the complexity of JUOs reach upper levels of command.

Training and Facilities

In conjunction with the shortcomings of American passive experience with cities, the joint force's current training from the tactical through the operational level does not adequately reflect urbanization trends. Though during the height of Operation Iraqi Freedom (OIF), military operations on urban terrain (MOUT) gained greater prominence, training remained primarily focused on the tactical level by nature of counterinsurgency.

Organizations like Asymmetric Warfare Group provided laudable techniques for tactical formations and subsequent training. However, because the Army focused on the brigade combat team (BCT) level deployment, both training and facilities followed suit. Ergo, training and facilities for echelons above brigade (EAB) suffered.

In many ways, the 2017 edition of FM 3-0 calls for a refocus to EAB in preparation for LSCO. Around 2014-2015, the combat training centers (CTC) refocused to decisive action training exercises (DATEs), rather than mission readiness exercises (MRXs). The shift in exercise design signified a departure from BCT-focused counterinsurgency operations. However, the facilities at the Joint Readiness Training Center, National Training Center, and the Joint Multinational Readiness Center, remain relatively untouched since counterinsurgency MRXs. The largest urban settings contain low-density towns with western-style buildings and wide streets, which reflect American urban design bias. The facilities at the tactical CTCs must reflect urbanization trends across the globe such as higher densities, taller buildings, urban flow considerations, etc. Other officers argued for better urban training facilities in the past after experiences with urban settings. For example in 1990, LTC Mike Menser, a training and doctrine officer, reflected on his experience in Operation Just Cause by stating, “Where do we train an infantry or artillery battalion to run a city, take care of prisoner/refugees, feed and police a populace, and operate the public utilities?”⁴ That question remains valid today. At EAB, current warfighter exercises (WFX) for corps and divisions conducted by the Mission Command Training Program (MCTP) emphasize maneuver in scenarios outside of cities. For example, the 19-04 Corps WFX, which concluded in April 2019, emphasized a peer competitor exercise on the Korean peninsula, which did not include

any events in or near cities. Because of the simulated nature of WFXs, MCTP offers tremendous opportunities by developing and training relatively low-cost, high-reward JUO scenarios. Though creating a large urban system for MCTP in the Joint Land Component Constructive Training Capability (JLCCTC) produces a large coding challenge for the National Simulations Center (NSC), the reward outweighs the cost. If the DoD establishes the JIUOC and JIUL, links to the NSC will offer a feedback loop informed by research and experimentation.

To address Stephen Graham's "urban war, rural soldier" observation, the DoD and US Army Installation Management Command (IMCOM) could consider developing a "Smart Base," which provides multiple benefits. First, installation costs represent a large percentage of the DoD budget and installations could benefit from efficiencies gained from smart city infrastructure. Each of the smart city dimensions in the BCSCW from the smart environment to smart mobility can apply to DoD installation management. Second, nearly every base design reflects American suburbanization with spacious housing, wide streets, and yards. However, detached single-family homes extend water and electrical lines, which reduce efficiency and increase costs. Upon initial thought, asking Americans to give up the typical American lifestyle seems difficult. However, the benefits can outweigh the sacrifices. For example, installation housing could use mixed-use development that may include four-floor high-end flats of equal square footage, with community centers, childcare, and restaurants on the bottom floor. Though the mixed-use development sacrifices personal yard space, it could include well-designed local parks and recreation centers. With slightly greater density and perhaps smart mixed-modal transportation, families may not need two cars, lowering their monthly bills. While a

smart base could reduce governmental and personal resource costs, the concept will provide DoD employees slightly greater passive understanding of world urbanization trends, which may prepare them for future JUOs.

Recommendations for Future Study

The previous recommendations identify concepts that need further study and exploration. However, as it pertains to the subject of the research, urban LSCO and JUOs represent a range of military operations (ROMO). This study strictly focuses on large-scale offensive operations in cities. As researchers explore other ROMOs in cities, further research must analyze possible scenarios that lead to offensive operations in cities. For example, similar to the US experience in Somalia, can humanitarian assistance and disaster relief lead to urban LSCO. Along that line of thinking, researchers must explore how the concept of lodgments and delays featured in Multi-Domain Operations 2.0 may contribute to JFCs conducting a defense in cities. This study postulates a few examples of techniques in offensive urban LSCO in the smart city, but the joint force must conduct further analysis to develop techniques to leverage smart city infrastructure for other types of JUOs. Given the study's recommendation of creating a Joint Interagency Urban Laboratory, the subject has many avenues for future study across the multi-disciplinary field of urban studies, which could be explored by the JIUL.

Conclusion

By its analogous technological and philosophical nature, the smart city offers a useful model to think about the prosecution of urban large-scale offensive operations. In planning against a defending opponent, the JFCs will require positions of relative

advantage to overcome the initial advantages attributed to the defense of urban terrain. The operational challenges of large cities caused by increased urbanization require careful analysis, experimentation, and planning. Fortunately, future JFCs can leverage various layers of the smart city digital infrastructure to gain positions of relative advantage both prior to and during JUOs. Simply put, the joint force must take a smarter approach to urban operations.

¹ Walter E. Kretchik, *U.S. Army Doctrine: From the American Revolution to the War on Terror* (Lawrence, KS: University Press of Kansas, 2011), 111.

² Joint Chiefs of Staff (JCS), Joint Publication (JP) 3-06, *Joint Urban Operations* (Washington, DC: Government Publishing Directorate, November 20, 2018), III-16.

³ City of Santa Monica, “Santa Monica Facts and Figures,” accessed April 19, 2019, https://www.smgov.net/Departments/HED/Economic_Development/Doing_Business_in_Santa_Monica/Business_Climate/Santa_Monica_Community_Profile.aspx.

⁴ Lawrence A. Yates, *The U.S. Military Intervention in Panama: Operation Just Cause, December 1989-January 1990* (Washington, DC: Center of Military History, 2014), 479.

GLOSSARY

Center of Gravity. The source of power that provides moral or physical strength, freedom of action, or will to act. Also called COG.¹

Central Business District. The commercial and business center of the city, often referred to as the financial district.

Consolidate Gains. Activities to make enduring any temporary operational success and set the conditions for a stable environment allowing for a transition of control to legitimate authorities.²

Connectivity Protocol. The system capability that allows various devices to connect to the internet and each other. Examples include WiFi, Bluetooth, and LoRaWAN.

Joint Urban Operations. Joint operations planned and conducted on, or against objectives within a topographical complex and its adjacent natural terrain, where man-made construction or the density of population are the dominant features. Also called JUOs.³

Internally Displaced People. Persons or groups of persons who have been forced or obliged to flee or leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognized border. Also called IDPs.⁴

Internet of Things. The domain that includes the internet, all physical devices that have the ability to connect to the internet, and their associated connectivity protocols.

Lines of Effort. In the context

Lines of Effort. In the context of planning, using the purpose (cause and effect) to focus efforts toward establishing operational and strategic conditions linking multiple tasks and missions. Also called LOE.⁵

Megacity. A city containing ten million or more people.

Offensive Cyber Operations. Missions intended to project power in and through cyberspace. Also called OCO.⁶

Operational Reach. The distance and duration across which a force can successfully employ military capabilities.⁷

Position of Relative Advantage. A location or the establishment of a favorable condition within the area of operations that provides the commander with temporary

freedom of action to enhance combat power over an enemy or influence the enemy to accept risk and move to a position of disadvantage.⁸

Smart City. City initiatives that try to improve urban performance by using data, information and information technologies to provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration among different economic actors, and to encourage innovative business models in both the private and public sectors.⁹

Smart City Operations Center. The central location that receives and analyzes data to produce information useful for a city manager's decision-making.

Venturi Effect. The force produced as fluid or wind passes through a canalized point.

Wireless Sensor Network. A group of dispersed sensors that collect various data that connects to the internet and each other through assorted protocols.

¹ Joint Chiefs of Staff (JCS), Joint Publication (JP) 5-0, *Joint Planning* (Washington, DC: Government Publishing Directorate, June 16, 2017), GL-6.

