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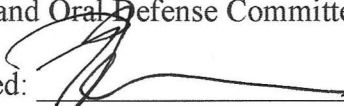
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EXECUTIVE SUMMARY

Title: Joint Fires: Leverage for Fighting in a Future Megacity

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Thesis: Future Joint Fires requires an efficient, simplified, and adaptive system in order to support maneuver forces operating in the highly complex, dynamic, and densely populated environments of the megacity.

Discussion: The twenty-first century is progressing towards increased urbanization, insecurity, and over population, challenging the historical 'norms' for modern states. Within these trends, over population caused by exponential population growth, massive migration, and urban sprawl continues to increase the sizes of urban centers. While the current definition of a megacity is comprised of inhabitants numbering ten million or more, the actual number is unimportant. What is significant about this urban terrain is the presence of complex networks, density, and sophisticated infrastructure in these cities.

This landscape presents unique challenges to fire support planners. The horizontal and vertical faces of modern structures, and the internal and subterranean spaces present unavoidable gaps in current fires systems and platforms ability to employ today's existing direct and indirect capabilities. The confined area in this setting will also force maneuver forces into a dangerously close fight, amplifying the need for future joint fires capabilities to employ weapons with increased accuracy and flexibility.

Conclusion: To meet this need, a new concept for joint fires in complex urban terrain is necessary. The system must decrease the amount of time that elapses from an observer controller's initial request to the point of delivery. Efficiency is needed with a combined fires coordination cell that intertwines the battle rhythm of intelligence-based operations with a simplified method of fires clearance, delivery, and de-confliction. Additionally, as technology continues to advance in the fields of unmanned aerial systems, guidance kits, and smart multi-sensors, joint fires planners must capitalize on this technology and fuse it with the next generation of smart weapons. Doing so, will ensure that joint fires remains relevant and continues to provide commanders with the necessary leverage to defeat future adaptive enemies in highly complex urban settings.

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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PREFACE

The future of Joint Fires can provide the key difference in enabling a small maneuver force's success to fight and win within a megacity. The future fires concepts and technological advances must address the need for Joint Fires to provide efficient, simple, and adaptable solutions. Success in this realm will ensure the ensuing close fight in the urban environment can be overcome, and fires will be able to provide the adequate leverage necessary, enabling a smaller and highly equipped unit to dislodge a numerically larger force.

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21st Century Megacities: A Challenge for Multi-domain Control

The twenty first century continues to progress towards increased urbanization, insecurity, and over population challenging the historical ‘norms’ for modern states. Within these trends, over population caused by exponential population growth, massive migration, and urban sprawl continues to increase the sizes of urban centers. The US National Intelligence Council predicts that the world’s population in urban areas will increase to sixty percent by 2030¹. This trend will certainly increase the size of the worlds current 27 Megacities. Additionally, in its Global Trends 2030 report, the council believes that the next twenty years will see a faster growth of peri-urban or “rurban” areas compared to city centers.² This means that the already infinitely complex megacity, defined to have ten million inhabitants or more, will also increase in horizontal size by a number of miles.

To a fire support planner, a geographically large and densely populated megacity would appear the same as the triple canopy jungle does to a leafcutter ant. This concrete and steel ‘jungle’ is comprised of a diverse terrain consisting of multi-level layers: subsurface, surface, elevated, and the airspace surrounding and above³. Planning, employing, and de-conflicting fires within this terrain will require superiority in access and coordination across the triad (land, air, and sea) of domains. The US Army’s Capabilities and Integration Center (ARCIC) Deep Futures Unified Quest war game has recently explored operating in a Megacity, placing its blue

¹ US National Intelligence Council, *Global Trends 2030: Alternate Worlds*, (Washington DC: US Independent Agencies and Commissions, 2013), 116.

² US National Intelligence Council, 117.

³ Army Capabilities Integration Center, *The Megacity: Operational Challenges for Force 2025 and Beyond*, May 8, 2014, http://www.arcic.army.mil/app_Documents/ARCIC_Report_Unified-Quest-14_The-Megacity-Operational-Challenges-for-Force-2025-and-Beyond_08MAY2014.pdf

force in a scenario of escalated violence in a complex urban environment. The results unsurprisingly noted that combat arms capabilities, mobile firepower and aviation assets, and general maneuver capabilities were challenged by the proliferation of low grade anti-access and weapons amongst a smaller yet determined enemy force. The results highlight the key effects on a military force delivered from the characteristics of a complex urban environment. The nature of this terrain reduces the range of combat to the ‘close fight’, challenging the application of fires and maneuver with its vertical face and subterranean spaces. It will also force maneuver to smaller and more agile elements; redefining mass from large combat divisions to smaller more specially equipped squads. These challenges lead ARCIC Concept and Development Directorate director BG Christopher McPadden to look beyond 2025, stating “there is no historical precedent for the scenario that [ARCIC] engaged in” (speaking of Megacities).⁴

To this end, the purpose of the first section of this work is to examine the historical case study of Japan’s invasion of the Malayan peninsula and subsequent sacking of Singapore in 1941-1942. While Singapore does not fit today’s definition of a Megacity, the operational lessons pertaining to fire support from Japan’s military campaign offer insight into gaining full spectrum dominance. Their significance enabled the numerically smaller Japanese force to route the British, Australian, and Indian forces defending the fortress city of Singapore. The last section will examine a new concept for joint fires in the densely populated and complex megacities of today and highlight key aspects and shortfalls that must be addressed in order to ensure future success.

