

Spring 2019

Steel Monsters: Soviet Tank Development during the Second World War

Jeremy Paugh

Concordia University - Portland, jlpaugh1@gmail.com

Follow this and additional works at: <https://commons.cu-portland.edu/theses>



Part of the [History Commons](#)

CU Commons Citation

Paugh, Jeremy, "Steel Monsters: Soviet Tank Development during the Second World War" (2019). *Undergraduate Theses*. 185.
<https://commons.cu-portland.edu/theses/185>

This Open Access Thesis is brought to you for free and open access by CU Commons. It has been accepted for inclusion in Undergraduate Theses by an authorized administrator of CU Commons. For more information, please contact libraryadmin@cu-portland.edu.

HST 493- Steel Monsters: Soviet Armor Development During World War 2

A senior thesis submitted to
The Department of History

College of Arts & Sciences

In partial fulfillment of the requirements
for a Bachelor of Arts degree in History

By: Jeremy Paugh

Faculty Supervisor _____
Dr. Joel Davis *Date*

Department Chair _____
Kimberly Knutsen *Date*

Dean, College of
Arts & Sciences _____
Dr. Michael Thomas *Date*

Provost _____
Michelle Cowing *Date*

Concordia University

Portland, Oregon

May, 2018

Abstract:

This thesis aims to explore the far-reaching effects of armored warfare and tank development on the outcome of the Eastern Front of the Second World War, where Nazi Germany and the United Soviet Socialist Republics fought an existential war that would decide the destiny of Eastern Europe. As such, this thesis provides background information on the Nazi ideology that opened this theater of the Second World War before delving into German tank development, examining several vehicles that had a significant impact on armored development in general as well as within the theater when these vehicles raged across the steppes of Russia and Ukraine. The perspective then changes to cover the Soviet response to the invasion, the general flow of the war in this theater after Operation Barbarossa, culminating with the Battle of Berlin. Several important facets of this front such as the Soviet implementation of Deep Battle philosophy and the evacuation of Soviet war industry to the Ural Mountains is also covered. Finally, common trends in Soviet armor that allowed their tanks and other armored vehicles to prevail over Nazi Germany will be discussed, and an overview of several significant Soviet armored vehicles ranging from self-propelled guns to an assortment of tank destroyers and the vaunted T-34 and IS-2 medium and heavy tanks is also explored.

Table of Contents:

Abstract	1
Table of Contents	2
Acknowledgements	3
Body	4
Bibliography	94
Appendices	97

Acknowledgements

I could not have completed this project without the help of numerous people in my life who have assisted my work greatly. I would first like to thank Dr. Joel Davis, my advisor, for agreeing to work with me on this project and helping me form a cohesive and coherent, if brief treatise on a theater of the Second World War that often doesn't get much attention here in the United States. Dr. Davis, thank you very much for putting up with my rough first drafts, and barely-refined iterations and helping me to build my argument. I'd also like to thank the other members of my committee, Dr. Gerd Horten and Dr. Michael Thomas, not only for agreeing to work with me on this project but also for treating me as a valued member of their other courses and allowing my knowledge of various history-related topics to grow immensely. Dr. Thomas in particular has had an extraordinarily positive effect on my experience here at Concordia and once gave me a valuable "pep talk" I still remember frequently today. Many thanks also to Keryn Neary for doing the administrative magic behind the scenes, and of course to my loving family, who encourage me to read, learn, and seek the truth in all things. I also thank my friends, and cohort members who have supported me throughout the duration of this project. I hope that I've made a small contribution to the body of knowledge that you can all be proud of for participating in. Thank you very much.

In the waning days of the First World War, a new weapon emerged that would change ground warfare forever. The tank, built to break the stalemate of trench warfare, had entered the battlefield. Lumbering vehicles boasting tracked propulsion, armored plating, and multiple weapon emplacements, tanks presented a terrifying visage that hailed the mechanization of warfare in the modern era. These new metal monsters were the mechanized iteration of cavalries of ages past and would rapidly carve out a niche for themselves on the battlefields of western Europe. Although traditional cavalry still had a minor role on this modern battlefield, they would ultimately be supplanted by these new machines. Nevertheless, tanks were still a new force on the battlefield whose potential had not been fully realized. The Second World War would change this paradigm dramatically.