² HQDA, FM 3-0, Glossary-7.

³ JCS, JP 3-0-6, GL-4.

⁴ United Nations Human Rights, Office of the High Commissioner, "Questions and Answers about IDPs," accessed April 12, 2019, <https://www.ohchr.org/EN/Issues/IDPersons/Pages/Issues.aspx>.

⁵ JCS, JP 5-0, GL-11.

⁶ Joint Chiefs of Staff (JCS), Joint Publication (JP) 3-12, *Cyberspace Operations* (Washington, DC: Government Publishing Directorate, June 8, 2018), GL-5.

⁷ JCS, JP 3-0, GL-14.

⁸ HQDA, FM 3-0, 1-18.

⁹ Marsal-Llacuna, Colomer-Llinàs, and Meléndez-Frigola, "Lessons in Urban Monitoring Taken from Sustainable and Livable Cities to Better Address the Smart Cities Initiative," 611-22.

APPENDIX A

CODING INSTRUMENT

Theme	Sub-Theme	#	Quotation	Source
Protection of Key Infrastructure	Municipal Water System	1	"A special order will be issued concerning the demolition of the water system and the electrical installations."	XIV Corps, <i>Report of Japanese Defense of Cities</i> , Manila Naval Defense Force Order 43 (February 3, 1945), pg 1.
		2	"Special effort was also made to secure the vital installations of the water system"	XIV Corps, <i>Report of Japanese Defense of Cities</i> (July 1, 1945), pg 19.
		3	"The 1st Calvary Division, in an enveloping move, drove through Santa Maria, the Novaliches water shed area, Novaliches Town, and scattering all enemy resistance before it, reached Grace Park in the Northeastern section of Manila at 1835I, 3 February 1945."	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol.1 pg 34.
		4	"On 5 February 1945, the Army Commander directed XIV Corps to seize, in accordance with a given priority, the principle features of the Manila Water Supply System in the water shed area east of the city, making the maximum effort consistent with the demands of the tactical situation."	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol.1 pg 36.
		5	"Intelligence reports indicated that the enemy intended to destroy or possibly pollute the source of water for the Manila area. Early seizure of these sources of water supply was therefore vital and even to the existence of the city's population."	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol.1 pg 36.
		6	"On this same day (Feb 6) ...A special force from the 7th Cavalry Regiment captured Novaliches Dam, one of the main features of the Manila water system. The enemy had placed demolition charges at key points on the dam but the rapidity of its seizure by our forces prevented his blowing the structure. On 7 February 1945, the division seized the Balara Filters intact."	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol.1 pg 37.
		7	"On that date, elements of the 7th Cavalry Regiment captured San Juan Reservoir, thus securing three of the four main features of the Manila Water System, Ipo Dam being the only one not secured yet."	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol.1 pg 38.
		8	"The area West of San Juan River was secured, and the Balara filters were captured."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 83.
		9	"the 7th Cavalry was protecting Novaliches Dam and Balara Filters and was moving to secure the San Juan Reservoir by 1800 7 February."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 90.
		10	"On 6 February, orders were received from Commanding General, 1st Cavalry Division to seize and secure the Manila Water Supply System extending from Novaliches Dam to San Juan Reservoir."	7th Cavalry Regiment, <i>Historical Report, Luzon Campaign 27Jan to 20Jun45</i>
		11	"At 1300i, on the 5 th of February, in anticipation of these orders and to prevent the flooding of the line of communication, G Troop departed the Am Tracs from Novaliches and at 1625I had secured the dam."	7th Cavalry Regiment, <i>Historical Report, Luzon Campaign 27Jan to 20Jun45</i>
		12	"In the meantime, the 2d Squadron, less G Troop, under the command of LT COL William L. Nash, moved by motor and foot to secure the Balara Filter System which was the backbone of the Manila Water Supply. At 061900I the Filter Plant was secured. The Japs had the entire system electrically wired for demolition s and planned to blow the plant at 1930I"	7th Cavalry Regiment, <i>Historical Report, Luzon Campaign 27Jan to 20Jun45</i>

Protection of Key Infrastructure	Municipal Water System	13	"The following morning F Troop moved on foot to secure the San Juan Reservoir."	7th Cavalry Regiment, <i>Historical Report, Luzon Campaign 27Jan to 20Jun45</i>
		14	"7th Cavalry: The regiment less the 1st Sq moved through Novaliches and continued to Manila assembling in the vicinity of (822695). G Trp was sent to Novaliches Dam securing the installation and killing 5 Japs, 3 of whom were equipped with demolition charges." (Entry for 4 1800-5 1800 February)	1st Cavalry Division, <i>G-3 Operations Reports, Luzon Operation</i>
		15	"General: The Novaliches water shed dam and the Balara Water Filters were secured by 2nd Sq. 7th Cav. Both installations were prepared for demolitions but were rendered safe by bomb disposal squads. Bridges on Talipapa-Marakina road were found destroyed by burning." (Entry for 5 1800-6 1800 February)	1st Cavalry Division, <i>G-3 Operations Reports, Luzon Operation</i>
		16	"Dam was prepared for demolitions. During the night a small party of Japs carrying explosives attacked our position apparently with the intention of destroying the dam. The attempt was not successful and all were killed or fled. All mines in the dam area were removed. The Balara filters were also secured by the 7th Cav."	1st Cavalry Division, <i>G-3 Operations Reports, Luzon Operation</i>
		17	"The 2d Squadron (less G Trp) moved to Balara Water Filters and with F Troop continued the advance to secure San Juan Reservoir. At the close of the period, F Troop had reached Cubao."	1st Cavalry Division, <i>G-3 Operations Reports, Luzon Operation</i>
		18	"An incipient attempt to destroy this important Manila water reservoir and flood the Tuliha River Valley was confirmed when patrols out from the bridge during afternoon 5 Feb killed 3 enemy carrying demolition equipment"	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		19	"On the E flank, patrol across Mariquina River to Calumpang and patrol to Santolan report no contact but in the vic Balara filter 7th Cav continues to be harassed by an undetermined number of enemy who apparently are intent on destroying the water supply."	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		20	"During the night of 9-10 Feb, small parties of enemy constantly attempted to infiltrate the 7th Cav perimeter at Balara filters. 16 enemy wearing Army uniform were killed, 2 of whom were carrying satchel charges with grenade detonators. The enemy also directed sporadic artillery and mortar fire on the filters during the night."	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		21	"While mopping up the first ridge NE of the filters, C Trp 7th Cav found 3 dead Japs carrying much demolition material, and a large quantity of dynamite apparently left by parties attempting to reach the filters during that night. These persistent attacks and the presence of such large quantities of dynamite and other demolitions indicate the enemy's determination to destroy the Manila water system."	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		22	"AM 10 Feb- a bunker at El Deposito found with 9 wires leading to it was investigated. It was found that 9 separate installations were wired for demolition and this bunker was the control station. Natives report demolition charges in RCA Building were to be set off from this point."	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		23	"Some eighty artesian or deep wells in the city and its suburbs could provide some water, but even assuming that these wells were not contaminated and that pumping equipment would be found intact, they could never meet requirements for only two weeks. Therefore Krueger directed General Griswold to seize the principal close-in features of the city's modern pressure system as rapidly as possible."	Smith, <i>Triumph in the Philippines</i> , 1993, pg 250.
		24	"The 37th Division, fearing that the flames would spread into residential districts, gathered all available demolitions and started destroying frame buildings in the path of the fire. The extent of these demolitions cannot be ascertained- although it is known that the work of destruction continued for nearly twenty-four hours- and is an academic point at best since the demolitions proved largely ineffective in stopping the spread of the flames."	Smith, <i>Triumph in the Philippines</i> , 1993, pg 255.

