Transportation Infrastructure:
A Critical Component for Deterrence in Europe

A Monograph

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The United States and NATO allies are unable to project combat power in Eastern Europe to the magnitude required to defeat Russia in a conventional conflict. Much of the road and rail networks in Poland and Eastern Europe were developed to meet the logistical requirements of the Soviet Military during the Cold War. This monograph evaluates the critical shortfall in transportation infrastructure in Eastern Europe and its effect on power projection for NATO and US militaries as they prepare for future multi-domain operations. Following World War II, the US and Central European states rapidly repaired and built new critical infrastructure which ushered in a period of remarkable economic growth. New transportation infrastructure, developed under military oversight, also enabled the rapid movement of personnel and equipment critical in deterring Warsaw Pact forces in the German Democratic Republic. The methods of infrastructure development introduced after WWII provide prescient insights into Europe, NATO, and US efforts to prevent hostility. These insights provide considerations and tools for policymakers and military commanders involved in the deployment of forces abroad.

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Abstract

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The United States and NATO allies are unable to project combat power in Eastern Europe to the magnitude required to defeat Russia in a conventional conflict. As the US Army transitions away from actions focused on counterinsurgency to large-scale combat operations (LSCO), military planners are reframing the operational environment in Poland and Eastern Europe. Much of the road and rail networks in Poland and Eastern Europe were developed to meet the logistical requirements of the Soviet Military during the Cold War. This infrastructure is not capable of supporting large-scale deployments of armored formations which are critical in deterring Russian aggression in Europe.

This monograph evaluates the critical shortfall in transportation infrastructure in Eastern Europe and its effect on power projection for NATO and US militaries as they prepare for future multi-domain operations. Following World War II, the US and Central European states rapidly repaired and built new critical infrastructure which ushered in a period of remarkable economic growth. New transportation infrastructure, developed under military oversight, also enabled the rapid movement of personnel and equipment critical in deterring Warsaw Pact forces in the German Democratic Republic. The methods of infrastructure development introduced after WWII provide prescient insights into Europe, NATO, and US efforts to prevent hostility. These insights provide considerations and tools for policymakers and military commanders involved in the deployment of forces abroad.

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Abbreviations

DOD – Department of Defense

ERP – European Recovery Program

FRG – Federal Republic of Germany

MDO – Multi Domain Operations

MLC – Military Load Classification

NATO – North Atlantic Treaty Organization

PESCO – Permanent Structured Cooperation

SEP – System Enhancement Program

TEN-T – Trans-European Transportation Network

TENtec – Trans-European Transportation Network

TRADOC – Training and Doctrine Command

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Introduction

Today, just as in a generation before, America's armored military formations embark across the Atlantic to support allies in Europe. Unlike the previous generation in the 1980s, though, the part of Europe that awaits these formations is profoundly different and much of its infrastructure is unable to support their weight. The roads and bridges in West Germany and Central Europe in the 1980s supported heavy US military units during their rotations overseas. Currently, the United States and NATO allies are unable to project combat power in Eastern Europe to the magnitude required to defeat Russia in a conventional conflict. As the US Army transitions away from actions focused on counterinsurgency to large-scale combat operations (LSCO), military planners are reframing the operational environment in Poland and Eastern Europe. The refocus to operations in this region reveals the shortcomings of fragile road and rail networks mostly constructed during the Cold War under the oversight of Warsaw Pact governments.

Much of this transportation infrastructure, built to support Soviet logistical systems, is now crumbling and is inadequate in meeting the demands of modernized armored military formations.[1] A common definition of transportation infrastructure includes the networks of road, rail, air and naval ports as well as inland waterways.[2] The operational environment in Poland and Eastern Europe shares many commonalities with Central European nations during the Cold War as they raced to improve transportation infrastructure to meet both economic and deterrence requirements.

The infrastructure of Central Europe at the beginning of the Cold War could not support

[1] Syndey J. Freedberg, "Poland Deal Lays Ground Work for Division-Strength Deployment," *Allies, Land Warfare*, June 13, 2019, accessed February 13, 2020, https://breakingdefense.com /2019/06/poland-deal-lays-groundwork-for-division-strength-deployment/.

[2] Melissa Kearney, Brad Hershbein, and Greg Nantz, "Racing Ahead or Falling Behind? Six Economic Facts about Transportation Infrastructure in the United States," *Brookings.edu*, May 8, 2015, accessed February 28, 2020, https://www.brookings.edu/research/racing-ahead-or-falling-behind-6-economic-facts-about-transportation-infrastructure-in-the-united-states.

the emerging requirements stemming from the polarization of the US and the Soviet Union. The US and its allies assumed the task of not only aiding in the economic recovery of Europe but in developing the transportation infrastructure needed to support growing deterrence efforts against the backdrop of global Communist aggression. This support occurred over a tumultuous period in world history in which the US lost primacy over nuclear weapons resulting in the re-emergence of large-scale combat operations as a strategic deterrence method.

Like the refocus and transition to large-scale ground combat during the Cold War, the United States today cannot afford to jeopardize its operational advantage in force projection to Europe. Winning the first engagement in modern large-scale competition will likely have strategic implications as it has for most of American history. Therefore, it is necessary for the United States and its allies maximize the potential of its armored formations through operational mobility, enabled by key infrastructure, to both deter and if necessary, win the first fight and provide the for follow-on operations.

This monograph evaluates the critical shortfall in transportation infrastructure in Eastern Europe and its effect on power projection for NATO and US militaries as they prepare for future multi-domain operations. The monograph proposes several recommended actions through the analysis of theory, historical analysis, and current doctrine. The study begins with the examination of the current requirement for transportation infrastructure for the US Army and the gap that exists in Eastern Europe.

The first section identifies and analyzes requirements for operational mobility outlined in future oriented Army Concepts as well as contemporary US Army doctrine. The analysis of US Army doctrine includes a brief review of the evolution of mobility requirements from 1976 to present for contextual understanding in the subsequent historical case studies. Following the identification of mobility requirements, the section continues with an operational feasibility assessment of current transportation infrastructure in both Central and Eastern Europe from both EU and US perspectives. The section concludes with a review of current Department of Defense

efforts to resolve the problem of operational mobility and identifies the critical gap that infrastructure development could fill.

The next section introduces three distinct models for infrastructure development during critical periods of the Cold War: Pre-Marshall Plan, the Marshall Plan, and NATO investment and effort up until the reunification of Germany. Each of these models developed as a result of the strategic aims of the US, later NATO, and range from 1945-47 (the Economic Model), 1948-1952 (the Military Model), and 1953-1989 (the Unified Model). These models provide insight into how alliances function to achieve the common goal of deterring aggression and interference through the development of transportation infrastructure. The historical analysis also provides evidence to support the precedence of infrastructure development in Europe to meet the dual-use requirements of both civilian and military traffic.

The historical analysis incorporates the development of US Army doctrine during the Cold War with a special emphasis on the introduction of Active Defense and AirLand Battle. The monograph examines the development of this doctrine amidst the evolving landscape of Central Europe as a symbiotic relationship began to emerge between rapidly growing transportation infrastructure and the NATO forces positioned to defend it against the Warsaw Pact. This valuable relationship in US military history provides insight into the current dilemma NATO planners face with the reorientation to potential large-scale ground combat in Europe. This section draws comparisons between Central Europe during the Cold War and the modern context of Poland, the Baltic States and East Europe. This section concludes with a summary of each of the infrastructure development models to enable a better understanding of a potential way forward for modern NATO military planners.

The final section incorporates the requirements and gaps in infrastructure outlined in the beginning of the monograph with the historical case studies to suggest recommended actions on behalf of the US Department of Defense and NATO. Recommended actions include closer cooperation between NATO and the European Union, increased funding for upgrading and

creating new transportation infrastructure, and providing engineering expertise to the governments of affected states to hasten the pace of economic growth.

The Current Problem

A Critical Requirement in MDO

The US Army and the Joint Force face a complex and multi-faceted problem projecting power in central and Eastern Europe. Infrastructure capability and mobility are key components in answering many of the operational problems posited in the US Army TRADOC Pamphlet (TP) *the U.S. Army in Multi-Domain Operations 2028*. Infrastructure development addresses questions concerning the Joint Force ability to both "penetrate enemy anti-access and area denial systems throughout the depth of the Support Areas" and "exploit the resulting freedom of maneuver to achieve operational and strategic objectives through the defeat of the enemy in the Close and Deep Maneuver Area".[3] The presence of capable transportation infrastructure is most pronounced between the Operational Support Area through the boundary of the Close and Deep Maneuver Area as depicted in Figure 1. Adversaries create layered standoff in these support areas by limiting the options friendly commanders have at their disposal and will likely exploit the lack of capable roads and bridges.

[3] US Department of the Army, TRADOC Pamphlet (TP) 525-3-1, *The US Army in Multi-Domain Operations: 2028* (Washington, DC: Government Printing Office, 2018), ix.