⁴ Daniel Wasserbly, “War Games: ‘Unified Quest’ Trials US Army Operations in Future Megacities”, *Jane’s International Defense Review* 47 (2014), <http://search.proquest.com/>.

The Malayan Peninsula and Singapore Battle Case Study

Positioned at the southern tip of the Malayan Peninsula, Singapore possessed natural protection by the fact it was comprised of an island, provided ready access to the sea through a busy and strong commercial port, and a garrison of the elite British Empire's army. The fortress city reinforced against naval incursions served as a crown jewel for British foreign policy and commerce beginning at the end of the 19th century.

However, tensions increased between Japan, the U.S., and Britain over increasing influence in the Pacific and levied naval restrictions from the fallout of World War I and 1920s Naval Treaties. While Japan maintained a persistent policy of avoiding conflict up until 1939, preparations for war continued in case conciliations failed. Finally, in response to the effect of the U.S.'s heavy economic sanctions, Japan determined force was the only option to grasp key raw materials and protection for a regional hegemony. The Malayan Peninsula and island city of Singapore were essential to Japan's strategy; the former providing rich access to rubber, iron, aluminum and petroleum and the latter a strategic launch point for foreign naval powers to reinforce against Japan. Taking both together, Japan stood to gain dominance over the major choke point for control of the Straits of Malacca, the gateway between the Indian and Pacific Oceans and rid Southeast Asia of western influence.⁵

Planning for Defense: Background and British Strategy

With the adoption of the 'Singapore Strategy', the British became the primary defense force for the Malayan Peninsula and Singapore. Originally conceived in 1921, the strategy evolved around the Royal Navy's (RN) ability to reinforce the port of Singapore and surrounding

⁵ Alan C. Headrick, *Bicycle Blitzkrieg: The Malayan Campaign and the Fall of Singapore*, (Pickle Partners Publishing, 2014), 11-12. Apple iBooks edition.

waters with a strong enough presence to thwart any Japanese threat.⁶ While initially a sound strategy due to British naval strength, ultimately advances in aviation technology and the events in Europe during the opening events of World War II proved the strategy lacking.

To reinforce the forces in Singapore, British Admiralty and Prime Minister Winston Churchill set a course for the RN that weighed deployment timetables against Japan's projection abilities. With a moderate land force in place, British planners felt that navy reinforcements dispatched from waters near England could arrive in time to defend any Japanese threat. If attacked, the British would conduct a delaying action with expectations of the fleet to arrive within forty-two days.⁷ Singapore's naval base, built for heavy defense against an attack from the sea with 16-inch guns and coastal defense and artillery positions was the perceived launch point for the main fleet. This period for relief however was sidelined once combat radiuses and ordnance capabilities of aircraft in the 1930-1940s increased. Recognizing that a direct attack from the sea was now unlikely, the Royal Air Force (RAF) began building airbases in the northeast sector of the Malayan Peninsula in order to intercept any Japanese attack from greater distance into the South China Sea. Consequently, the small army British Lieutenant General Percival received must defend the entire Malayan Peninsula rather than only the small island city of Singapore. As a result, the combined British, Australian, and Indian forces stretched themselves thin without the means to coordinate and mass against the looming Japanese assault.

Nearing the end of the second Sino-Japanese War, Japan postured forces on the island of Hainan in 1939, just off the coast of China, with their eyes set towards western Indochina.

⁶ Brian P. Farrell, "High Command, Irregular Forces, and Defending Malaya, 1941-1942", *Global War Studies* Vol. 8 Issue 2 (December, 2011): 35, <http://search.ebscohost.com/>.

⁷ Farrell, "High Command, Irregular Forces, and Defending Malaya, 1941-1942", 35; see also Brian P. Farrell, *The Defence and Fall of Singapore 1940-1942*, (Stroud: Tempus, 2005), Ch 1-2.

Shortly thereafter with the defeat of France in the spring of 1940, the focus of World War II in Europe increased the “period for relief” for the British Malaya Command to six months.⁸ Despite the situation at home, General Percival’s knew his situation was grim... “He asked for minimum requirements of two tank regiments and 48 infantry battalions, plus 556 aircraft. He received no tanks at all, only 33 infantry battalions, mostly raw troops, a few heavy guns and 141 aircraft.”⁹ In the end, Percival’s total force comprised of ten infantry brigades and eleven squadrons, reinforced with the two Indian divisions and an Australian division. The only additional forces dispatched were the battleship Prince of Wales and battlecruiser Repulse, dubbed Force-Z, with escorts; a decision displaying the seriousness of England’s situation. Ultimately this placed the forces on the Malayan Peninsula charged with defending Singapore to the last in a precarious position against an encroaching, battle hardened, and capable enemy.