Protection of Key Infrastructure	Municipal Water System	25	“While the 37th Division was fighting the fires and clearing its sector of the city north of the river, additional elements of the 1st Cavalry Division had been coming into the metropolitan area.”	Smith, <i>Triumph in the Philippines</i> , 1993, pg 255
		26	“January 10, 1945- For the last week, we heard heavy blasts and earth-shaking rumbles, which our camp engineers attributed to dynamiting. The heavy blasting went on day and night. North, east, south, and west- everywhere we looked we saw smoke and flames. If the water and power were included on their scorched earth list, we were doomed.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 240.
		27	“February 5, 1945- There was no electricity and very little water. Fortunately the army had dug many latrines. In spite of diarrhea and illness, we could not leave the good food alone.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 249.
		28	“The rehabilitation of the water system was carried out by the army engineers. Water was furnished to civilians first by the use of army water supply points and later through the regular water mains. At the beginning of March, the water supply was partially restored.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign, Staff Sections</i> , pg 161.
		29	“The sanitary quality of the water supplied to civilians by the army water points was satisfactory whereas practically all of the private wells, including the so called “artesian” ones showed bacteriological evidence of fecal contamination.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign, Staff Sections</i> , pg 161.
		30	“Fire engines from the Manila Fire Department together with many civilians were pressured into service. These measures were also ineffectual as water was not readily available. The enemy had destroyed the pumping stations of the city water system causing a lack of pressure on the mains.”	148th Infantry Regiment, <i>Historical Record, Report After Action Part I</i> , pg 5-6.
		31	“All persons were warned against polluted water and halazone tablets were carried by all personnel for purification purpose. This plus the establishment of division water points under the control of the engineers also contributed in keeping down the incidence of amebiasis within the regiment.”	148th Infantry <i>Historical Record, Report After Action Part IV, Medical</i> , pg. 4.
		32	“Except in the city of Manila, artesian (free flowing) wells were available all along the rout of advance. Water distribution points were established behind all front line elements and in the vicinity of division troops. In Manila, the first points were established on the city water line. This source ran out very quickly and points were established at pump-wells. Most of these wells although they were 400-500 feet deep, did not furnish adequate water. However, after much experimenting with a number of wells, two developed into very satisfactory sources and were used for the remainder of the period.”	117th Engineer Combat Battalion. <i>Report After Action Against the Enemy in the Luzon Campaign: 1 November 1944 to 30 June 1945</i> . pg 16.
		33	“Water Supply. Official water points were set up in the vicinity of all troop concentrations. Water was filtered and chlorinated so as to maintain a residual chlorine level in the canvas storage tanks at 2 ppm. All towns of any size had a central water supply derived from cased Artesian wells, varying from 100-1000 feet deep. These were used as the water sources, rather than drawing water from shallow dug wells or rivers.”	XIV Corps <i>M-1 Operation, Part II</i> , 29 July 1945, pg 110.
		34	“About 16 February, the motor gasoline situation became very critical, due to insufficient facilities for transporting it from rear areas to the Army Supply Point...these tankers mad daily turn-arounds to Dagupan, hauling bulk motor gasoline, involving a round trip of 170 miles at an average turn-around time of 18 hours.”	XIV Corps <i>M-1 Operation, Part II</i> , 29 July 1945, pg 110.
		35	“Water Supply- the city water supply was seriously damaged by the enemy, and was not in operation during February. Two Engineer Water Supply Companies and the Portable Water Purification Units of the divisions served both Army troops and civilians.”	XIV Corps <i>M-1 Operation, Part II</i> , 29 July 1945, pg 135.
		36	“Water sources were largely contaminated streams coursing through the city. These had to be used as they were the only water sources available. Chlorine residuals were maintained at 2-4 ppm. Bacteriological analyses of all the water points were made, and the treated water from all but three points was found to be potable. One of the three points was closed, and the chlorine residual increased in the other two.”	XIV Corps <i>M-1 Operation, Part II</i> , 29 July 1945, pg 135.

Theme	Sub-Theme	#	Quotation	Source
Protection of Key Infrastructure	Municipal Sewage System and Sanitation	37	"The former city sanitary engineer was instructed to assemble his staff to function under the control of the group on Rizal Avenue. The following activities were carried on between 10 February and 1 March: Burial of 1,604 bodies from the city streets and hospital morgues, Building and disposal of garbage refuse, Unstopping and reconditioning of public toilets, Collection of water samples."	Sixth Army, <i>Report of the Surgeon Luzon Campaign, Staff Sections</i> , pg 161.
		38	"Absent electricity and running water, conditions throughout the city deteriorated."	James M. Scott, <i>Rampage</i> , pg 249.
		39	"Adding to the misery, the lack of running water meant that the only means of flushing toilets was with buckets of water hauled in from outside"	James M. Scott, <i>Rampage</i> , pg 268.
		40	"Generators provided power, and pit latrines served as toilets since there was no running water."	James M. Scott, <i>Rampage</i> , pg 313.
		41	"Japanese likewise navigate the city's water mains for attacks"	James M. Scott, <i>Rampage</i> , pg 319.
		42	"With no electricity, running water, food, or even fuel for cooking, the challenge proved daunting...Not only did the aid station lack toilets but Lichauco had no bedpans, soap, or towels; the only water came from wells"	Lichauco, <i>Dear Mother Putnam</i> , Entry for February 19, 1945, pg 213.
		43	"Absent running water and toilets- and with an outbreak of dysentery- feces littered the sanctuary"	James M. Scott, <i>Rampage</i> , pg 377.
		44	"Considering the sanitation problems posed by the presence of nearly a million civilians in the metropolitan area, General Krueger had good reason to be especially concerned about Manila's water supply."	<i>Triumph in the Philippines</i> , 1993, pg 250
		45	"January 13, 1945- There was no water on the second or third floors of the Big House, and the first-floor toilets were jammed with people day and night."	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 241.
		46	"February 5, 1945- There was no electricity and very little water. Fortunately the army had dug many latrines. In spite of diarrhea and illness, we could not leave the good food alone."	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 249.
		47	"The sanitary quality of the water supplied to civilians by the army water points was satisfactory whereas practically all of the private wells, including the so called "artesian" ones showed bacteriological evidence of fecal contamination."	Sixth Army, <i>Report of the Surgeon Luzon Campaign, Staff Sections</i> , pg 161.
		48	"The following are some of the problems presented, with attempted solutions- (a) burials- Several thousand bodies of Japanese soldiers and civilians killed were scattered throughout the city among the ruins of buildings. Many of these were difficult to find, and often had to be located by odor. The 37 th Division employed a full-time civilian burial detail, under the supervision of their medical inspector...The Manila Department of Sanitation under the supervision of Sixth Army disposed of the dead from civilian hospitals and rear areas of the city."	XIV Corps <i>M-I Operation, Part II</i> , 29 July 1945, pg 134.
		49	"Water Disposal- Army troops disposed of kitchen wastes by burial. Human wastes were disposed of in slit trenches. Civilians disposed of garbage and human wastes indiscriminately onto sidewalks, gutters, streets and backyards. By the end of February the fly breeding and filth therefrom had increased alarmingly, and presented a serious menace to health of the command and civilians."	XIV Corps <i>M-I Operation, Part II</i> , 29 July 1945, pg 135.