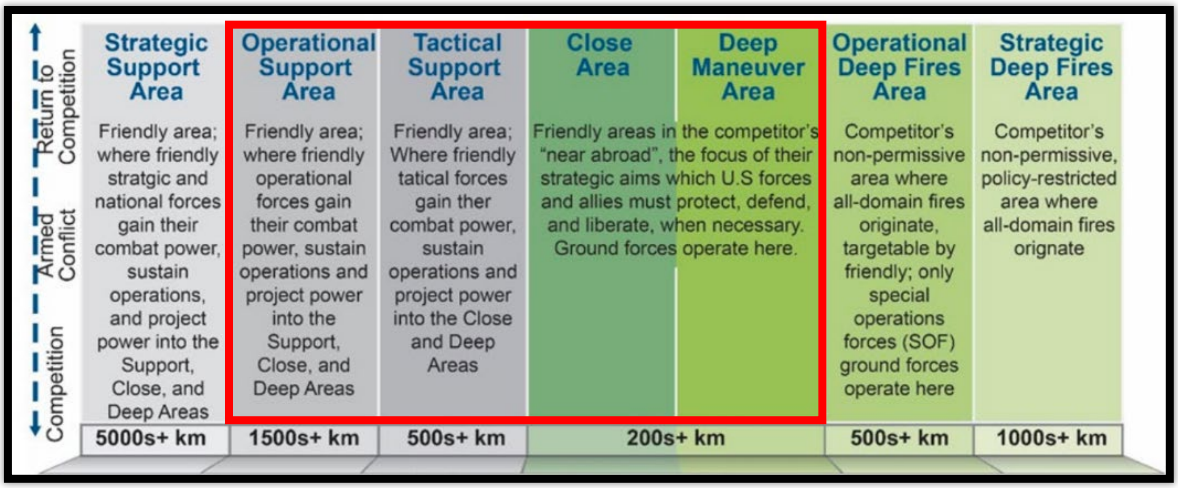

Figure 1. MDO Framework: transportation infrastructure abroad most critical from the Operational Support Area to the Deep Maneuver Area. Source: US Department of the Army, TRADOC Pamphlet (TP) 525-3-1, The US Army in Multi-Domain Operations: 2028 (Washington, DC: Government Printing Office, 2018), 8.

Units operating within the operational and tactical support areas rely on the availability of routes to degrade the effect of an adversary's standoff and enable the successful penetration of friendly forces.[4] A multitude of routes enables commanders to disperse units and create dilemmas for an enemy targeting their movement. In the past, robust transportation and economic infrastructure enabled NATO commanders to achieve effective dispersion in West Germany critically limiting the standoff generated by Warsaw Pact forces over the border. However, today, without adequate rail, road and bridge networks NATO forces are unable to carry heavy modern armor formations and provide multiple avenues to support units in the close area. Successful penetration, facilitated by multiple routes of advance, enable forward presence and expeditionary forces to project power abroad.

Infrastructure capability, though significant in support areas, remains critical in the close area to support the exploitation of a successful penetration of enemy standoff. Critical gaps in bridge and tunnel infrastructure during this exploitation can become division and corps level wet-

[4] US Army, TP 525-3-1, 37.

gap crossings in the close area. Though the army is postured to negotiate these obstacles, reducing them while under enemy direct fire prematurely shifts the "decisive space" for the Joint Force commander. Decisive spaces are the "locations in time and space (physical, virtual, and cognitive) where the full optimization of the employment of cross-domain capabilities generates a marked advantage over an enemy and greatly influence the outcome of an operation."[5] NATO planners in the 1960s faced and understood a similar problem, the critical vulnerability the Rhine River posed as a defensive line and as a result shifted the placement of their units over one hundred kilometers east beyond this obstacle.[6] Capable infrastructure affords the commander to employ a decisive space outside of the dangerous and resource intensive gap crossing operation.

The U.S. Army in Multi-Domain Operations 2028 concept is future focused and outlines these problems to guide the development of MDO Capable force packages by 2028 and ultimately MDO Ready by 2035. These force packages will rely on infrastructure capable of supporting their weight as well as providing numerous routes to enable dispersion from the operational support area through the close area. Infrastructure development, under defense oversight, must commence immediately in Poland and Eastern Europe to satisfy the requirements of present and future forces. At the present rate of development, future commanders will have fewer options in degrading a robust and advanced layered standoff. Commanders of an MDO Capable or Ready formation will expend valuable resources, after decades of production, prematurely and cede the initiative to an adversary. Though future focused MDO concepts identify requirements that capable infrastructure can satisfy, US Army doctrine from the end of the Cold War to today also recognize the significance of road and rail networks.

Historical Infrastructure and Doctrine (from 1973 to 1986)

[5] US Army, TP 525-3-1, 20.

[6] Donald A. Carter, *Forging the Shield: the US Army in Europe, 1951-1962* (Washington, DC: Center of Military History, 2015), 435.

US Army doctrine evolved significantly after World War II to reflect the changing operational environment. The loss of nuclear primacy shortly after WWII and experiences in both the Korean and Vietnam War changed the war the US would fight and deploy its forces.[7] The US Army recognized the increasing importance of mobility and dispersion for battlefields that could include the introduction of nuclear weapons. The Army also recognized the growing concern that future combat would increasing rely conventional forces despite the nuclear capabilities of modern militaries. US Army operational maneuver, especially in Europe, later underwent critical analysis following the Arab-Israeli War in 1973.[8] US Army leaders realized the increasing vulnerability of armored formations to portable missile systems. The growing need for dispersion heightened the requirement for viable transportation infrastructure in Europe. Israeli experiences with the dispersion of armored formations in 1973 generated the demand for a reassessment of the Active Defense doctrine during that period.

Active Defense emphasized the mobility of units, postured to react to an enemy provocation, especially in the likely case they will fight outnumbered.[9] Active Defense, captured in FM 100-5 published in 1976, reflected the reorientation of the US Army from predominately counter insurgency operations in Vietnam to the conventional problem of Soviet armored formations in Europe.[10] The 1976 version of FM 100-5 relied heavily on bringing a "winning concentration of forces at the point of actual combat."[11] The concentration of forces highlighted here was a foundational element of the doctrine and necessary for a NATO force that would

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[7] Robert R. Tomes, *US Defense Strategy From Vietnam to Operation Iraqi Freedom* (New York, NY: Routledge, 2007), 1.

[8] US Department of the Army, Field Manual (FM) 100-5, *Operations*, (Washington, DC: Government Printing Office, 1976), 2-2.

[9] US Army, FM 100-5 (1976), 3-1.

[10] John L. Romjue, *From Active Defense to AirLand Battle: the Development of Army Doctrine 1973-1982* (Fort Monroe, VA: US Training and Doctrine Command, 1984), 13.

[11] US Army, FM 100-5 (1976), 3-5.

likely fight greatly outnumbered.

The realities of mature and robust transportation infrastructure in Western Europe in the 1970s shaped the prevalence and reliance on concentration in doctrine. West Germany and Western Europe benefited from years of aggressive infrastructure development that provided a unique operational environment. Critics of Active Defense highlighted the overemphasis of the defense as well as the assumption that battlefields outside of Europe would afford the rapid horizontal tactical concentrations introduced in the 1976 edition of FM 100-5.[12] The US Army acknowledged these critiques as well as others and introduced AirLand Battle doctrine in the 1986 edition of FM 100-5.

AirLand Battle emphasized high and mid-intensity conflict that would be fought in two different environments addressing a deficiency in Active Defense. The new doctrine defined these environments either as either mature, containing robust infrastructure, and capable lines of communications or immature theaters that rely on external support.[13] AirLand Battle also addressed the critique that Active Defense was over reliant on the rapid tactical concentration of outnumbered forces.

The new manual identified the requirement for large formations (Corps, Field Armies, and Army Groups) to coordinate and concentrate against enemy vulnerabilities.[14] The new doctrine, as compared with Active Defense, relied much less on rapid concentration than Active Defense did as it also focused on the development of deep attack capabilities.[15] These updates to the 1986 doctrine increased the importance of rail and roadways in combat as they enable concentration both at the tactical and operational level. Technological improvements in anti-tank

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[12] Romjue, *From Active Defense to AirLand Battle: the Development of Army Doctrine 1973-1982*, 19.

[13] US Department of the Army, Field Manual (FM) 100-5, *Operations*, (Washington, DC: Government Printing Office, 1986), 2.

[14] US Army, FM 100-5 (1986), 24.

[15] Ibid, 3.

weapons and armored main gun systems also led to the increased demand for dispersion and mobility of formations heightening the demand for transportation infrastructure.