Planning for Invasion: Background and Japanese Strategy

Increasing German advancements in 1940, the defeat of France and forced withdrawal of British forces in Europe combined with the Japanese view of western support to the Chinese in the Second Sino-Japanese war only served to dampen diplomatic efforts to avoid war. Finally, a month after the surrender of France in July 1940, US President Roosevelt dealt a final blow to Japan. Roosevelt froze Japanese assets in America and through the Export Control Act blocked the export of key items such as oil and chemicals to Japan, essentially anything perceived as a ‘war making material’. Additionally, the American, British, China, and Dutch East Indies embargoes combined to reduce Japan’s needed imports by an estimated 75 percent.¹⁰ This fatal chain of events served to choke Japan. Its military planners estimated that their country’s ability

⁸ Farrell, “High Command, Irregular Forces, and Defending Malaya, 1941-1942”, 36-37.

⁹ James Leasor, *Singapore-The Battle That Would Change the World*, (London: James Leasor Ltd, 2011), 32. Apple iBooks Edition.

¹⁰ James Leasor, *Singapore-The Battle That Would Change the World*, 307.

to wage war with diminishing reserves would occur prior to any hopes of negotiated diplomatic settlements. Consequently, Japan decided war was inevitable and planning began to seize the initiative by ridding the threat of the US Pacific Fleet at Pearl Harbor and simultaneously invading the Malayan Peninsula to take Singapore from the British.

As early as January 1941, Japanese intelligence collection on the Malayan Peninsula and Singapore began to shape the strategy for Japan. Through the cover organization Taiwan Army No. 82 Unit, Japanese intelligence officials labored on two major issues. First in developing requirements and necessary data to fight in a jungle environment and the second to determine the overall British force laydown and status.¹¹ The results correctly identified that the Singapore Fortress defenses were vulnerable to an attack from the north and British air and ground forces lacked an interlocked defense against an invasion against the Malayan Peninsula. The impact of environmental conditions in the jungle with dense and inhospitable terrain condensing mobility to the road and rail networks on the peninsula, and potential for the combined British command to easily delay Japanese advancements pushed Lieutenant General Yamashita Tomoyuki to develop a new concept. Seeing speed as the critical factor in defeating the enemy on the peninsula, General Yamashita adapted a 'driving charge' (kirimomi sakusen) strategy to gain the initiative and maintain a tempo that British forces could not react in time to regroup.¹² To accomplish this, Yamashita turned down an offer for five divisions, accepting only three in order to maintain speed and a balance in logistical requirements. This force was reinforced with heavy artillery, a tank brigade, and an air division of 459 planes with an additional 159 planes from the

¹¹ Alan C. Headrick, *Bicycle Blitzkrieg: The Malayan Campaign and the Fall of Singapore*, 3-4.

¹² Farrell, "High Command, Irregular Forces, and Defending Malaya, 1941-1942", 43-44.

Imperial Japanese Navy.¹³

The invasion began on 8 December, 1941 within hours of the attack on Pearl Harbor. With a near simultaneous landing of the main force in Singora and Patani, Thailand and Kota Bharu, Malaya, Yamashita's 25th Army pressed forward immediately after landing with unrelenting air coverage from forward bases in Thailand. Four days later, the Japanese had advanced nearly 100 miles south, capturing primary RAF airfields and outflanking any resistance.¹⁴ British aircraft mainly comprised of the Buffalo and Vildebeest were quickly destroyed by the Japanese air interdiction operations. Easily outmaneuvered by the new Japanese A6M 'Zero', most met untimely destruction, depriving the British and Indian defenders of much needed protection. As part of the Japanese 'driving charge', a series of J-hook movements using two thirds of the force was used to maneuver to the flanks of the British and Indian forces after making contact. In anticipation of the extreme jungle heat and desire to maintain maximum speed, the Japanese applied the use of the normal bicycle to capitalize on maintaining the initiative over the retreating British and Indian forces. Together with the dominance of the skies above the peninsula, this 'bicycle blitzkrieg' maintained constant pressure on the combined British and Indian forces. Always on the move, appearing on the flanks of the jungle viewed as impenetrable by the British, the Japanese advanced south through the peninsula despite the best efforts of the defenders. When the British and Australians were able to resist on the west coast, the Japanese simply shifted to the use of amphibious envelopments to continue their flanking attacks (See Appendix 1). The final blow enabling Japan to completely isolate Singapore by air and sea was the sinking of HNS Prince of Wales and Repulse on 10 December. The blow astonished the western world and destroyed any hope

¹³ Alan C. Headrick, *Bicycle Blitzkrieg: The Malayan Campaign and the Fall of Singapore*, 5.

¹⁴ Alan C. Headrick, *Bicycle Blitzkrieg: The Malayan Campaign and the Fall of Singapore*, 4.

General Percival and his coalition had in relief.