Theme	Sub-Theme	#	Quotation	Source
Protection of Key Infrastructure	Municipal Electrical System	50	"A special order will be issued concerning the demolition of the water system and the electrical installations."	XIV Corps, <i>Report of Japanese Defense of Cities</i> , Manila Naval Defense Force Order 43 (February 3, 1945), pg 1.
		51	"The large steam turbine plant was rendered completely useless by the destruction of all six of the generator units and some of the steam turbine ends."	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol. 4, pg 134.
		52	"With no electricity, running water, food, or even fuel for cooking, the challenge proved daunting...Not only did the aid station lack toilets but Lichauco had no bedpans, soap, or towels; the only water came from wells"	Lichauco, <i>Dear Mother Putnam</i> , Entry for February 19, 1945, pg 213.
		53	"On the night of 10-11 February, the 129th Infantry drove the enemy off the rest of Provisor Island and by 1300 it was considered secure."	37th Infantry Division, <i>After Action Report, The Luzon Campaign (M-I Operation) Part II</i> , 1945
		54	"On 11 and 12 Feb, the enemy slowly gave ground south of the Pasig and on 12 Feb he was holding a line along Isaac Peral Street. Heavy resistance had been encountered in the Power Plant on Provisor Island but this was eliminated on 11 Feb."	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-I Operation) Logistics, Part V</i> , 1945
		55	"XIV Corps would secure portions of the electrical power system at the same time its troops were capturing the water supply system. During the Japanese occupation much of the power for Manila's lights and transportation had come from hydroelectric plants far to the south and southeast in Laguna Province, for the Japanese had been unable to import sufficient coal to keep running a steam generator plant located within the city limits."	<i>Triumph in the Philippines</i> , 1993, pg 250.
		56	"It appeared that Laguna Province might be under Japanese control for some time to come, and it could be assumed that the hydroelectric plants and the transmission lines would be damaged. Therefore, Sixth Army directed XIV Corps to secure the steam power plant, which was situated near the center of the city on Provisor Island in the Pasig."	<i>Triumph in the Philippines</i> , 1993, pg 250-51.
		57	"The Americans had hoped to secure the power plant intact, but even before troops had reached the island the Japanese had damaged some of the equipment, and what was left the Japanese and American artillery and mortars ruined. There was no chance that the plant would soon deliver electric power to Manila."	<i>Triumph in the Philippines</i> , 1993, pg 263.
		58	"January 10, 1945- For the last week, we heard heavy blasts and earth-shaking rumbles, which our camp engineers attributed to dynamiting. The heavy blasting went on day and night. North, east, south, and west- everywhere we looked we saw smoke and flames. If the water and power were included on their scorched earth list, we were doomed."	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 240.
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Theme	Sub-Theme	#	Quotation	Source
Fire as an Obstacle to Maneuver	The Use of Fire	70	“The enemy had deliberately set fire to the business district, which was burning furiously, and his snipers were active all along the division line of communication through the city.”	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol.1 pg 34.
		71	“Fires along the Pasig River, some set by enemy demolitions, others by artillery operations in that area.”	Sixth Army, <i>Report of the Luzon Campaign</i> , Vol.1 pg 37.
		72	“On the 5 th the smoke and dust were so intense, and the heat from burning structures so terrible, that little progress could be made.”	XIV Corps <i>M-1 Operation, 29 July 1945</i> , pg 86.
		73	“Demolitions played an important part in the defense of the city, inasmuch as they were used to great effect in destroying bridges prior to our entry and in demolishing sections of buildings after occupation.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 7.
		74	“Guerilla Reports of that period referred to accelerated defense preparations, the construction of underground machine shops, the installation of demolitions of buildings, and salvaging war materials in Manila.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 8-9.
		75	“Another document directed that as large a quantity of aviation gasoline and bombs as possible be removed from the suburbs to suitable places within the city so that they might be used as ‘weapons of attack or as material for the production of weapons’”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 9.
		76	“Molotov cocktails, many with red phosphorus as the incendiary substance, were found in practically every house and building that had been occupied by the enemy. It is believed that they were used to start the many fires the Japanese left in the areas they evacuated.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 10.

Fire as an Obstacle to Maneuver	The Use of Fire	77	“These incendiaries were also dropped into the streets from windows of buildings and thrown from room to room and floor to floor. They produced relatively few casualties but were effective delaying weapons.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 10.
		78	“Time-fused incendiary shells were used to start many of the city fires which destroyed blocks of buildings in the immediate path of our advance. Air bursts about twenty feet above the roofs discharged incendiary pellets into the buildings, while accompanying high explosive air bursts discouraged immediate fire-extinguishing operations”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 11.
		79	Although fires set by withdrawing units and by artillery emplaced in the southern sections of the city delayed the progress of our troops, the resistance offered by the northern Japanese forces was comparatively weak.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 14..
		80	“With the Objective of the city of Manila, whose presence was discernible in the distance from columns of smoke arising from burning buildings, the 148th and 145 th Inf Regiments, advancing on foot on Highway 3, met scattered enemy resistance all along the route.”	37th Infantry Division, <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 24.
		81	“Soldiers and Military Police were able to establish order by the following morning, assisted in part by the fact that there was nothing left to loot after the buildings had all burned down.”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945
		82	“By 2035 a shift in the wind moved the wall of flames toward Bilibid Prison and threatened to destroy it. All of the demolitions available to Manila were gathered and efforts made to establish a fire break.” (Entry-5 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 26.
		83	“While a number of fires had been started by the Japanese throughout the city, the first deliberate destruction of the city became apparent in the Escolta District, where the retreating Japanese not only started many fires but were demolishing the heart of the Manila Business district with time fused explosives.” (Entry-5 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 26.
		84	“K Co, 148th Inf, reached a point 200 yards from the Pasig River, but so intense was the heat from the fires in all the buildings along the river bank that it was forced to withdraw 200 yards where the evening and night hours were occupied with picking off Japanese snipers silhouetted against the fiery background.” (Entry-5 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945
		85	“The 148th Infantry, returning to the smoldering ruins of the Escolta district, reached the Pasig River at 1340, securing it in regimental zone by 1630” (Entry-6 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 27.
		86	“The Commanding General instructed the Division Engineer to send all available demolition and to pick up additional demolition at San Fernando, to send to Manila and make an effort to curb the fire.”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V</i> , 1945
		87	“It was decided that this fire, which was cunningly fed by gasoline which had been planted by the enemy, would not only cause loss of life but would only aggravate it to attempt to curb same.”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V</i> , 1945
		88	“By 1330 the situation was well in hand with patrols moving in all direction encountering heavy sniper fire. Several fires were burning in the city.” (Entry for 3 1800-4 1800 February)	1st Cavalry Division, <i>G-3 Operations Reports, Luzon Operation</i>
		89	“General: The Novaliches water shed dam and the Balara Water Filters were secured by 2nd Sq. 7th Cav. Both installations were prepared for demolitions but were rendered safe by bomb disposal squads. Bridges on Talipapa-Marakina road were found destroyed by burning.” (Entry for 5 1800-6 1800 February)	1st Cavalry Division, <i>G-3 Operations Reports, Luzon Operation</i>
		90	“Extensive demolitions being carried on throughout the city may indicate, however, that only a brief delaying action is contemplated.”	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>

Fire as an Obstacle to Maneuver	The Use of Fire	91	“The enemy has conducted extensive demolitions throughout the city since our entry, destroying large quantities of fuel and ammo and other supplies. Many fires are reported burning at end of period.”	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		92	“At the same time he continues extensive demolitions in the southern central, and southeastern part of the city and sniping is still current in portions of the city already occupied.”	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		93	“January 7, 1945- Tremendous billows of thick smoke surrounded the city. How soon would our forces reach the city? How soon would we eat? Another death.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 240.
		94	“January 10, 1945- For the last week, we heard heavy blasts and earth-shaking rumbles, which our camp engineers attributed to dynamiting. The heavy blasting went on day and night. North, east, south, and west- everywhere we looked we saw smoke and flames. If the water and power were included on their scorched earth list, we were doomed.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 240.
		95	“January 12, 1945- From the downtown section of the city, only a short distance from our camp, we continued to hear earth-shaking blasts day and night, and the sky was brilliantly illuminated by huge fires. Two more deaths.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 241.
		96	“January 21, 1945-Violent explosions shook the city after dark tonight, and it seemed that a monstrous torch had lighted the city. It looked like the Nips were making certain that there would be very little left of the city when our forces returned.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 242.
		97	“February 2, 1945- The destruction of the city went on. Heavy blasting day and night, and there was an overwhelming curtain of smoke over the entire city.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 245.
		98	“Fires and demolitions set by the enemy forced a withdrawal from the Pasig River during the night of 5-6 Feb. These fires and demolitions covering the entire regimental front were fanned by a strong wind from the South and spread rapidly through the heart of the business district of downtown Manila. Demolitions were employed in an unsuccessful effort to clear a fire break in the closely spaced buildings.”	148th Infantry Regiment, <i>Historical Record, Report After Action Part I</i> , pg 5.
		99	“Fire engines from the Manila Fire Department together with many civilians were pressured into service. These measures were also ineffectual as water was not readily available. The enemy had destroyed the pumping stations of the city water system causing a lack of pressure on the mains.”	148th Infantry Regiment, <i>Historical Record, Report After Action Part I</i> , pg 5-6.
		100	“The fire swept the area from the Pasig River North to Azcarraga Street reaching the walls of the Bilibid Prison. The fire was brought under control along this wide street running East-West across its path. Early in the evening it became evident that Bilibid Prison would have to be evacuated. All military units in the city were ordered to furnish vehicles of all types to assist in this work.”	148th Infantry Regiment, <i>Historical Record, Report After Action Part I</i> , pg 6.
		101	“The flames in the meantime had reached the southern walls of the prison where they were brought under control along Azcarraga Street. Our positions along the Pasig River were reoccupied as the fires subsided, and by 1600i, 6 Feb the North bank of the Pasig River was again completely occupied.”	148th Infantry Regiment, <i>Historical Record, Report After Action Part I</i> , pg 6.
		102	“No demolition work was necessary during the campaign, except as part of assault teams. An attempt was made to fight fires set by the Japanese in the City of Manila through the use of demolitions, but this proved ineffective and a costly expenditure of meager supplies of explosives.”	117th Engineer Combat Battalion. <i>Report After Action Against the Enemy in the Luzon Campaign: 1 November 1944 to 30 June 1945.</i> pg 14.
		103	“That night our forward elements met bitter resistance downtown. As the day closed the ground shook to terrific explosions from mined buildings and great columns of flame bursts from within them. A careful and complete plan for the destruction of the city was being carried into effect by the Japanese.-and we were powerless to stop it- we had no way of knowing in which of thousands of places the demolitions were being controlled.”	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division : 1940-1945.</i>