FM 3-0 and the Need for Capable Infrastructure

The 2017 version of FM 3-0 captures a similar refocus for the US Army after years of counterinsurgency operations and again emphasizes the significance of transportation infrastructure on the battlefield. FM 3-0 nests within TP 525-3-1 and builds on ideas from AirLand Battle with emphasis on preclusion, operational maneuver and force projection. FM 3-0 defines preclusion as taking action in advance to stop something from happening.[16] The manual identifies area denial as an action to limit friendly freedom of action within an operational area usually for shorter range actions. Adversaries, like the deployment of short and medium range missiles by Warsaw Pact nations, limit the freedom of action of units to deny the critical concentration of military forces. Preclusion increases the requirement for dispersion in support and close areas for both sustainment units engaged in operational maneuver and tactical units in contact with an adversary. Just as NATO units in West Germany relied on robust transportation infrastructure to achieve dispersion, future militaries will need capable road and rail networks to degrade adversarial preclusion.

FM 3-0 captures a remarkable shift to large-scale combat operations to prepare the US Army for combat that could include the rapid movement of sizable units. Active Defense in 1976 and AirLand Battle in 1986 both recognized the growing importance of large-scale force projection originating with operations focused in Central Europe adapting quickly to a global capability. Each of three field manuals highlight the importance of concentration and dispersion on increasingly complex battlefields. There is a gradual transition after Active Defense to relieve adversarial standoff through deep operations enabling freedom of action for maneuver from

[16] US Department of the Army, Field Manual (FM) 3-0, *Operations*, (Washington, DC: Government Printing Office, 2017), 1-10.

support to close areas. The rapid build-up of transportation infrastructure in Central Europe in the 1970s enabled the actions identified in both Active Defense and later AirLand Battle.

The Current Gap in Infrastructure Capability

The rate of infrastructure development within NATO member nations in Central and Eastern Europe diminishes the ability of the Joint Force to penetrate and exploit the standoff generated by Russia. The general lack of available road and rail networks in what were previously nations within the Warsaw Pact limit the dispersion and concentration required on the modern battlefield. Increasingly weighty armored formations further complicate the issue of route of advance availability from the support to the close areas. The issue originated when the US and Soviet Armies rapidly increased the weight of armored formations to offset each other during the Cold War.

From 1961 until the introduction of the M1 Abrams in the 1970s the US Army relied on the M60-series as its Main Battle Tank. NATO defense planners used armored platforms like the M60 to gauge the capability of bridge and rail networks and worked with civilians engineers to ensure future transportation infrastructure would support its weight.[17] The M60 and its successor the M1 Abrams both increased by twenty-five percent in weight just twenty years after their introduction in an effort to increase survivability.[18]

The M1 Abrams continues to increase in weight with the implementation of the M1A2 System Enhancement Program (SEP) Version 3 to 73.2 tons in Fiscal Year 2020.[19] A net increase in weight of over thirty-five percent from the introduction of the M1 in 1975. The increasing

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[17] Thomas Zeller, *Driving Germany: The Landscape of the German Autobahn, 1930-1970* (New York, NY: Berghahn Books, 2007), 181.

[18] Timothy P. Clapp and Joseph F. Cassidy, *Historic Weight Growth of US Army Combat Vehicle Systems* (Newport News, VA: Military Traffic Management Command Transportation Engineering Agency, 2002), 8.

[19] US Department of the Army, "Abrams Tank Upgrade," *asc.army.mil*, accessed February 13, 2020, https://asc.army.mil/ web/portfolio-item/gcs-m1-abrams-main-battle-tank/.

weight of armored platforms in NATO places further strain on the already limited capability of transportation networks in Central and Eastern Europe. Russia, the most significant NATO competitor in the region, takes a different approach to survivability as it continues to develop much light main battle tanks with the T-14 Armata projected at around fifty tons significantly lighter than the US M1 tank.[20] Without the infrastructure to hold the growing weight of armored formations, the US and NATO members are at a relative disadvantage in projecting ground forces into Poland and Baltic states. The European Union, outside of the institution of NATO, recognizes the strategic significance of this relative disadvantage and the security dilemma it faces.

The European Union created the Permanent Structured Cooperation (PESCO) in 2017 to coordinate security and defense policy. PESCO conducted an initial assessment of transportation infrastructure in the Baltic nations and found that in general "the maximum height clearance of road bridges, as well as the weigh tolerance of certain bridges, is not sufficient for oversized of over-weighted military vehicles." The assessment found similar shortfalls in rail capability within the Baltic States to support oversized military equipment.[21] Much of the transportation infrastructure in Europe completed after the conclusion of the Cold War was built to support civilian requirements.[22] The EU maintains the current status of road and rail networks across the continent to broadcast these deficiencies.

The EU Trans-European Transport Network (TENtec or TEN-T) maps reveal the current distribution of transportation infrastructure in Europe. The database represents present and future

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[20] Stefan Bühler, "The T-14 Armata from a Technical Point of View," *The Future of Rising Operations*, April 17, 2018, accessed February 13, 2020, https://www.offiziere.ch/?p=33534.

[21] High Representative of the Union for Foreign Affairs and Security Policy, "Joint Communication to the European Parliament and the Council on the Action Plan on Military Mobility," (Brussels, BE: European Commission, 2018), 4.

[22] Tania Latici, *At a Glance: Military Mobility* (Brussels, Belgium: European Parliamentary Research Service, 2019), 2.

upgrades to the network but reveals the current gap in dispersion deemed essential in US Army concepts and doctrine. Western Germany has ten "core" road networks with less than 100 kilometers of separation between each as compared with Poland with three core road networks and almost 250 kilometers between each.[23] Economic and military policies instituted after WWII are directly responsible for robust transportation networks in western Germany and are discussed later in the historical analysis section. According to the EU, road and rail networks in Poland and the Baltics remain unable to project heavy military equipment at a large scale. NATO, working parallel to PESCO and the EU, also find capability gaps in these infrastructure networks.

NATO established the Joint Support and Enabling Command (JSEC) in 2019 to assess and assure the movement of follow-on forces across Europe.[24] Ground mobility remains one of the priorities for the new command with road and bridge weight-bearing capacity its greatest limitation in infrastructure.[25] NATO forces will test ground mobility in Central and Eastern Europe in the upcoming Defender 20 exercise. Defender 20 will see the deployment of a US Army Division to Europe to test feasibility of rapidly deploying a large organization overseas. The exercise will test the aging roads, bridges, and bases built in Warsaw Pact nations that were designed to support Soviet forces. Soviet logistical support was "austere" compared to the US standards of supply and sustainment.[26] Defender 20 will likely highlight the need for greater

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[23] European Commission, "Core Network Corridors on the TEN-T," *Mobility and Transport*, January 21, 2020, accessed February 13, 2020, https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/maps.html.

[24] Joint Security Enabling Command "NATO's New Joint Support and Enabling Command Declares Initial Operational Capability," *Joint Support and Enabling Command*, September 18, 2019, accessed February 13, 2020, https://jsec.nato.int/newsroom/news-releases/natos-new-joint-support-and-enabling-command-declares-initial-operational-capability.

[25] Marta Kepe, "Military Mobility Returns to the Forefront in Europe," *NATO Priorities*, June 25, 2018, accessed August 25, 2019, https://www.defensenews.com/smr/nato-priorities/2018/06/25/military-mobility-returns-to-the-forefront-in-europe/.

[26] Syndey J. Freedberg, "Poland Deal Lays Ground Work for Division-Strength Deployment," *Allies, Land Warfare*, June 13, 2019, accessed February 13, 2020, https://breakingdefense.com /2019/06/poland-deal-lays-groundwork-for-division-strength-deployment/.

infrastructure development as well other challenges.

The US Army and NATO train and equip themselves to overcome obstacles like rivers by conducting wet-gap crossings with tactical bridging equipment. Though NATO maintains some ability to cross forces over rivers it does not have "enough capacity available to emplace one doctrinal crossing of a 400-meter wet gap by an Armored Brigade."[27] This capability shortfall is exacerbated by the presence of six major rivers with average gaps over 300 meters within the region.[28] The US and NATO face significant obstacles in projecting large-scale organizations outlined in the MDO concept as well as contemporary US doctrine.

At present, the US does not have a cogent international strategy for infrastructure development which further complicates combat power projection abroad. Much of the US effort shifted away from the development of roads and rail abroad over concerns that recipient nations could not repay or maintain completed projects.[29] In many cases though, the critical limitation is not funding for infrastructure but the "shortage of projects that have been planned and prepared to the point where they are ready for investment."[30] Planning and preparing projects requires engineering expertise that many nations in Eastern Europe lack. Many nations in Europe need the "technical capacity to select and implement complex projects" to upgrade and build new transportation infrastructure.[31]

At its current state, transportation infrastructure in Poland and other nations in Eastern

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[27] United States Army Corps of Engineers, "The Art, Challenge, and Science of River Crossing," produced by the Office of the Chief of Public Affairs, *2019 AUSA Warriors Corner*, October 16, 2019, accessed February 13, 2020, video, https://www.dvidshub. net/video/715437/2019-ausa-warriors-corner-art-science-and-challenges-river-crossing-usace.

[28] Ibid.