By 31 January, with all remaining defenders locked into Singapore, Yamashita positioned his army across the Johore Strait, ready for a siege on the city. With artillery staged on the heights of Johore Bahru, the entirety of Percival's remaining defensive positions across the strait was all within range. Despite his positional advantage and dominance of the air and sea, Yamashita knew the battle for Singapore needed to end quickly. His forces were outnumbered nearly three to one and his logistical train was stretched to the maximum.

My attack on Singapore was a bluff. I knew that if I had to fight long for Singapore, I would be beaten. That is why the surrender had to be at once. I was very frightened all the time that the British would discover our numerical weakness and lack of supplies and force me into disastrous street fighting.¹⁵

Fortunately for the Japanese, Percival never perceived these dire conditions. Following the crossings by the 5th and 18th divisions on 8 February, the Japanese moved inland to secure the Tengah airfield and seize the water reservoirs that supplied Singapore's freshwater supply. Already heavily damaged by nearly continuous bombing since the onset of the invasion, control of the reservoir proved to be the final finishing blow for the defending forces struggling to hold on. By 13 February, the disaster was complete; with an estimated twenty-four hour water supply remaining, civilian casualties numbering an estimated 2,000 a day, and a threat of rampant disease due to the piled corpses and lack of water for sanitation, General Percival was forced to an unconditional surrender on 15 February.

Lessons for Fires Planners

Given the definition for Joint Fire Support as "all things that include joint fires that assist air, land, maritime, and SOF to move, maneuver, and control territory, populations, airspace, and

¹⁵ J. Bowyer Bell, *Besieged: Seven Cities Under Siege*, (New York: Chilton Books, 1966), 105.

key waters”, the following key lessons are inferred from this case study.¹⁶

First and most importantly, application of fires can provide a force with multi-domain dominance. The Japanese’s constant pressure against Singapore and targeting of the British airfields and capabilities through air interdiction operations succinctly helped General Yamashita maintain the initiative during the entire seventy days of the operation despite being numerically inferior. Additionally, the sinking of HMS Prince of Wales and Repulse provided dominance of the seas and removed any chance the British forces had in influencing Japan’s continued onslaught. With complete isolation of Singapore by air and sea, the Japanese had created what we describe today as full spectrum superiority, and in this case it was accomplished without overwhelming mass. Full spectrum superiority provides control of the operational environment through the seizure, disruption, control, or destruction of the adversary’s critical factors, to include the operational and strategic centers of gravity.¹⁷ With the dominance of the air and sea, Japanese forces effectively destroyed both the allied strategic and operations centers of gravity; respectively the ability to reinforce through the RN and the air and naval capabilities positioned on the Malayan Peninsula. Without control in the multi-domains, the battle may have continued considerably longer.

Second, the application of fires should serve to isolate the urban area.¹⁸ Isolating the fortress city of Singapore not only prevented reinforcement as described above; it also prevented escape for the allied forces from the island city. Primarily due to the geographic environs, the job of cutting off the city was simplified for the Japanese. With the final stroke, Yamashita’s

¹⁶ US Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington, DC: Joint Chiefs of Staff, August 11, 2011), III-24.

¹⁷ US Joint Chiefs of Staff, *Joint Urban Operations*, Joint Publication 3-06 (Washington, DC: Joint Chiefs of Staff, November 20, 2013), III-20.

¹⁸ US Joint Chiefs of Staff, *Joint Urban Operations*, IV-15.

25th Army crossed the Johore Strait and cut off the remaining water supply to the city. Accomplished initially through the intense air bombing campaign, the killing blows to the reservoir at the completion of the campaign ended with a heavy three-day artillery barrage. Isolation and removal of key life preserving resources can be delivered through fires; also delivering huge psychological effects.

While Singapore does not fit today's definition of a Megacity, its urban terrain presented Japanese military planners with some of the same challenges in the modern era. The 1941-1942 Malayan campaign displayed the ability of fires to support and synchronize with operations to maintain optimum tempo, enabling Japanese forces to maintain the initiative from start to finish. Despite the canalizing effect of the jungle on Japanese forces, which effectively narrowed their actions to within a few hundred yards from the roads, they were able to maintain forward momentum and synchronize air and surface against the allied defensive positions. Tomorrow's planners will confront a similar canalizing terrain in the Megacity. This concrete and steel terrain will force a more condensed force to operate in a three dimensional area with vertical and horizontal surfaces and internal spaces. The effect of dense infrastructure and civilian populations will severely inhibit the use of massed fires in the future compared to that the Japanese forces experienced for Singapore. In order for the future application of fires to provide the same multi-domain dominance shared by the Japanese forces of 1942, a new concept is necessary to address the use of fires in the complex urban environments of Megacities beyond 2025.

Future Concept for Joint Fires

Purpose

The purpose of this concept is to provide an overall structural framework for joint fires in support of future operations in the megacity. It also serves to identify the unique requirements and key challenges posed by this future operating environment.