Fire as an Obstacle to Maneuver	The Use of Fire	104	"Imagine the major portion of the downtown shopping and business sections of Columbus or Cleveland or Cincinnati suddenly erupting in smoke and flames."	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division : 1940-1945.</i>
		105	"Our troops were forced to move back from this holocaust, lest they be trapped and incinerated, as were so many helpless Filipinos."	Robert S. Beightler, <i>Report on the Activities of 37th Infantry Division : 1940-1945.</i>
		106	"From the roof of our headquarters I watched, enraged at the wantonness of what I saw. The sky was a copper-burnished dome of thick clouds. So great was the glare of the dying city that the streets, even back where we were, were alight as from the reflection of a reddish moon. Great sheets of flame, swept across the roof-tops sometimes spanning several city blocks in their consuming flight."	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division : 1940-1945.</i>
		107	"The roar, even at that distance, was like a Bessemer converter, and the earth shook frequently as yet more of the powerful demolition charges exploded, sending fountains of flame and debris in a hot, swirling eruption to meet the dense clouds overhead."	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division : 1940-1945.</i>
		108	"From them came a frantic call for help because the fires of the burning city were rapidly reaching the prison. There was no time for advance preparation. Hastily, every available truck was rounded up. The First Cavalry Division at once sent us many trucks and drivers to augment our own."	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division : 1940-1945.</i>
		109	"Through the smoky streets these courageous men went, all night long, ignoring the snipers, and flames and the tottering buildings. The smoke was so dense they burned their headlights, ignoring the peril of doing so. And they brought every one of these internees back to our shoe-factory headquarters."	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division : 1940-1945.</i>
		110	"The city burned all night, all the next day and the next night. But soon only rubble and steel were left. The flames died for lack of fuel."	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division: 1940-1945.</i>

Theme	Sub-Theme	#	Quotation	Source
Fire as an Obstacle to Maneuver	US Destruction Using Fire	111	"No doubt when peace comes the enemy will argue that it was the American shells that destroyed Manila, but such arguments can be refuted by unquestioned evidence. As troops of the 37th Division approached the Pasig they were met on every side by the sound of explosions and falling buildings. That these demolitions were previously planted and installed is authenticated by captured Order No. 43."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 87.
		112	"The company found the building heavily fortified and withdrew to allow a heavy concentration of white phosphorus shell to be brought down on it."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 113.
		113	"At 1800 on the 22nd the enemy still held a small area in the West half of the basement which was soon cleared by flame throwers and pole charges."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 114.
		114	"The wall was 40 feet thick at the base and tapered through 16 feet of height to a width of 20 feet at the top."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 116.
		115	"At Fort Santiago, the fighting continued all day in and around the ruined buildings, thick walls, ancient dungeons, and numerous tunnels and recesses which harbored enemy, and which one were turned into death-traps by hand-grenades, flame throwers, and gasoline poured down into the holes and ignited."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 123.
		116	"This heavy gunfire partially neutralized the Southern and Eastern portions of the building, and at 1230 cavalryman stormed it with flamethrowers."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 130.
		117	"In difficult room to room and floor to floor fighting among corridors, stairways, and against barricades and breastworks defended by the enemy with light machine guns, rifles, and hand grenades, troops of the 1st Battalion, 148th Infantry slowly but steadily gained the upper hand by the effective use of flame throwers and gasoline drums ignited by thermite."	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 132.
		118	"As it was desired to capture Manila as intact as possible, and since a large fraction of the civil population was still inside the city when U.S. Forces attacked, bombing of Manila or any part of it was forbidden, and the use of artillery fire against enemy fortifications was greatly restricted."	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 20.
		119	"The casualty rate was alarming and the attack was slowed up to a point where more powerful measures were required. These measures consisted of attaching tanks, tank destroyers, and 4.2" mortars to the infantry and a greater use of artillery... Artillery fire was still restricted to known Japanese positions but so many enemy riflemen were interspersed within the positions that artillery area fire immediately in front of the advancing troops became the rule rather than the exception... counter-fire resulted in almost total destruction of the defended areas."	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 20.
		120	"Holes and pillboxes should be burned out by flame throwers and then covered, and small parties should be organized to search the building thoroughly, checking debris, holes, and all possible hiding places."	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 24.
		121	"In one instance, Japanese held the second floor of a building and commanded the stairways by the use of hand grenades thrown from sandbagged positions out of sight. A flame-throwing tank was brought into the doorway and maneuver into position to shoot flame up the stairs into enemy defenses."	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 25.
		122	"On another occasion a flame-throwing tank discharged its flame through the window into a deeply recessed and sandbagged machine gun position destroying the enemy."	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 25.
		123	"One principal advantage of this weapon is that the flame and smoke spread when they hit, fill the embrasures, and pour into ports and other openings, while the operator can stand at an angle from which he cannot be seen from within the embrasure."	FM 31-50 <i>Attack on a Fortified Position and Combat in Towns</i> , 31 January 1944, pg 31

Fire as an Obstacle to Maneuver	US Destruction Using Fire	124	“Use of Incendiaries. Incendiaries will often be a potent factor in town fighting. Frequently the quickest, surest, and most economical way of dislodging an enemy from a building will be to burn it...The use of incendiaries must be carefully controlled since flame is a double-edged weapon which may affect either side.”	FM 31-50 <i>Attack on a Fortified Position and Combat in Towns</i> , 31 January 1944, pg 66.
		125	“On the North during the night 11-12 February, the 1st Battalion accomplished its advance by bazooka, flame throwers, and pole charges neutralizing and capturing four 20mm guns in the process of seizing the circular cemetery by dawn 12 February.” (Entry-13 February 1945)	37th Infantry Division, <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945
		126	“The tedious process of eliminating this fanatical group with flamethrowers, burning oil, and demolition charges, continued throughout the rest of the day.” (Entry-22 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945
		127	“In Fort Santiago, the fighting continued all day around the ruined bldgs., ancient dungeons, thick walls and a number of tunnels and recesses which harbored enemy and which were penetrated with hand grenades and flame throwers.”	37th Infantry Division, <i>G3 Reports</i> , 23 Feb 45, pg 2
		128	“The white phosphorus grenade has been found to be an excellent weapon for close-in fighting and in use against enemy in confined emplacements.”	129th Infantry Regiment <i>Historic Report, Section VII “Lessons Learned,”</i> pg. 3.