[29] Daniel F. Runde, Conor M. Savoy, and Charles F. Rice, *Global Infrastructure Development: A Strategic Approach to US Leadership* (Washington, DC: Center for Strategic and International Studies, 2016), vi.

[30] Ibid.

[31] The European Investment Bank, *Investment Report 2018/2019: Retooling Europe's Economy* (Kirchberg, LU: European Investment Bank, 2018), 11.

Europe do not support the requirements outlined in future US Army concepts or current doctrine. This deficit poses an unnecessary risk to NATO's mission and forces in the region. In the past, NATO and the US Army faced a similar problem in the aftermath of WWII with force projection in Europe. Transportation infrastructure was heavily damaged, and nations were at a standstill until critical repairs were made on rail and road networks.

Historical Analysis

After the defeat of Germany, the War Department, later the National Military Establishment and Department of Defense, led efforts to improve and create transportation infrastructure in Europe. The following analysis encompasses infrastructure improvements sponsored primarily by the United States but with assistance from allies from 1945 to 1989 in Central Europe. This period offers prescient insight into how the US and European allies worked together to thwart aggression and offers valuable lessons for the contemporary operational environment and MDO. At the conclusion of World War II, relentless infrastructure development aided in operational and strategic efforts in preventing another world war and deterring Soviet Union expansion in Europe. The subsequent analysis incorporates three distinct models of infrastructure improvement that emerge during this period: pre-Marshall Plan (1945-1947), the Marshall Plan (European Recovery Program 1948-1952), and economic infrastructure improvements until the late 1980s.

The impetus for the creation of transportation infrastructure increased significantly after 1945. The United States began their effort immediately after the Nazi capitulation with the aim to repair and replace pre-existing roads, bridges, and railways within Germany.[32] American aims transitioned considerably after the discovery that the USSR possessed nuclear weapons and again after the North Korean invasion of South Korea. As infrastructure improved in Europe, US Army

[32] Robert P. Grathwol and Donita M. Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991* (Washington DC: Center of Military History and Corp of Engineers, 2005), 25.

doctrine exploited the evolving strategic landscape and the exponential growth in lethality within armor systems. US Army doctrine developed in the 1970s leveraged the exponential growth of roads and bridges in Western Europe as compared with the meager Soviet advancement in infrastructure providing a critical operational advantage for NATO forces. The US effectively diminished the layer of standoff generated by Soviet forces on the border between democratic and communist nations. The origins of this advantage began with the Allied occupation of Germany and the repair of war damage.

The Economic Model: German Recovery 1945-1947

Following World War II much of German critical economic infrastructure lay in ruins. Over seventy five percent of the critical bridges across the country were destroyed severely hampering population movement and the potential for economic growth.[33] As a result of its degraded infrastructure, German industrial output by many measures was next to zero further exacerbating recovery efforts.[34] The leader of the American occupation forces after 1945, General Lucius Clay, understood the need for German economic recovery and began infrastructure repair and improvement immediately after assuming command. The majority of infrastructure repair in West Germany occurred during this first model (1945-1947). The primary aim of the repair was economic enhancement, but this effort directly enabled the operational advantage of NATO forces in the future.

During this period US political leaders on the other side of the Atlantic, as a reflection of their domestic base, held little sympathy for a defeated Germany though their people faced significant hardships amidst a war-torn landscape. Joint Chiefs of Staff (JCS) Directive 1067 captured these sentiments on behalf of the Departments of State, War, and Treasury outlining the

[33] Grathwol and Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991*, 7.

[34] John Killick, *The United States and European Reconstruction, 1945 – 1960* (Chicago, IL: Fitzroy Dearborn Publishers, 1997), 61.

policy for the military occupation of Germany. The directive paradoxically outlined General Clay's responsibility to both punish and relieve destitution only to the extent that aid prevented disease and unrest.[35] General Clay believed that the retaliatory and contradictory nature of JCS 1067 exhibited the disconnect between leaders in Washington DC and the new reality Germans now faced.

Prior to Clay's assumption of command, the Potsdam Conference in the summer of 1945 highlighted the interests of the other allied nations amongst US concerns. British, French, and American members all agreed to retribution, de-Nazification, de-militarization and to maintain responsibility of zones within western Germany.[36] This was a significant and fortunate departure from the Morgenthau Plan before the World War II concluded. That plan sought to gut Germany's industrial capacity in its entirety and in turn to boost the output of Britain and France. The plan sought to transform Germany into agrarian and pastoral nation which would inhibit the repair and construction of economic infrastructure. The European Allies wanted to ensure, amid economic competition aims, that Germany remained industrially stunted to preclude any future attempt to militarize. The Allies gradually began to understand that post-war Germany needed its economy to enable a successful recovery and that de-industrialization would lead to unnecessary suffering.[37] Continued pursuit of this policy would have drastically hindered economic infrastructure development in Germany and as a consequence limit the future deterrence of Soviet aggression just thirty years later.

As a result of the rejection of the Morgenthau Plan, the US government authorized over $670 million in credit and loans during the period of the economic model to achieve an acceptable level of recovery in Germany.[38] This funding enabled the War Department to establish

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[35] Jean E. Smith, *Lucius D. Clay: an American Life* (New York: Henry Holt and Company), 202.

[36] Killick, *The United States and European Reconstruction, 1945 – 1960*, 52.

[37] Ibid, 51.

[38] Ibid, 45.

peace within the US zone of occupation through the repair and construction of infrastructure. The funding also supported the Department of State in its task to distribute, at no cost to the beneficiary, much needed German coal to the rest of Europe as other nations sought to recover from the war. General Clay decided to dramatically increase the level of reconstruction and even to improve infrastructure in an effort to export more coal which some perceived as a breach of the limitations JCS 1067 outlined.[39]

As a result of the funding through the War Department and General Clay's initiative, West Germany swiftly rebuilt its economic infrastructure. These infrastructure improvements, combined with effective economic policies, boosted the industrialization of Germany. Over 700 of the critical bridges in West Germany were repaired and improved with additional capacity for economic transportation as well as 96% of all railways like those in Figure 2..[40] The rapid and effective repair of infrastructure enabled a hobbled Germany to begin its integration back into European trade and markets. Germany's return to European and international economic systems began to slowly loosen reliance on its military occupiers for subsistence. Though limited, the gradual move towards West German independence and unification reassured US Army planners who were balancing the military presence in Europe amidst the growing demand for the return of American soldiers..[41] The US Army, amongst construction priorities, remained in Germany primarily for constabulary and peace efforts.

[39] Killick, *The United States and European Reconstruction, 1945 – 1960*, 61.

[40] Grathwol and Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991*, 7.

[41] Benn Steil, *The Marshall Plan: Dawn of the Cold War* (New York: Simon and Schuster Paperbacks, 2018), 20.

Figure 2. April 1945: US Engineers repair a critical railway bridge that linked Germany and Belgium. Source: Robert P. Grathwol and Donita M. Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991* (Washington DC: Center of Military History and Corp of Engineers, 2005), 25.

The US government did not immediately burden its military with deterrence in the later part of 1945 and 1946 as a result of the newly won peace. There was no sizable conventional threat to distract the military from its intended purpose in Europe, to relieve populations from the ravages of war and initiate a path for US withdrawal. President Roosevelt promised that all US troops would return from Europe after the conclusion of hostilities. Additionally, strategic planners accepted risk in a hollowing of the conventional force as the US briefly held a monopoly on the use of the atomic bomb.[42] As a result of these drivers and the demobilization focus for the military, there was little substantive change in Army doctrine during this model of infrastructure development.[43] The Soviet Union shared many of the same concerns its allies the UK, US and France had immediately after World War II though the government responded to the crisis in a

[42] Kenneth Anderson, *History of US Military Operations Since World War II* (New York: Brompton Books Corp, 1984), 10.

[43] Leo J. Daugherty, "Un-preparing for War: US Army Combat Training Doctrine 1945-1950," *History.army.mil*, accessed January 17, 2020, https://history.army.mil/events/ahts2015/presentations/seminar2/sem2_DrLeoDaugherty_UnpreparingForWar.pdf.

different manner regarding its infrastructure.

Joseph Stalin, then the political leader of the Soviet Union, was primarily concerned with establishing a buffer state in Germany and Poland to prevent future European aggression into Russia.[44] Soviet leaders learned the value of oil to an industrial wartime economy as it critically increased its petroleum reserves after assuming jurisdiction of Poland, Romania, and Hungary.[45] Though the Soviet Union strove to ensure political unity with East Germany, its leaders did not provide the same guidance and resources to repair its infrastructure. Some of the road, bridge, and rail systems were eventually repaired but many were not improved until the 1970s.[46] The dramatic disparity in infrastructure development in East German directly influenced the operational environment for the Soviet Union decades later. The lack of mature and modern East German infrastructure in the 1970s yielded a decisive advantage the US and NATO leveraged until the fall of the Berlin Wall. The Department of Defense recently (2003 to 2012) applied a similar economic benefit model in Iraq for infrastructure development but with dramatically different results.