Background

The future megacity presents unique challenges to forces that are not necessarily original; however, their nature compounds the affects on potential operations. To appreciate these issues, it is important not to narrowly define a megacity as a metropolis of ten million people or more.¹⁹ In addition to merely holding a large population, the megacity possesses an extreme level of complex networks. These extend from social relationships to a sophisticated array of infrastructure. Additionally, the density of the human terrain within a megacity provides another layer of complexity. Combining these characteristics create a uniquely dynamic personality to the megacity which serves to provide a natural resiliency. Future enemies will exploit this terrain and the complex networks similar to the recent observations noted in Baghdad, Fallujah, Gaza, Grozny, and the like. The application of fires in these environments all possess the same goal in common with the previous Battle of Singapore case study - to enable a smaller force to dislodge a numerically superior force and gain domain dominance.

The forces required to operate in the future megacity will challenge our principle of mass, at least as it is currently understood. The purpose of mass is to “concentrate the

¹⁹ Fred Pearce, “How Big Can Cities Get?,” *The New Scientist Magazine*, June 17, 2006, 41. <http://www.newscientist.com/article/mg19025561.600-ecocities-special-ecopolis-now.html>

effects of combat power at the most advantageous place and time to produce decisive results... massing effects of combat power, rather than concentrating forces, can enable even numerically inferior forces to produce decisive results and minimize human losses and waste of resources.”²⁰ The center of this principle is concentrated around combat power, which is often equated to measurements in ratios of military hardware. Fighting in future megacities will significantly limit the volumes of military hardware that can be pressed into the fight within the city. Thus, joint doctrine does correctly elude to the point that concentration of forces, and by extension hardware, is not the key to mass. Instead, the ‘concentration of the effects of combat power’ is the key to success. This places the application of joint fires center stage. It can serve to provide the leverage necessary for a smaller force to dislodge a larger force and effectively deliver control of the various domains. Therefore, given the highly complex, dynamic, and densely populated environments of a megacity, Joint Fires requires an efficient, simplified, and adaptive system in order to support future maneuver forces operating in the megacity.

Assumptions

For the purpose of this concept, the following assumptions are applicable. The first three, which stem from the overarching US Army’s Operating Concept, are directly related.

(§)²¹

²⁰ US Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington, DC: Joint Chiefs of Staff, August 11, 2011), A-2.

²¹ US Army, *TRADOC Pamphlet 535-3-1*, (Fort Eustis, VA: Headquarters US Army, 31 October, 2014), 8.

- 1) Adversaries will be able to achieve tactical, operational, and strategic surprise based on rapid application of available and emerging technologies in both manned and unmanned systems. (§)
- 2) The land, air, maritime, space, and cyberspace domains will become more contested as U.S. military technological advantages decrease. (§)
- 3) Changes in technology and geopolitical dynamics as well as the enduring political and human nature of war will keep war in the realms of complexity and uncertainty. (§)
- 4) Future challengers, specifically non-state actors, will exploit the constraint on the US and other nation states belonging to international organizations such as the United Nations to obey international laws directing the rules of armed conflict.
- 5) The US will be forced to commit military force to a complex and densely populated environment much like the megacity previously described.

Challenges

The current operating environment in urban environments present significant challenges to modern designs of applying firepower and the current methods of planning for fires in general. The megacity will reduce combat to extremely close quarters, and require what Lieutenant General Van Riper terms as “Measured Firepower”, a concept he first mentioned in his 1997 study on how operations are affected by urbanized terrain.²² Limited observation and increased interference on communications due to the complicated structures and city landscape will challenge command and control, coordination, clearance, and de-confliction of fires. The unique

²² Paul K. Van Riper, “A Concept for Future Military Operations on Urbanized Terrain”, *Global Security*, July 25, 1997, III-12.

terrain of this complex urban environment will defy current weapon systems, method of delivery, and munitions effectiveness. Applied correctly however, a new and simplified concept for joint firepower, coupled with increased technological capabilities, will enable a small maneuver element to overcome these challenges enough to oust an adversary hiding in this urban environment.

Increasing Operational Capabilities with Joint Firepower

Building Efficiency and Quickening Targeting Cycles

While today's methods for planning are effective at delivering a crushing blow to modernized large enemy formations, it requires a heap of plans, orders, and systematic steps. Defined in the joint services publications, the joint targeting cycle "supports the JFC's joint operation planning and execution with a comprehensive, iterative, and logical methodology for employing the ways and means to create desired effects that support achievement of objectives."²³ The effects of the Cold War are carried forward in our processes such as the 72-hour Air Tasking Order (ATO) cycle and combined intelligence collection and targeting boards at the corps through brigade levels. While very important, this system does not lend itself to providing the speed and immediacy necessary for a force confronted with the close battle in the urban environment. Decisions made by the force engaged regarding the use of assets, clearance of fires, and de-confliction of fires will be forced into a span of minutes vice days. Time to make these decisions is not a luxury offered by the current system of targeting once the maneuver force is engaged.