Theme	Sub-Theme	#	Quotation	Source
Civilians on the Battlefield	Evacuation of Internees	129	“The influx of battle casualties in the Manila area placed a heavy load on the hospitals at that point. The problem was accentuated by need to care for civilian internees totaling nearly 4,000, of which a large proportion were in need of hospital care.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign</i> , Staff Sections, pg 157.
		130	“The medical department officers arrived in Manila on the early morning of 5 February 1945 and went to Santo Tomas University for the purpose of assisting in the medical care of internees.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign</i> , Staff Sections, pg 161.
		131	“Word had been received by higher that interned at the University of Santo Tomas were some 4,000 American citizens and Allied prisoners held at Malaccan Palace. It was believed that when pressure was put upon the Japanese within the city of Manila, the enemy might take some effort to harm these internees. It was therefore concluded that one of the first objectives within the city proper was the campus of the University and the Palace.”	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 83.
		132	“Upon investigating they discovered 800 American prisoners of war. These prisoners had been abandoned by their jailors, and inasmuch, as the city was still filled with enemy snipers, they had been left within the prison walls for their own protection.”	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 86.
		133	“The flames came so close to Bilibid Prison that on the night of 5-6 February the released prisoners of war had to be evacuated.”	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 86.
		134	“Late in the day, 4 February, elements of the 148th Inf opened the gates of Bilibid Prison, freeing 465 civilian internees and 810 American prisoners of war found therein.”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 25.
		135	“Meanwhile, with all of the vehicles of the Division and large number borrowed from the 1st Cavalry Division the occupants of Bilibid Prison were transferred to the Ang-Tibay Shoe Factory (37th Division CP), 1275 persons being moved and settled into temporary quarters by 2400” (Entry-5 February 1945)”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945

Civilians on the Battlefield	Evacuation of Internees	136	“Many of the internees and prisoners of war were unable to walk. The task of moving them under such conditions was tremendous. All Divisional and attached troops in vicinity of the CP assisted in the transfer, and quantities of cots and food were procured, latrines dug, and the factory building was converted into a temporary refuge, while still housing the Division headquarters personnel and communication facilities.” (Entry-5 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945 pg 26.
		137	“At 0930 the G-4 was notified by the Commanding General that 5,360 internees had been liberated at Santo Tomas University and were badly in need of food, also that those elements of the 1st Cavalry Division, which had entered the city, had been cut off from their service units and that it was the Division’s responsibility to furnish them with 10,000 “K” rations.”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V</i> , 1945
		138	“Temporary ration supplies for the internees of Santo Tomas University and liberated personnel of Bilibid Prison, was a serious problem due to lack of transportation and low level of the Division dump.”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V</i> , 1945
		139	“Continuous intense sniping was encountered within the city as the flying columns pressed forward and seized Malacanan Palace and Santo Tomas University liberating the majority of 3000 political prisoners confined in the latter. An est 200-300 enemy seeking protection behind some 300 internees remaining in their possession continued to engage the main portion of our advance force.”	1st Cavalry Division, <i>Luzon Operation, G-2 Periodic Reports (1Feb45-1Apr45)</i>
		140	“February 7, 1945- This day had been a nightmare! There had been many direct hits on the Big House and many of our people had been killed or wounded.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 250
		141	“February 10, 1945- Enemy shells again struck our building, and we had more wounded and dead.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 253
		142	“February 10, 1945- We wanted to get away! We had enough of killing and warfare!”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 254
		143	“From them came a frantic call for help because the fires of the burning city were rapidly reaching the prison. There was no time for advance preparation. Hastily, every available truck was rounded up. The First Cavalry Division at once sent us many trucks and drivers to augment our own.”	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division: 1940-1945.</i>
		144	“Through the smoky streets these courageous men went, all night long, ignoring the snipers, and flames and the tottering buildings. The smoke was so dense they burned their headlights, ignoring the peril of doing so. And they brought every one of these internees back to our shoe-factory headquarters.”	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division: 1940-1945.</i>

Theme	Sub-Theme	#	Quotation	Source
Civilians on the Battlefield	Internally Displaced People (IDPs) as an Obstruction of Maneuver	145	“There were also great numbers of civilian casualties, some of which were received by Sixth Army hospitals.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign</i> , Staff Sections, pg 157.
		146	“The problems of dealing with the civilian population in Manila was delegate to the XIV Corps. Various units and staff officers from Sixth Army were attached to the corps to assist.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign</i> , Staff Sections, pg 157.
		147	“Due to the Japanese policy of destruction of Manila and atrocities committed against civilians by Japanese troops, the civilian medical facilities were unable to function in the manner that had been expected. Many hospitals were destroyed and civilian casualties were heavy, particularly from destroyed area south of the Pasig River.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign</i> , Staff Sections, pg 161.
		148	“Medical supply for civilians was taken from Army stocks and issued to PCAU Surgeons at the same depot from which army units were supplied.”	Sixth Army, <i>Report of the Surgeon Luzon Campaign</i> , Staff Sections, pg 161.
		149	“A serious interference with progress was the advent of approximately 2,000 refugees who came streaming out of the first floor of Del Monico Church on to Gral Luna.	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 123.
		150	“Chief among these conditions may be mentioned the prohibition of aerial bombing by American forces and the initial restrictions on our artillery fire, both of which measures were prompted by the humanitarian desire to spare the lives and property of a friendly people. Likewise the presence of these people in the city during the battle operated as a marked deterrent to the adoption of other forceful measures.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945), preface by COL F.W. Hein.
		151	“On the other hand, the enemy’s problems were simplified by: (a) the disproportionately large number of automatic weapons available as a result of the cannibalization of armament on planes and ships (b) the prohibition against aerial bombing by American forces; (c) the initial restrictions of our artillery fire, a procedure prompted by our desire to preserve property to the greatest possible extent and (d) our efforts to protect the friendly civilian population and our consequent reluctance to proceed ruthlessly.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945), pg 13.
		152	“As it was desired to capture Manila as intact as possible, and since a large fraction of the civil population was still inside the city when U.S. Forces attacked, bombing of Manila or any part of it was forbidden, and the use of artillery fire against enemy fortifications was greatly restricted.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945), pg 20.
		153	“Initially, sections of the city were attacked by Infantry, using small arms. Artillery fire was restricted to counter-battery and to observed fire on known enemy strong points. The casualty rate was alarming and the attack was slowed up to a point where more powerful measures were required. These measures consisted of attaching tanks, tank destroyers, and 4.2” mortars to the infantry, and a greater use of field artillery. However, as the main line of Japanese resistance was reached, it became apparent that destruction of the buildings in the path of advancing troops was essential. Artillery fire was still restricted to known Japanese positions but so many riflemen were interspersed within the positions that artillery fire immediately to the front of the advancing troops became the rule rather than the exception.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945), pg 20.
		154	“Civilian Control. The problems of controlling and administering the civilian inhabitants will nearly always arise, and may be complicated by a flow of refugees into built-up areas.	FM 31-50 <i>Attack on a Fortified Position and Combat in Towns</i> , 31 January 1944, pg 66.
		155	“Among the obstacles encountered by the Division’s advance in Manila was the presence of swarms of the native population who crowded the streets cheering the American Troops.” (Entry-5 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 26.