It is important to distinguish the difference in policies applied in Iraq in 2003 and in Germany after 1945 to better understand the future employment of the economic benefit model for infrastructure development. The most significant difference in the political contexts of these two periods was the designated purpose of transportation infrastructure development. General Clay and the War Department after World War II sought to prevent the mass starvation of German citizens through aggressive improvements in road and bridge capacity. A growing economy would limit starvation and instability in West Germany which would lead to growing

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[44] Steil, *The Marshall Plan: Dawn of the Cold War*, 23.

[45] Kenneth Anderson, *History of US Military Operations Since World War II*, 15.

[46] Crosbie E. Saint, "The Fulda Gap: A Personal Perspective from Platoon Leader to Army Group," in *Fulda Gap: Battlefield of the Cold War Alliances*, ed. Dieter Krüger and Volker Bausch (New York: Lexington Books, 2018), 150.

Soviet influence amidst a relatively secure environment. In the contemporary example, the Department of Defense aimed to decrease growing violence in Iraq through direct investment to economic infrastructure amidst an increasing unstable operational environment.[47] Investment in the repair of existing roads and bridges as well as the development of new infrastructure and security programs totaled over $60 billion during the period of 2003 to 2012.[48] A majority of this funding, $27.3 billion, went to security efforts with only $11.9 billion going directly to infrastructure programs.[49]

The substantial funding of security programs to support reconstruction in Iraq highlights a critical difference in political concerns and the stability of Germany after 1945. The immediate results of economic infrastructure investment in Germany were commercial growth and stabilization amidst an overall decline in violence after the dismantlement of the Germany military industrial apparatus.[50] The Government of Iraq experienced the opposite effect after the completion of transportation infrastructure projects with a rapid decline in security and stability. These results were due in part to rampant corruption amongst construction firms hired to complete projects and the insurgent exploitation of expanding road networks to spread violence across Iraq.[51] The significant difference in outcomes from the US experience in Germany and later Iraq emphasize the importance of security during infrastructure development. Lessons from road construction in Iraq further highlight the critical timing of infrastructure development and

[47] Tamar Gomez, "Highways to Hell are Paved with Good Intentions: Road Building and Violence in Iraq," (London, UK: Imperial College London, 2018), 20.

[48] Special Inspector General for Iraq Reconstruction (SIGIR), "Final Report to the United States Congress," (Arlington, VA: Office of the Special Inspector General for Iraq Reconstruction, 2013), vi.

[49] Gomez, "Highways to Hell are Paved with Good Intentions: Road Building and Violence in Iraq," 9.

[50] Lucius D. Clay, *Decision in Germany* (Garden City, NY: Doubleday and Company Inc, 1950), 318.

[51] Gomez, "Highways to Hell are Paved with Good Intentions: Road Building and Violence in Iraq,' 16.

that the economic development model is most effectively leveraged during periods of relative peace.

Poland and the Baltic states in Eastern Europe, are in a period of peace and stability conducive to effective economic infrastructure development. The Polish economy, as the largest industrial power in Central Europe, would greatly benefit from the infusion of investment in roads and bridges.[52] Additionally, infrastructure in Poland would require minimal repair and its leaders have already identified the economic need for the expansion of infrastructure to enhance the mobility of goods and services.[53] The US Department of Defense, like the War Department after World War II, could provide operational mobility guidance alongside Polish and Baltic political leaders in an effort to develop dual-use infrastructure. This new infrastructure would enable the continued economic growth of allies in the region while bolstering NATO deterrence efforts via the extension of the operational reach of armored formations.

The economic enhancement model practiced from 1945 to 1947 sought to relieve civilians from the hardships of war through investment in transportation infrastructure. This policy continued after 1947 but during a dramatically changing strategic context. The relationship of the United States and the Soviet Union continued to falter and clear indicators for conflict and even a future world war began to emerge. Through this transformation, the US headed the European Recovery Program (also known as the Marshall Plan) in 1948 and Europe witnessed the birth of the North Atlantic Treaty Organization in 1949.[54] The aim of US policy transitioned to containment of communism and its means expanded to include additional military capacity on top of economic development in Europe. The Military Model in the next section introduces the US

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[52] Peter Zeihan, *The Accidental Super Power* (New York: Twelve Hachette Book Group, 2014), 246.

[53] The International Bank for Reconstruction and Development and the World Bank, "Urban Mobility in Eastern Poland: The Way Forward," (Washington, DC: World Bank Group, 2015), 5.

[54] North Atlantic Treaty Organization, "Founding Treaty," North Atlantic Treaty Organization, accessed January 26, 2020, https://www.nato.int/cps/en/natolive/topics_67656.htm.

Department of Defense support military mobility through infrastructure development in Europe.

The Military Model: The Marshall Plan and NATO 1948-1952

The critical relationship among the World War II allies, deteriorated in 1948 at least in part because of the ongoing quadripartite (US, UK, French, and Soviet) supervision of Germany and whether the country would be unified and eventually free.[55] Prior to the fallout with the Soviet Union, the economic infrastructure repair led by the US War Department, and later the National Military Establishment, largely completed their task to repair and construct transportation infrastructure in West Germany.[56] Most of the economies of western Europe, especially Germany, were no longer constrained by damaged railways, roads and bridges and governments were eager for growth. The US government answered both the indecision over the fate of Germany as well as the need for further economic stimulus with the European Recovery Program (ERP) or Marshall Plan on April 3rd, 1948.[57] As the strategic relationship with the Soviet Union evolved into a Cold War, however, it became clear to leaders in the United States that economic programs alone would not deter aggression.

The original intent of the Marshall Plan was to seek "peace and stability for free men in a free world…by economic rather than military means."[58] The Marshall Plan funded the shipment of essential goods such as food, fuel, equipment and vehicles for much of western Europe in the effort to protect fragile democratic nations from communist aggression.[59] US policymakers believed that countries recently freed from totalitarian rule, like West Germany, were susceptible to Soviet influence and protecting newly found democracy could stave off another world war.

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[55] Clay, *Decision in Germany,* 344.

[56] Steil, *The Marshall Plan: Dawn of the Cold War*, 569.

[57] Ibid, 260.

[58] Ibid, 248.

[59] Steil, *The Marshall Plan: Dawn of the Cold War*, 263.

These critical shipments under the ERP enabled the collaboration of nations that would later form NATO.[60] The Marshall Plan, though initially designated primarily for economic aid, later included controversial provisions for military assistance to be administered through the newly ratified NATO.[61]

While President Truman signed the Marshall Plan, Berlin became the new frontline of the failing Soviet-US relationship. What began as a negotiation over the monetary currency for Berlin, a zone shared then by all of the quadripartite nations, quickly devolved into a Soviet blockade. The Soviet blockade halted food shipments and even electricity to the population in West Berlin creating a perilous situation and forcing the US to react.[62] Under the command of the General Clay, the Berlin Airlift relieved the population of West Berlin until the Soviets lifted the siege almost a year later. The showdown tested and firmed US resolve and brinkmanship in its commitment to West Germany and Europe. Though a tactical success, the blockade revealed several shortfalls in the US strategy to protect several fledgling democratic economies. The Truman administration believed the only definite way to break the blockade was with military means but fear of escalation and even concern of the US military ability to succeed in large-scale combat discouraged this option.[63] After the Soviets lifted the siege of Berlin, Washington decided to supplement economic stimulus with military development as the Berlin Airlift confrontation had forever changed US policy in Europe.

After the conclusion of the Berlin Airlift in 1949, the US developed another stimulus package but with the aim to support the militaries of the newly formed NATO as well as other European nations. The Military Assistance Program (MAP) began in 1949 with almost $1 billion

[60] Ibid, xiv.

[61] Steil, *The Marshall Plan: Dawn of the Cold War,* 260.

[62] Steil, *The Marshall Plan: Dawn of the Cold War,* 273.

[63] Ibid, 277.

(c. $11 billion in 2020) in funding.[64] Unlike the Marshall Plan from a year earlier, this program sought to increase the military readiness of Western and Central European nations to deter further Soviet aggression.

The conflict in Berlin revealed the vulnerability of ports and lines of communication along roads and bridges from northern Germany. The US military assessed the freshly repaired economic infrastructure as "untenable" in the event a war broke out with Communist forces in the east.[65] With funding for MAP secured from the US government, the National Military Establishment outlined the need for a new logistical system along transportation infrastructure in France and West Germany. The current state of roads and bridges in France were deemed ill-suited to enable the massive buildup of American forces needed if forces from the USSR invaded Western Europe.[66] The US and its European Allies realized that infrastructure built to suit a budding economy now needed to grow even further to meet the demands of NATO and its partners.