In order to shorten the time resident in the decision and asset employment cycles, this concept argues that the Find, Fix, Finish, Exploit and Analyze (F3EA) method of synchronizing

²³ US Joint Chiefs of Staff, *Joint Targeting*, Joint Publication 3-60 (Washington DC: Joint Chiefs of Staff, January 31, 2013), I-10.

intelligence, operations, and targeting is more responsive than the traditional Decide, Detect, Deliver, and Assess (D3A) cycle. The US Army primarily uses the latter at the Corps and Division levels to harness effects of both lethal and nonlethal effects in conventional battles.²⁴ While recognizing that the F3EA cycle provides key flexibility for Time Sensitive Targets (TST), the Army and other services do not rely heavily on it for planning. US Special Operations Command, however, routinely institutes this cycle into its operations. It has become the main synchronization system for the US's efforts in counter terrorism. The key aspect provided by F3EA is speed, thereby creating space and time for crucial decisions and engagement of highly dynamic enemies and fleeting opportunities. General Votel, the previous commander of Joint Special Operations Command, refers to F3EA as "the machine, the process of how we do business."²⁵ While F3EA speeds the process of fires decisions cycle along, it does not provide the answer to structural alignment for joint fires elements.

Fires cells exist within each level of organized maneuver forces from the company to division and corps levels, and increase in complexity and manpower requirements within larger forces. The purpose of this construct is to measure the efforts of multiple forces and levy the limited availability of fires assets against them. While justified and necessary in a large theater level campaign where multiple forces are simultaneously engaged, these varying level of agencies will hamper the maneuver forces in scenarios involving urban fighting. Instead of relying on multiple cells to plug into the targeting and asset allocation cycles, the smaller forces

²⁴ Headquarters Department of the Army, *The Targeting Process*, Field Manual 6-30, (Washington DC, Department of the Army, November, 26, 2010), II-1-III-8.

²⁵ Donna Miles, "Socom Strives to Preserve, Build on Capabilities for Future," *US Department of Defense News*, May 16, 2013. <http://www.defense.gov/news/newsarticle.aspx?id=120063>

actively engaged within a megacity will require a more agile and simple fires cell with immediate access to fires assets.

The US Air Force addressed a similar issue with the development of Remote Split Operations (RSO) under the auspices of their developing advanced Unmanned Aerial Systems (UAS) program. This system of control enables the Air Force to provide commanders across the globe with access to armed unmanned vehicles that effectively fuse the find, fix, and finish phases of F3EA. RSO provides numerous advantages by effectively linking a launch and recovery element forward deployed operating under line of site control with a different aircrew in a separate location in a ground control station through a satellite control link.²⁶ Normally, the ground control station, as part of the mission command element, operates within the confines of the continental US, thereby avoids risk to crews, takes advantage of improved infrastructure, and operates on the global scale providing easy transitions from one theater of operations to another. RSO provides theater commanders with key flexibility through the use of UAS; however, it remains geared towards the larger battle. It still requires the coordination and linkages to an air operations center, intelligence enterprises, and fires coordination cells. Each link requires additional time and increases the overall length of time from identified need to delivery for an element in a close fight in the urban setting.

Simplification From Request to Delivery

In order to provide the speed and reaction time necessary to support the elements engaged in the close fight of a megacity, the various steps involved and separate organizations tied into

²⁶ Ken Callihan, "Enhancing National Security Cooperation Policy With Remotely Piloted Aircraft", *The Defense Institute of Security Assistance Management Journal*, (2013): <http://www.disamjournal.org/m/articles/enhancing-national-security-cooperation-policy-with-remotely-piloted-aircraft-786>

the system for delivering a fires solution must be simplified. Additionally, the intricacies of planning, approval and clearance, and de-confliction cannot overburden the forces engaged in the fight. Therefore, a new element similar to both the traditional Fire Support Coordination Centers (FSCC) and Joint Air Operations Centers (JAOC) can simplify the solution by providing the attributes of both into a single entity. By combining the two elements, planning and access to relevant intelligence can instantly be fused with the traditional fires approval and de-confliction processes. Essentially this will combine both tactical fire direction and clearance of fires with the same element directly linked to the information and operations centers, thereby eliminating a need for a separate element and simplifying the time constrained cycle of delivering the fires solution to the force in need.

The fusion of the two centers would be extremely challenging in a major theater of war in which large volumes of units and multiple layers of fires assets are present. However, on the smaller scale required for operations within a megacity and pertinent to this concept, combining the FSCC and JAOC into a new hybrid fires element will bring numerous advantages. Within a single element, all fires from air, space, land, and sea can be coordinated with a single staff of technical experts. Planning airspace coordination and de-confliction of both air and surface fires can be simultaneously executed with the fires solution or asset chosen without additional steps or outside organizations to the Joint Task Force (JTF) providing the command and control for the operation. Additionally, this hybrid element can be scaled as small as necessary and packaged together with necessary command and control systems onto an Air Force 4631 pallet system, making it functional and deployable on board any US military cargo plane such as the C-17 or C-130 air frames.