Civilians on the Battlefield	Internally Displaced People (IDPs) as an Obstruction of Maneuver	156	“Large numbers of civilians, both white and native, were known to be in the area South of the Pasig River, and particularly in the Walled City, and of course it was desired to spare them if possible. To that end artillery fire was restricted to observed fire upon known targets.” (Entry-7 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 29.
		157	“Every effort had been made to spare the civilian population known to be held in captivity somewhere in the area, but as the tactical need for heavy fire power increased permission was sought and obtained to place area artillery fire in front of our advancing lines without regard to pinpoint targets.” (Entry-10 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, 32.
		158	“Japanese soon became aware of this attitude and not only were such areas reinforced, but civilians were often used as a screen.” (Entry-10 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 32.
		159	“Meanwhile, however, civilians escaping from time to time from the enemy held area indicated that groups of Japanese were leaving from the vicinity of the Manila Hotel and the port area by small boats attempting to move into the Little Tokyo area and thence along the coast to the west. Blanket orders to the civilian population to stay out of Manila Bay were relatively ineffective. (Entry-14 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 35.
		160	“A number of bombing missions were dispatched by higher echelons to known enemy positions far South of the Pasig River, with careful avoidance of any areas known to contain civilians.” (Entry-14 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 35.
		161	“Immediately following our initial penetration into this enemy stronghold, a steady stream of civilian refugees and patients, long held virtually captive by the Japanese in the hospital, began to pour into our lines, greatly hindering military operations. By the end of the afternoon over 2000 civilians had been channelized into an emergency assembly area east of Taft Avenue. The evacuation continued throughout the night and an estimated total of 7000 were eventually rescued.” (Entry-17 February 1945)	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945, pg 40.
		162	“Securing the Eastern portion, main hospital building, liberated large numbers of civilian inmates (some white) who are being evacuated to assembly area East Taft Av. Total freed by end of period over 200, estimates of total inmates in building 7000.”	37th Infantry Division , <i>G3 Reports</i> , 17 Feb 45, pg 1
		163	“In the 148th Inf sector, increasing resistance developed as the troops moved to the S. A serious interference with progress was the discovery of approximately 2,000 refugees, who commenced streaming out of the first floor of Del Monico Church on Gral Luna. These refugees consisted entirely of women and children, nuns and several priests.”	37th Infantry Division, <i>G3 Reports</i> , 23 Feb 45, pg 2.
		164	“148th Infantry Regt: Remainder of civilian internees and inmates evacuated throughout the nite (<i>sic</i>). Estimate total rescued 7,000.”	37th Infantry Division, <i>G3 Reports</i> , 18 Feb 45, pg 1.
		165	“A considerable amount of confusion was encountered at the bridge across the Pasig River, by the clamor of frightened civilians trying to get to the north side of the river. This was soon placed under control by the assignment of ambulances and cargo trucks to assist in the evacuation of these people.”	37th Infantry Division <i>After Action Report, The Luzon Campaign (M-1 Operation) Logistics, Part V</i> , 1945
		166	“Artillery fire was not employed in this area as civilian reports indicated that the enemy were holding several thousand civilians of all nationalities captive in the hospital.”	148th Infantry Regiment, <i>Historical Record, Report After Action Part I</i> , pg. 8.
		167	“This direct fire was employed as a last resort and every caution possible was taken to prevent casualties among the civilian prisoners.”	148th Infantry Regiment, <i>Historical Record, Report After Action Part I</i> , pg. 8.
		168	“In the early afternoon the entire attack was delayed for several hours until over 3,000 civilians, released by the enemy to confuse our attack, could be evacuated from St. Augustine Cathedral and Del Monico Church.”	145th Infantry Regiment, <i>Tactical History of 145th Infantry Regiment, Luzon Campaign</i> , pg 14.

Civilians on the Battlefield	Internally Displaced People (IDPs) Cont.	169	“This phase, covering the period from 5 February 1945 to 3 March 1945, involved the battle for the city of Manila and it’s final security. The enemy, in an effort to delay blue forces, virtually destroyed the city by fire and demolition, and then withdrew to elaborate defensive positions on the south side of the Pasig River.”	129th Infantry Regiment, <i>Report After Action: Luzon, P.I. JAN 9, 1945-June 30, 1945, Section I</i> , pg. 5.
		170	“We used tanks, flame-throwers, tank-destroyers, smoke, infantry- everything but air bombing, which was forbidden and artillery was used moderately because it was restricted.”	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division: 1940-1945.</i>
		171	“To me the loss of a single American life to save a building was unthinkable. The 37th had always believed in the use of heavy fire power to the maximum and we had, therefore, picked up the reputation of being about the most wasteful division in the theatre in the expenditure of artillery ammunition.”	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division: 1940-1945.</i>
		172	“Well, our losses in that inferno became of such concern to me that the Corps Commander, a grand soldier who was also greatly worried about the heavy toll, and I were able to get restrictions lifted to permit both direct and overhead, or indirect fire. From then on, putting it crudely, we really went to town.”	Robert S. Beightler, <i>Report on the Activities of the 37th Infantry Division: 1940-1945</i>
		173	“The losses had manifestly been too heavy for the gains achieved. If the city were to be secured without the destruction of the 37th and the 1st Cavalry Divisions, no further effort could be made to save the buildings; everything holding up progress would be pounded, although artillery fire would not be directed against structures such as churches and hospitals that were known to contain civilians. Even this last restriction would not always be effective, for often it could not be learned until too late that a specific building held civilians.”	Smith, <i>Triumph in the Philippines</i> , 1993, pg 264.
		174	“February 15, 1945- We sympathized with the Chinese and Filipino refugees, who continued to seek safety in the camp, but the plight of some of the whites, the Nazis, the collaborators, the neutrals, the third-party nationals, left many of us cold and unsympathetic.”	Tressa R. Cates, <i>The Drainpipe Diary</i> , 1957, pg 254-255.

Theme	Sub-Theme	#	Quotation	Source
Un-coded Quotes		175	“As it was later proven, the enemy expected the American forces to approach from the South. Thus as the two divisions moved into the city from the North, Rear Admiral Mitsuji Iwabuchi, the overall defense commander, found his organized positions facing the wrong way...”	XIV Corps <i>M-1 Operation</i> , 29 July 1945, pg 87.
		176	“However, the stubborn resistance of the garrison did credit his truculence as a fighter, and the ruthless destruction of property was a reflection of the tenacity of his efforts.”	XIV Corps, <i>M-1 Operation</i> , 29 July 1945, pg 87.
		177	“This building was later identified as the New Police Station and, similar to all new buildings in Manila, was of earthquake-proof construction. On the morning of 15 th , the attack against the building was launched again, supported by heavy mortar concentrations, direct fire from 105-mm self-propelled guns, and medium tanks.”	XIV Corps, <i>M-1 Operation</i> , 29 July 1945, pg 104.
		178	“The main purpose of the enemy in defending Manila was threefold: first, to effect maximum attrition of American fighting power by utilizing the advantages of natural and man-made defenses within the city; secondly, to delay the occupation and utilization of the Port of Manila as long as possible; thirdly, to cripple the city as a base for future military operations and as a center for civilian production and governmental control.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 1.
		179	“The diverse units and individuals were successfully organized into the Manila Naval Defense Force under the command of Rear Admiral Iwabuchi, Mitsuji.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 3.