Existing transportation infrastructure in Europe was unable to support a buildup of US forces. This fundamentally undermined the credibility of America's new deterrence efforts.[67] To rectify this strategic deficiency, US defense planners outlined a proposal to build a series of transportation networks and lines of communication from the west coast of France to military forces in West Germany as depicted in Figure 3. The new construction included the improvement and development of rail lines, waterways, airway, highways, and oil pipelines. Although, planners met resistance from French politicians, the French eventually agreed to some construction but severely restricted US military presence in France. French policymakers feared that their

[64] Lawrence S. Kaplan, "A Community of Interests: NATO and the Military Assistance Program, 1948-1951" (Washington, DC: Office of the Secretary of Defense, 1980), 47.

[65] Grathwol and Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991*, 84.

[66] Grathwol and Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991*, 86.

[67] Carter, *Forging the Shield: the US Army in Europe, 1951-1962*, 1.

population and the French Communist Party would reject new construction for military means and the buildup of another foreign power on their soil. The US and France both conceded that construction would commence, but French contractors would complete all of the infrastructure with US defense members providing appropriate specifications for military equipment.[68]

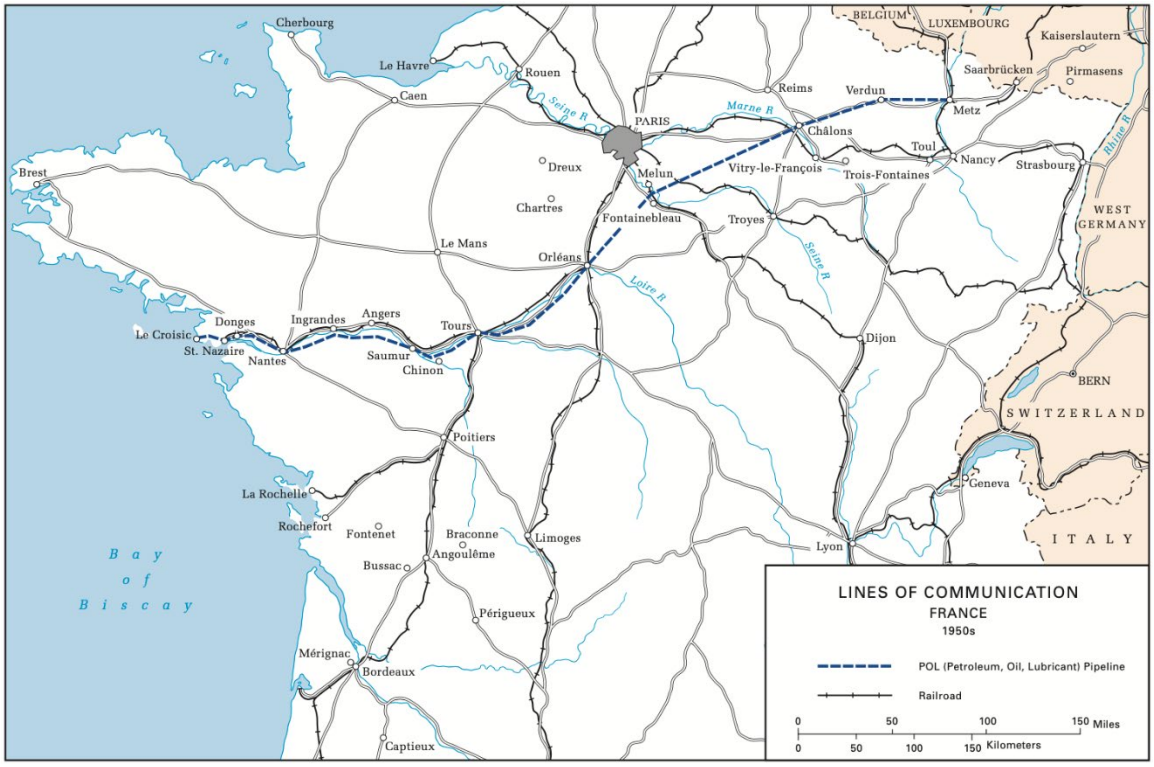

Figure 3. The plan for new lines of communication across France to support the US military in West Germany. Source: Robert P. Grathwol and Donita M. Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991* (Washington DC: Center of Military History and Corp of Engineers, 2005), 87.

Defense construction supervisors quickly realized that building infrastructure in France would prove to be more difficult than anticipated. The US Army attributed delays to language barriers, a lack of heavy construction equipment, the inexperience of French construction teams for large projects, and a stifling bureaucracy on both US and French ends.[69] In addition to the

[68] Grathwol and Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991*, 86.

[69] Grathwol and Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991*, 89.

difficulties faced in France, the burgeoning engineering demands from the Korean War further strained US military. By April 1952, the half-billion-dollar construction program in France was only partially complete.[70] The construction experience from 1948 to 1952 in France and much of western Europe offers valuable insight into a military model for future transportation infrastructure development.

The restrictions placed on the US military footprint in France severely hampered the progress of the lines of communication. The construction of this critical infrastructure failed to meet the timeline requested by US defense strategists with much of the projects completed almost a decade later in 1958.[71] Though military projects were amply funded, contractors and the French population were generally more supportive of construction that would directly enhance the economic potential of local and regional businesses.

Construction delays in France aside, West German infrastructure afforded the commander of the Seventh Army in Europe in 1951, General Manton S. Eddy, flexibility in determining his operational approach and offered his forces a distinct relative advantage over Soviet aligned forces in East Germany. General Eddy included valuable lessons about contemporary combat emerging from the Korean War into his formations.[72] Eddy and his staff acknowledged that they faced a numerically superior Soviet army and adopted a mobile defense to delay a potential attack. A mobile defense, as opposed to the traditional fixed defense, was more reliant on the superior transportation infrastructure repaired and improved in West Germany since World War II. Additionally, the limited war in Korea shattered the ideological notion that conflict between major powers after World War II could not only occur but escalate to a costly measure even without nuclear weapons.[73] This realization heightened the need for continuing the

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[70] Ibid, 91.

[71] Grathwol and Moorhus, *Building for Peace: U.S. Army Engineers in Europe, 1945-1991*, 119.

[72] Carter, *Forging the Shield: the US Army in Europe, 1951-1962*, 44.

[73] Bernard Brodie, *Strategy in the Missile Age* (Princeton, NJ: Princeton University Press, 1965),

development of roads and bridges in western and Central Europe but reframing the approach to accomplish it.

Future use of the military model for infrastructure development should incorporate dual military-economic considerations and ultimately the political support for large scale projects. Citizens housed near military infrastructure are likely to understand the significance of a road or bridge built for military purposes. Their acceptance of costlier more robust transportation infrastructure necessitates a transparency in its intent. Without the buy-in of local leaders and their commitment to the urgency of construction, prospective road and bridge development in contemporary Central Europe may be relegated to the pace of building military infrastructure in France from 1949 to 1952. US Army leaders, amidst efforts to build key infrastructure, were also focused the operational doctrine need to suppress a Soviet attack into West Germany.

The Unified Model: Building Modern Europe 1953-1989

The Unified Model for infrastructure development effectively incorporates aspects of both the economic and military models. This model built on the success and lessons of the previous models amidst the backdrop of escalating tensions between the US and the Soviet Union and the massive economic boom of the 1970s in Western and Central Europe. The Unified Model saw the greatest amount of transportation infrastructure development in the decade following the Marshall Plan spurred on by newly economically empowered nations. As a result of economic growth, NATO members and partners were increasingly able to provide funding for their own defense and rely less on the United States. The rapid development of economic infrastructure amongst NATO members outpaced that of the newly ratified Warsaw Pact nations. This pace of construction proved critical in the ultimate collapse of the Soviet Union and the unification of Germany. The acute transition in US strategy after the Korean War provides insight into the context of infrastructure construction in Europe.

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US grand strategy shortly after WWII through the Korean War saw the evolution of containment efforts to stem the growth of communism with special emphasis on Europe. The belief that the gradual loss of Europe to a single hegemon stoked fears of another world war, one in which the US fought diligently to prevent after the collapse of the Third Reich. The Korean War revealed that conventional forces remain relevant during an era dominated by nuclear deterrence policies like the "New Look."[74] President Eisenhower's administration developed the New Look shortly after the armistice in Korea. Eisenhower believed that the armistice was in part a result of the US threat to use nuclear weapons against North Korea and as result sought to increase the development of nuclear delivery capabilities. This policy dramatically changed the requirements of NATO forces in Europe as the New Look also shifted more of the burden for funding on alliance members enabling the US to balance its budget.

As a result of policies like the New Look, the NATO military committee adopted the military strategy of "Massive Retaliation" in 1954.[75] Massive Retaliation was an effort to deter any degree of aggression with the threat of US nuclear response. This military strategy left a calculated response difficult from the Soviet perspective and dangerously limited the options of NATO commanders when faced with conflict. Nuclear brinksmanship through Massive Retaliation proved difficult at the political level, but this military strategy enabled the growing independence of NATO members as the US continued to retract from its former position with policies like the European Recovery Plan. This newfound independence enabled the growth of national institutions and bureaucracy within countries like West Germany (officially independent in 1955) that would later prove vital to the massive growth of transportation infrastructure.[76] After nearly a decade as a national policy, Massive Retaliation and the NATO military strategy

[74] Tomes, *US Defense Strategy From Vietnam to Operation Iraqi Freedom*, 40.