The major challenge to this is connectivity and satellite bandwidth availability; however, as technologies increase it is conceivable that this hybrid element can provide the initial command and control of joint fires for forcible entry in the same manner the Supporting Arms Coordination Center (SACC) provided from ship in WWII.²⁷ Additionally, the small and tailored organization will increase the training and knowledge requirements on all the individuals involved. In today's operations, fire supporters are routinely tasked with missions unrelated to fires and the effect results in increased atrophy of perishable skills. This constraint will challenge future fire supporters as the hybrid element will require increased levels of knowledge in technical systems.

Future technologies are also emerging that enable the fire supporter attached to maneuver elements to more quickly send requests for fires and air support. A recent test by Marine Joint Terminal Attack Controllers (JTAC) using a ruggedized off the shelf android tablet with new software dubbed Kinetic Integrated Low-cost Software Integrated Tactical Combat Handheld or 'KILSWITCH' demonstrated a new low record of four minutes in delivering the 9-line request for Close Air Support (CAS).²⁸ Technologies are also increasing with the delivery of surface fires in mind. With the proliferation of smart devices, future concepts may lead to individual soldiers being able to load off the shelf software onto small hand-held smart devices and utilizing them in combat. With the help of one US Army Captain who spent \$30k of his own cash,

²⁷ M. F. Bernstein, "The Role of the SACC", *Marine Corps Gazette*, Vol. 98, 7 (2014): 32. <https://www.mca-marines.org/gazette/2014/07/role-sacc>.

²⁸ Andrew Tarantola, "KILSWITCH Android tablet delivers airstrikes in four minutes", *engadget.com*, April 10, 2015. <http://www.engadget.com/2015/04/10/kilswitch-android-tablet-delivers-airstrikes-in-four-minutes/>

iPhone launched an application called Tactical Navigator or TacNav for short.²⁹ The application provides coordinates and navigation tools that can easily be transposed to determine target locations for surface fires. As more technology emerges, the devices and future software can be combined with onboard combat systems in aircraft to merge requests for fire and observer position data with off the shelf devices through secure means to support combat operations. Combining this technology with a streamlined organization structure of the various fires elements will greatly enhance efficiencies and reduce the overall time required to deliver the fires solution from the initial requests.

Increasing Adaptability

Increasing adaptability addresses the need for future joint fires capabilities to provide maneuver elements with scalable options. Additionally, this concept must also address the major challenges the megacity will present to the application of fires within the urban terrain described above. Weight, payload, fusing options, target discrimination, angle of attack and delivery, time on station, and collateral damage will all be affected requiring new solutions and technology. Perhaps the greatest challenge in developing solutions to these challenges is the lengthy procurement process itself. Many scholars have touted the challenge of the iron triangle between good, fast, and cheap, citing that organizations rarely acquire more than two of the elements. To further complicate the issue, a developed solution in one area may not work in another. For example, the small diameter bomb was developed to control the effects of the weapon by reducing the explosive fill within the casing. It proved effective in Afghanistan against adobe structures; however, it may not produce the same result against glass-enclosed steel structures of

²⁹ Hugo Miller, "IPhones Guide Artillery Fire as Pentagon Plans App Store: Tech", *Bloomberg.com*, December 15, 2011. <http://www.bloomberg.com/news/articles/2011-12-15/soldiers-iphones-guide-artillery-fire-as-pentagon-plans-app-store-tech>

a modern city. In a case such as this, the desired result is in fact proven inversely proportional by creating more collateral damage. These issues place an emphasis on the adaptability of joint fires and future systems in order to remain a relevant tool for maneuver commanders in planning for operations in the urban environment.

Future systems of smart weapons are under development that may provide solutions to the challenges of weight, payload, fusing, and angle of attack and delivery. Advances in smaller man portable missile variants will provide maneuver elements with future direct attack options that will be effective in the urban environments. Systems such as the Battlehawk, Switchblade provide accurate, man portable, non-line-of-sight kinetic options capable of targeting enemies with standoff distances while minimizing collateral damage.^{30 31} Additional advances in air delivered systems such as Sensor Fused Weapons (SFW), Clean Area Weapons (CLAW), are underway to replace legacy cluster munitions technologies and replace them with blast fragmented unitary options. Combining these advances with advanced technological weapon delivery and smarter sensor and advanced guidance kits will further expand the options available.

Delivering weapons in an urban environment from an indirect platform requires an increased need for accuracy and maneuverability of the system. The horizontal and vertical planes presented by the congested infrastructure of a megacity reduce the capabilities of modern day air, artillery, and sea delivered weapons. Air to ground missiles will have limited airspace to maneuver and very tight corners to navigate through due to the urban canyons present between tall structures. Systems with ballistic trajectories such as artillery and naval surface fires are interrupted by the same, creating large intervening crests their rounds will intercept prior to