Un-coded Quotes	180	“Since Manila is located within an earthquake zone, its buildings are necessarily of very strong, heavy construction gauged by American Standards. As an example of this, the Finance Building in downtown Manila was so constructed that, as the lower portion of the outside walls disintegrated under the direct fire of our artillery, the walls and roof settled and the structure bent, rather than collapsed.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 4.
	181	“The Japanese used all types of earthquake-proof structures- private homes, churches, schools, and government buildings- as isolated strong points.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 4.
	182	“Of a total of about 101 bridges in the city of Manila and immediate environs, thirty-nine, were destroyed.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 7.
	183	“In this respect it is believed that by-passing too many strong isolated Japanese centers of resistance is a mistake, as the number of troops necessary”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 20.
	184	“If sufficient reserves are not immediately available, progress of the attack should be controlled by phase lines until strong points are eliminated.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 20.
	185	“The fighting which resulted in the destruction of these defenses and the final elimination of enemy resistance in Manila was in reality that which characterizes the attack of a fortified locality, and for discussion may be divided into three categories, namely normal fighting in city streets, the reduction of strong earthquake proof buildings, and the attack upon the Walled City (Intramuros)”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 20.
	186	“As it was desired to capture Manila as intact as possible, and since a large fraction of the civil population was still inside the city when U.S. Forces attacked, bombing Manila or any part of it was forbidden, and the use of artillery fire against enemy fortifications was greatly restricted.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 20.
	187	“Artillery fire was restricted to counter-battery and to observed fire on known enemy strong points.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 20.
	188	“Tactics recommended in FM 31-50 for combat in towns were used to great advantage by U.S. Forces in the street fighting in Manila. In the ordinary street fighting most principles used were orthodox.”	XIV Corps, <i>Report of Japanese Defense of Cities</i> , (July 1, 1945) pg 21.
	189	“The final objective will probably not be a houses or streets, but strategic points as the railroad station, telephone exchange, gas and other public utility works. These points will undoubtedly be included within strongly defended areas.”	FM 31-50 <i>Attack on a Fortified Position and Combat in Towns</i> , 31 January 1944, pg 62.
	190	“Built-up areas possess a third dimension not usually present in combat. It is possible to bypass an enemy by going directly over or under him. The possession of a position above that of the enemy gives a better fighting advantage.”	FM 31-50 <i>Attack on a Fortified Position and Combat in Towns</i> , 31 January 1944, pg 63.
	191	“Literal destruction of a building in advance of the area of friendly troops became essential and the Division had yet to determine upon a method of reducing the public buildings near the Intramuros which were known to be veritable fortifications, so heavy was their construction in earthquake-subjected Manila.” (Entry-10 February 1945)	37th Infantry Division, <i>After Action Report, The Luzon Campaign (M-1 Operation) Part II</i> , 1945
	192	“Basic Assumption- That the Japanese would suffer from serious shortages of fuel and lubricating oil for what armor and equipment they did have available. That the native population was entirely hostile to the Japanese, could be depended on to carry arms against them if given the opportunity, and would certainly provide the US with abundant intelligence.”	Headquarters, 37th Infantry Division, <i>Summary of General Yamashita and Other Responsible Commanders and Staff Officers</i> , 18 Feb. 1957

Un-coded Quotes		193	“Neither Gen Yamashita nor his Chief of Staff, nor that matter any of his officers interviewed, would accept any responsibility for the Battle of Manila. He stated that he had promised the civilians in the city that any fight for Manila would take place outside of the city itself.”	Headquarters, 37th Infantry Division, <i>Summary of Interrogations of General Yamashita and Other Responsible Commanders and Staff Officers</i> , 18 Feb. 1957
		194	“Some 16,000 Navy troops under Rear Admiral Iwabuchi, who was killed in action on one of the last days of the battle, reinforced by about 5,000 Army men, made up the forces in the city.”	Headquarters, 37th Infantry Division, <i>Summary of Interrogations of General Yamashita and Other Responsible Commanders and Staff Officers</i> , 18 Feb. 1957
		195	“The mission of Shimbu Group was of the same character of that of the Kembu Group- namely, to deny us for as long a time as possible, the use of air fields in vicinity of Manila and attempting to conduct guerilla warfare in the Manila area when forced to withdraw.”	Headquarters, 37th Infantry Division, <i>Summary of Interrogations of General Yamashita and Other Responsible Commanders and Staff Officers</i> , 18 Feb. 1957
		196	“About 16 February, the motor gasoline situation became very critical, due to insufficient facilities for transporting it from rear areas to the Army Supply Point...these tankers mad daily turn-arounds to Dagupan, hauling bulk motor gasoline, involving a round trip of 170 miles at an average turn-around time of 18 hours.”	XIV Corps <i>M-1 Operation, Part II</i> , 29 July 1945, pg 110.

APPENDIX B

SUPPORTING PHOTOGRAPHS

Theme 1: The Protection of Key Infrastructure



Figure 19. Civilians at One of Many Emergency Water Points Supplied by the 1361st Engineer Dump Truck Company (February 17, 1945).

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2902, Image 17 (College Park, MD: National Archives and Records Administration).



Figure 20. US Army Signal Corps Wire Crew Strings Heavy Communication Wire (February 11, 1945).

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2902, Image 108 (College Park, MD: National Archives and Records Administration).

Theme 2: Obstacles for Maneuver



Figure 21. Manila Burning. (February 8, 1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2902, Image 112 (College Park, MD: National Archives and Records Administration).



Figure 22. Ammunition Explodes in the Navy Hotel. (February 17, 1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2903, Image 147 (College Park, MD: National Archives and Records Administration).

Theme 3: Civilians on the Battlefield

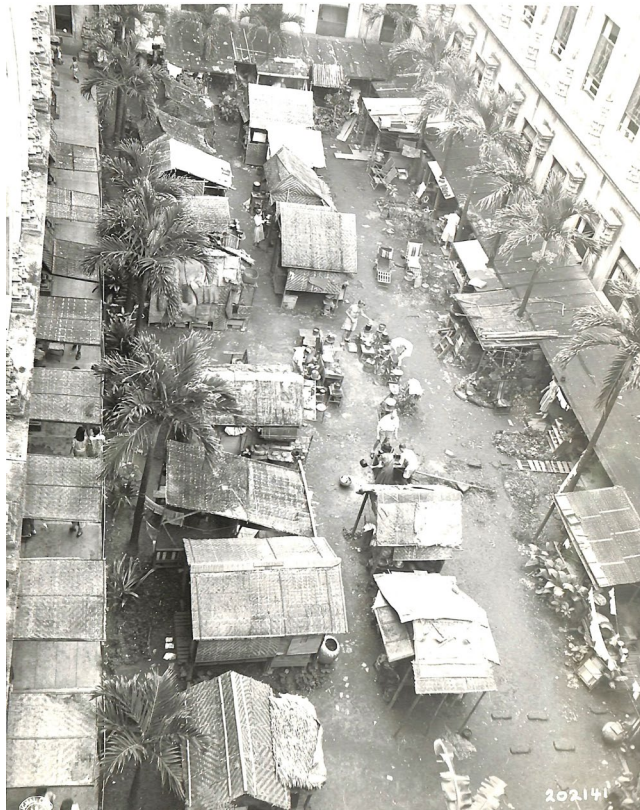


Figure 23. Internee Huts on Santo Tomas University Grounds (1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2902, Image 82 (College Park, MD: National Archives and Records Administration).



Figure 24. American Internees (February 3, 1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2903, Image 132 (College Park, MD: National Archives and Records Administration).

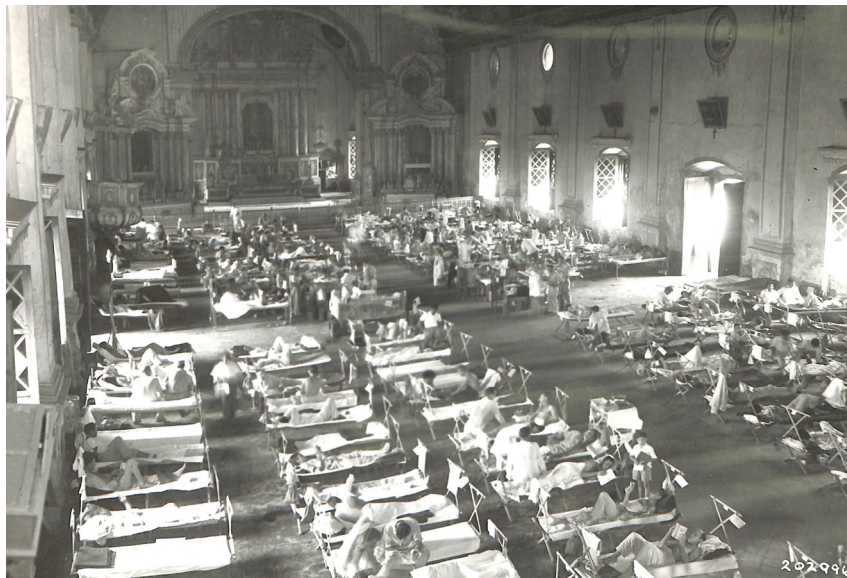


Figure 25. 21st Evacuation Hospital at Santo Domingo Church (February 12, 1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2903, Image 139 (College Park, MD: National Archives and Records Administration).



Figure 26. IDPs Freed by 1st Cavalry Division (February 12, 1945)

Source: US Army Signal Corps, *Philippine Islands – Luzon – Manila*, Records Group: 111, Album 2902, Image 101 (College Park, MD: National Archives and Records Administration).

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