[75] Ibid, 41.

[76] Zeller, *Driving Germany: The Landscape of the German Autobahn, 1930-1970*, 181.

continued to evolve following the Eisenhower administration.

President Kennedy's administration introduced "Flexible Response" in 1962 as an answer to the inherent risk and the limited military options with Massive Retaliation.[77] Flexible Response expanded the array of military options to include a conventional (ground forces) response in addition to nuclear retaliation. This new policy highlighted deficiencies in the readiness and modernization of US and NATO conventional forces as compared with Soviet competitors.[78] As conventional forces emerged as an option for deterrence, defense planners were concerned that US Army division needed additional firepower and mobility to meet the military requirements of Flexible Response.[79] The US Army fielded new armored capabilities and redesigned the structure of its divisions to adapt to its operational environment. Modernized NATO forces increasingly relied on the mobility offered by advanced transportation infrastructure even as the concept of the defense of West Germany itself underwent change.

Growing western European economic independence wrought through polices like the New Look had considerable influence on the NATO plan to defend against aggression. The US and NATO acted on the shift of US policy through the construction of new airfields and barracks in Germany and Europe.[80] In West Germany, the population and its elected officials were concerned that the NATO plan to withdraw to the Rhine River yielded too much territory to the Soviet Union. To prevent the loss of most of its territory, West German defense officials began to construct cantonment areas for its army much further east securing a larger amount of land. Many West German divisions were now within seventy miles of the border with East Germany and the Soviet Bloc.[81] The expansion and resolution of NATO and West German forces to defend further

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[77] Tomes, *US Defense Strategy From Vietnam to Operation Iraqi Freedom*, 46.

[78] Tomes, *US Defense Strategy From Vietnam to Operation Iraqi Freedom*, 46.

[79] Carter, *Forging the Shield: the US Army in Europe, 1951-1962*, 440.

[80] NATO Security Investment Programme, *50 Years of Infrastructure* (Brussels, Belgium: Infrastructure Committee, 2001), 21.

[81] Carter, *Forging the Shield: the US Army in Europe, 1951-1962*, 435.

east through newly built bases heightened the demand for transportation infrastructure within Germany.

The growing demand for roads and bridges fell to the fledgling Federal Republic of Germany (FRG) government for funding and construction. The Economic and Military Models for transportation infrastructure were no longer viable as the FRG stood as an independent nation no longer under the occupation of the allies. The previous models were only viable through funding furnished by the United States, a country that now turned its focus and stimulus on rebuilding its own conventional forces. The Federal Republic introduced a model that incorporated both the economic benefits of infrastructure development and the growing military need for roads and bridges for new armored formations. The Unified Model enabled the rapid growth in infrastructure needed to meet the demands of deterrence through more conventional means.

The Unified Model leveraged the growing economy of the FRG to fund the requirement for larger road networks. The economic boom in West Germany was due in large part to the policies introduced in the Economic Model as evidenced by the much slower rate of growth in the German Democratic Republic (GDR) on the opposing side of the border. The rate of economic transportation development is measured through ratio known as "mass motorization." Mass motorization is held as a 10:1 ratio for inhabitants to automobiles within a population. The Federal Republic quickly reached the state of mass motorization by 1961 and matched Great Britain and France by 1970.[82] The mass motorization of West Germany enabled its government to leverage a fuel oil tax to cover the costs of its enlarging road and bridge network. The increasing rate of transportation infrastructure development, though spurred on by economic demand, was distributed and controlled through the government of the Federal Republic and military planners in Bonn.

[82] Zeller, *Driving Germany: The Landscape of the German Autobahn, 1930-1970*, 184.

The West German army, the Bundeswehr, and NATO oversaw the construction of new barracks and cantonment areas that met the demands of the policy to shift their defense of the Federal Republic further east. In addition to military base construction, Bundeswehr planners also reviewed and approved the development of new transportation networks within West Germany to meet emerging security requirements. The military was systematically involved in the planning of new major roads to include the development of landing strips on the Autobahn throughout the country. These landing strips were roughly three kilometers in length and were a contingency option for pilots in the event that tensions between NATO and the Warsaw Pact escalated into war. By 1968, the Federal Republic completed six of these airstrips and planned to build at least fourteen more.[83] NATO later validated the utility of these airstrips in 1984 during a joint exercise that included the landing of large Hercules transport aircraft, Tornado jets, and A-10 Thunderbolts.[84] The military oversight of transportation infrastructure in West Germany granted the Bundeswehr a distinct advantage in mobility against the Soviet Bloc in the event that conflict returned to Central Europe. Department of Defense planners in the US, like defense planners in Bonn, also recognized the utility of mobility on a national level.

Legislators in the US passed the National System of Interstate and Defense Highways in 1956 in part to satisfy military requirements in the event of another world war.[85] The Department of Defense recognized the importance of operational mobility within the US and identified a gap in national mobilization capability. The interstate and highway act of 1956 allotted over $100 billion (c. $1 trillion today) to build a network of transportation infrastructure linking cities within

[83] Zeller, *Driving Germany: The Landscape of the German Autobahn, 1930-1970*, 184.

[84] Benedict Brook, "Secret Military Airfields are Hiding in Plain Sight," *New York Post*, April 17, 2017, accessed February 14, 2020, https://nypost.com/2017/04/17/secret-military-airfields-are-hiding-in-plain-sight/.

[85] Federal Highway Administration, "Interstate Highway System," *Highway History*, accessed February 14, 2020, https://www.fhwa.dot.gov/interstate/interstatemyths.cfm.

the US that had a population of 50,000 or greater.[86] The new US interstate system was set for completion by 1970 and drew most of its funding from a national gas tax collected by the Highway Trust Fund like the system instituted in West Germany.[87] Legislators and defense planners in both the US and West Germany recognized the importance of operational mobility amidst escalating tensions with the Soviet Union and both identified similar methods to generate development within their countries. The Federal Republic and the US both exploited the benefits of their growing economies to construct dual (military and economic) transportation infrastructure using the Unified Model.

The Unified Model of infrastructure development enables an efficient and effective system for the construction of dual use roads and bridges that satisfy both national economic and military requirements. NATO defense planners in West Germany benefited extensively from the new transportation networks in the 1970s as evidenced in their plans to defend against a potential breakthrough of Soviet forces towards the Rhine.[88] Robust transportation networks in the FRG enabled the rapid withdrawal of civilians in the event of an invasion as well as the operational mobility of NATO forces to defend the border. The modernized transportation network in West Germany also empowered the Bundeswehr and US forces to maximize their dispersion within the country. This dispersion was deemed essential for forces that faced the threat of nuclear weapons in addition to the conventional threat of armored Soviet formations.[89] The use of the Unified Model in West Germany satisfied the operational requirements of US and NATO forces and decisively outpaced the Soviet rate of production in the German Democratic Republic (GDR).

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[86] Smith, *Lucius D. Clay: an American Life*, 620. Conversion to real 2020 values incorporated inflation rates outlined by the US Bureau of Labor and Statistics available at: https://data.bls.gov/.

[87] Ibid, 620.

[88] East German Ministry of State Security, "East German Ministry of State Security, 'US and NATO Military Planning on Mission of V Corps/US Army During Crises and in Wartime,' (excerpt)," *History and Public Policy Program Digital Archive*, December 16, 1982, accessed February 14, 2020, http://digitalarchive.wilsoncenter.org/document/ 112680.

[89] Saint, "The Fulda Gap: A Personal Perspective from Platoon Leader to Army Group," 146.

The success in transportation infrastructure development was so effective in the FRG that it assisted US defense planners in the development of Active Defense doctrine introduced in 1976.

The Fulda Gap in West Germany served as one of many testing sites that aided in the development of the new Active Defense doctrine.[90] The Fulda Gap was the name given to a salient in the boundary between the FRG and GDR that NATO considered a vulnerability. A Soviet incursion through the gap would split West Germany in half.[91] Modernized road networks in the Fulda Gap and throughout West Germany enabled the operational reality envisioned within Active Defense and later AirLand Battle doctrine. NATO and US forces relied on roads and bridges capable of supporting the logistics and armored forces required to delay a numerically superior Soviet force. The mantra of "Fight Outnumbered and Win!" was feasible in large part to the superior accuracy and survivability of the new M1 tank, antitank systems like the Tube-launched Optically tracked Wire-guided (TOW) rockets, and the operational depth and mobility permitted by German infrastructure.[92] The superior capability of modernized infrastructure in West Germany enabled the operational mobility of NATO forces and greatly contrasted with Soviet efforts in the GDR.