³⁰ "Smart Weapons," *Textron Systems*, last modified June, 2014,

<http://www.textronsystems.com/weapon-sensor-systems/smart-weapons>

³¹ "Switchblade," *Aerovironment-Human Power*, last modified February 2015,

<https://www.avinc.com/uas/adc/switchblade/>

hitting the intended target. To address these challenges, further developments in unmanned aerial systems may yield unique solutions. Micro UAVs of the future may be able to combine flight telemetry data, pressure sensors, and range sensors such as radar, Light Detection and Ranging (LIDAR), or ultrasound with onboard imaging cameras to accurately map and locate targets in a virtual world.³² Equipping future weapon systems with this technology combined with National Geospatial-Intelligence Agency (NGA) advances in accurate spatial imaging and global mapping can yield the next generation of sensors and guidance systems capable of autonomous navigation in complex terrain. In affect, the smart sensor using LIDAR can sense the obstructions in its path in real time and relate it with onboard sensors to a virtual digital map programmed into its brain from the delivery platform. Placing advances such as these in low cost micro UAVs with small payloads capable of neutralizing an enemy hiding in confined spaces in the city will provide a new level of adaptability not yet realized. Associating this advancement to autonomous or future swarm tactics will provide the new age of massed fires, replacing legacy systems that cannot be employed with the confines of the terrain of a megacity.

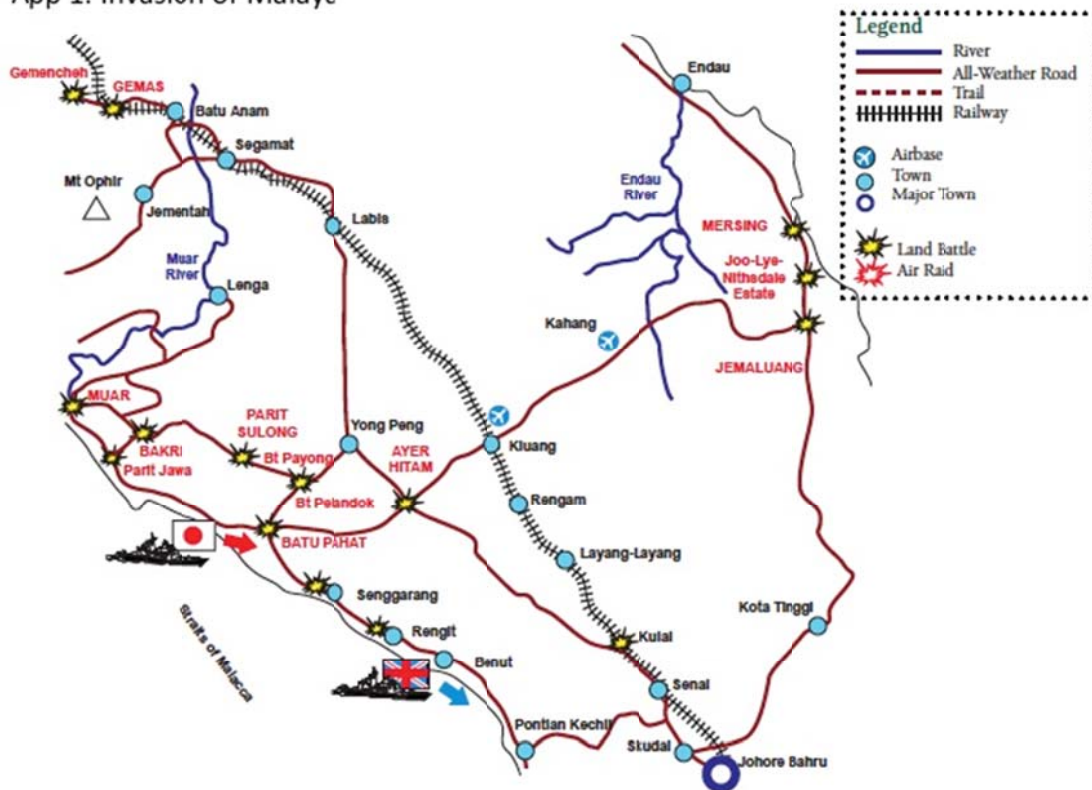
Conclusion

In order to provide maneuver forces operating within the confines of megacities, future joint fires concepts must address the unique challenges presented by the densely complex terrain presented in the megacities of 2025 and beyond. Future challenges from both state and non-state actors exploiting this operating environment will continue to seek gaps in US technological strengths by using both conventional and unconventional tactics and weapons. Future joint fires

³² James Alton Ross, "Computer Vision and Target Localization Algorithms for Autonomous Unmanned Aerial Vehicles", (masters thesis, Pennsylvania State University, 2008), 2-3.

solutions must be adaptive, simple, and focused in providing efficiencies to enable the future JTF to gain and maintain the initiative and provide the leverage necessary to defeat an adaptive enemy. New fires elements must suppress the length of time elapsed from request to delivery and harness new and emerging technologies in order to provide commanders with viable options to gain multi domain dominance, thereby enabling maneuver to dislodge a numerically superior enemy while maintaining his own economy of force. The ideas for solutions within this paper establish a baseline for the need for an efficient and adaptive joint fires system. Future developments are needed to advance the full capabilities of integrated changes in streamlined joint fires systems and organizations with developing technologies.

App 1. Invasion of Malaya



Appendix 1

Source: Brian P. Farrell, et al., "The British Defense of Singapore in the Second World War: Implications for the SAF", *Malayan Campaign 1941-1942*, vol. 6, (2008): 68.

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