Soviet and GDR defense planners recognized the significance of operational mobility in the event a major war broke out with NATO forces during this period. Soviet defense organizers outlined a robust plan to develop rail and road networks to run along east-west supply routes to satisfy the requirements of large-scale combat operations. The GDR government quickly realized, however, that these networks and the infrastructure development outlined in the 1960s far exceeded the reality national economic production.[93] The successful policies outlined during the

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[90] Ibid, 154.

[91] Saint, "The Fulda Gap: A Personal Perspective from Platoon Leader to Army Group," 162.

[92] Ibid, 152.

[93] Torsten Diedrich, "The German Democratic Republic and its Function in the Warsaw Pact," in *Fulda Gap: Battlefield of the Cold War Alliances*, ed. Dieter Krüger and Volker Bausch (New York:

Economic and Military Models as well as the ERP equipped the West German economy to produce what the East German economy could not. Soviet policies that sought to strip the East German economy of labor and capability now prohibited the funding and production of transportation infrastructure on a scale to compete with the West.[94] The US and the FRG could only raise the funding required for large-scale infrastructure development through a consumption tax on gasoline. NATO, the US and the FRG outpaced the GDR and Warsaw Pact in infrastructure development providing a critical advantage during the Cold War.

The critical advantage in NATO infrastructure overmatch during the Cold War remains possible for the economies of Poland and other European states. The economic requirements of transportation infrastructure in Poland, outlined earlier in the Economic Model, unified with the NATO requirement for operational mobility present a critical opportunity for the US Department of Defense. An analysis of the period of the Unified Model (1953-1989) in Europe renders many similarities to the current operational environment in Poland and Baltic states. Much like the economy of the Federal Republic, Poland and the Baltic States are eager for investment in infrastructure. Adopting a singular Economic or Military Model for infrastructure development limits the capacity for growth or worse – developing roads and bridges too feeble to support modern armored formations. The Unified Model offers the most efficient and effective method to deliver results that satisfy the economic, political, and operational demands present in Poland and the Baltic Nations today.

Recommendations and Conclusion

At the conclusion of WWII, US and European partners began work immediately to repair transportation infrastructure. From 1945 to the early 1970s road and rail networks in West Germany quickly surpassed those in neighboring countries. The rapid development of rail and

Lexington Books, 2018), 188.

[94] US Department of State, "German Democratic Republic," *Bureau of Public Affairs* (Washington DC: US Government Printing Office, 1982), 6.

road networks were critical components in meeting the rising demand for deterrence through conventional means against Soviet aggression. During this thirty-year span, infrastructure development in the Federal Republic of Germany simultaneously enabled economic growth and the operational mobility required for new US Army doctrine like Active Defense and later AirLand Battle. Today, Poland and neighboring Baltic States at the forefront of NATO power projection much as West Germany was during the Cold War. PESCO and NATO are currently making some effort to enable power projection in Eastern Europe, but the current rate of development will not meet the demands of modern armored formations.

PESCO, on behalf of the EU, recently budgeted $7.3 billion for the period of 2021-2027 to improve road and rail networks within the TEN-T to meet military mobility requirements.[95] This funding provides the means to upgrade and build new road and rail networks to meet the weight of military vehicles across Europe with only a portion going to Poland and Eastern European countries most in need of new infrastructure development.[96] These future projects are a step in the right direction but are woefully short of meeting the requirements outlined both in MDO concepts as well as FM 3-0 to project large units across Europe. NATO, like PESCO, is also taking steps to improve operational mobility in this region of Europe.

The NATO Defender 20 exercise will highlight transportation infrastructure shortfalls in both Poland and other Baltic states and the new JSEC will enable future efficiencies in operational mobility. NATO recently shifted some funding from efforts in Afghanistan to port and airfield projects in Europe to support power projection.[97] Additionally, NATO continues to

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[95] Brooks Tigner, "EU Inches Toward Full Correlation of its Transport Spending with Military Mobility Needs," *Jane's Defense Weekly*, June 6, 2019, accessed February 24, 2020, https://www.janes.com/article/89079/eu-inches-toward-full-correlation-of-its-transport-spending-with-military-mobility-needs

[96] European Commission, "Core Network Corridors on the TEN-T," *Mobility and Transport*, January 21, 2020, accessed February 13, 2020, https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/maps.html.

[97] Department of Defense, *Military Construction Program: FY 2019 Budget* (Washington, DC: Department of Defense, 2018), 10.

encourage commercial and government agencies in Europe to develop transportation infrastructure to meet the needs of modern military formations.[98] During the Cold War, the US and NATO adopted similar measures in encouraging partner nations to develop their infrastructure but coupled their request with both funding and engineering advisor assistance. Current NATO efforts, combined with those of PESCO, will not meet force projection requirements within the timeframe for future MDO Ready units in 2035.

Viable solutions to operational mobility challenges from support to close areas in Europe include collusion between PESCO and NATO, additional funding for infrastructure development, and the provision of construction expertise under military oversight. NATO and PESCO share similar visions for the future security of Europe against the aggressive acts of regional actors like Russia. Only through cooperation can these two institutions reach their shared goal of military capable infrastructure in critical corridors across Europe. Working in parallel not only reduces efficiency, but unnecessarily risks the construction of infrastructure catered to lighter European military requirements precluding the support needed for heavier US armor. Additionally, NATO must continue its efforts to preposition bridging equipment and stock to lessen the burden on strategic lift at the breakout of conflict. In the past, the FRG, Bundeswehr, and NATO worked towards similar ends after 1953 in the Unified Model and created critical efficiencies to maximize the effect funding had on infrastructure work.

Funding for infrastructure development must satisfy projects that meet both military and civilian use (dual use). In the Unified Model, West Germany's rapid ascent to mass motorization in the 1960s and 70s assured the funding stream necessary to build the bulk of its current highway system to satisfy dual use requirements. Like West Germany during the Cold War, funding from external stakeholders like PESCO and NATO today will not meet the rate of transportation

[98] Timo S. Koster, *Reinforcement of NATO Forces and Military Mobility* (the Hague, Netherlands: Netherlands Atlantic Association, 2018), 17.

infrastructure development needed to satisfy defense requirements.

The growing economies of Poland and other Baltic States must eventually furnish the bulk of the funding for infrastructure. These economies, at their current state, cannot afford the scale of construction needed to meet NATO military requirements for force projection without significant support. Poland remains significantly behind Germany and the US in motorization at only fifty-three and thirty-eight percent of capacity respectively further aggravating domestic funding for infrastructure projects.[99] The US Department of Defense, Department of State and allied partners must expand and encourage investment and aid to assist in growing a Polish economy eventually capable of supporting its own infrastructure development. Investments in dual use transportation infrastructure are a start in the process of improving Poland's economy.[100]

The most significant part of the solution for mobility challenges in Eastern Europe remains the provision of construction expertise with accompanying military oversight to local governments. Advisory support to smaller Polish and Baltic municipalities will assist in the generation of the scope of work necessary to begin construction on infrastructure projects, what many financial institutions deems as more important than funding.[101] Additionally, experts in infrastructure development will aid in the upgrade of existing infrastructure through cost effective means enabling the use of more funding for new infrastructure projects.[102] NATO military expertise, unlike the experiences in France during the Military Model, is currently welcomed in

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[99] David W. Jones, *Mass Motorization and Mass Transit: an American History and Policy Analysis* (Bloomington, IN: Indiana University Press, 2008), 25.

[100] The Council of Economic Advisors, *The Economic Benefits and Impacts of Expanded Infrastructure Investment* (Washington, DC: Executive Office of the President of the United States, 2018), 1.

[101] The European Investment Bank, Investment Report 2018/2019: Retooling Europe's Economy (Kirchberg, LU: European Investment Bank, 2018), 11.

[102] Roumen V. Mladjov, "Efficient Methods for Upgrading or Reinforcing Existing Bridges," *Articles, Structural Rehabilitation*, October 2015, accessed February 24, 2020, https://www.structuremag.org/?p=9130.

Poland and Baltic states.[103]

NATO and the US Department of Defense are postured to support the development of transportation infrastructure alongside the EU and PESCO. These institutions are in a better position to accomplish the task of building roads, rail and bridges in Europe than their predecessors at the conclusion of WWII. The dual-use nature of economic infrastructure development appeases the concerns of political and military leaders alike and greatly benefits the citizens of Poland and Eastern European nations situated between the interests of both the US and Russia.

Poland and the Baltic States can close their infrastructure gap through close cooperation with the EU and NATO, leveraging funding for economic growth, and utilizing civilian and military advisors to upgrade and build new projects in their countries. Like the efforts of the nations in Central Europe during the Cold War, Poland and the Baltic States today are in a position to greatly improve their transportation infrastructure to deter aggression and secure their sovereignty into the future.

[103] Moira Fagan and Jacob Poushter, "NATO Seen Favorably Across Member States," *Pew Research Center*, accessed February 24, 2020, https://www.realclearpublicaffairs.com/public_affairs/2020/02/13/nato_seen_favorably_across_member_states_484081.html.

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