Though primarily fielded by the western Allies during World War 1, these new weapons did not go unnoticed by other nations. Nazi Germany and the Soviet Union invested heavily in developing armor doctrine in the interwar period, with devastating results. Once World War 2 began, Nazi Germany possessed impressive armored forces and had integrated them into traditional battle tactics to form a powerful combined arms strategy that took western Europe by surprise. Turning his attentions to the east, Adolf Hitler saw an opportunity to expand his Reich into Eastern Europe and Russia. Intent on violently expanding the lands under its control, Nazi Germany invaded the USSR with huge numbers of tanks and other armored vehicles forming the vanguard of his force. Hitler planned to quickly occupy the western reaches of the Soviet Union and kill or enslave every man woman and child of the Slavic peoples, whom he considered *untermenschen*, or sub-humans. This was in Hitler's mind a *vernichtungskrieg*, or war of

extermination against the Soviet peoples, designed to violently depopulate their lands to make room for the envisioned Greater Germanic Reich.

The Soviet Union however, did not surrender as quickly as anticipated. Despite Nazi Germany's superior tactics and training the USSR possessed the world's largest tank forces at the outset of hostilities, with thousands of light tanks as well as newer, heavier vehicles such as the early model T-34. These new tanks caught the Nazis by surprise, and although they failed to significantly slow the Axis' momentum, the existence of these vehicles set off an arms race between the Soviet Union and Nazi Germany. As the war raged both sides mass-produced significantly better armed and armored tanks and other fighting vehicles that caused a paradigm shift in armored warfare as a direct result of this conflict.

Though the fighting on the Eastern Front during the Second World War is far too grand in scale to examine every facet in detail in this thesis, the following will provide an overview of the armored warfare that took place there during the Second World War. Tanks were an essential component of the ground warfare from this front throughout the conflict, with both sides fielding vast number of tanks and other armored vehicles as the centerpiece of their ground operations. Additionally, this theater saw significant changes to armored doctrine and design that have affected tank development ever since and significantly affected the outcome of the conflict on this front. The Soviet Union may well have fallen to the Nazis had they had not focused their tank development on vehicles such as the T-34 which used innovative and versatile designs and were cheap to produce. Further, these designs would comprise the bulk of the Soviet Union's tank forces by the end of the war, supplanting older light tank designs with much more heavily armed and

armored vehicles. Finally, the Soviet Union's tank force had been gutted by Josef Stalin's purge of officers throughout the Red Army in the years prior to the Second World War, necessitating the rediscovery of strategic-level maneuvers such as Deep Battle that enabled the Red Army to turn the tide of war against the Wehrmacht.

To illustrate this argument, this thesis has been divided into three sections. The first section covers the German invasion, illustrating the threat Nazi Germany posed to the peoples of the Soviet Union with the Nazi plans to violently depopulate the lands they conquered after pushing back the Soviet forces with coordinated use of panzer divisions (massed armor formations). A brief introduction to tank types will be offered, as these categories were commonly used by both the Nazis and the Soviets to classify their vehicles and determine their use in combat. Next, a selection of significant German vehicles will be examined, showcasing the changes the Nazis made to their armored doctrine in this theater as the war progressed and the trend towards much heavier vehicles by the end of the war.

The second section will focus on the Soviet response to the German invasion, examining the reasons the Red Army suffered terrible losses in the opening months of the war. The methods the Red Army used to turn the tide of battle via the rediscovery of strategic-level operations that had been discarded in the wake of Stalin's purges will also be examined. Additionally, the preservation of Soviet war industry via evacuation to the east will be explored alongside common design trends in Soviet armor during this period. An overview of combat on the front as a whole with a focus on Soviet operations will also be provided to illustrate how Soviet armored divisions contributed to the ultimate victory in the conflict.

The final section provided is an in-depth look at an array of Soviet armored vehicles that were particularly essential to the war effort. This section will illustrate the pivot away from old light tank designs to heavier vehicles like the T-34 which made use of technological advancements such as angled armor, better engines, and higher-caliber guns to outmaneuver and defeat their German opponents. These vehicle's characteristics were also optimized for mass production at a low cost and focused their efforts on being good at multiple roles rather than the emphasis placed on heavier armor and overengineering like their late-war German counterparts. Additionally, a look at heavy Soviet assault guns is provided to emphasize the Soviets' use of vehicles in multiple roles and the cost-effective means by which they defeated the Germans, whose vehicles were generally much more expensive to manufacture.

Part 1: The German Invasion

The invasion of the USSR by Nazi Germany was the singular event that kickstarted the fighting in this theater and led to millions of deaths as well as huge advancements in armored warfare. The invading Germans were the catalyst from which all future Soviet tank development during the war stemmed and would change the standards by which armored warfare was conducted forever. When the Germans invaded, they sought to conquer the lands of eastern Europe and replace the indigenous Slavic peoples with German colonists to expand Hitler's Reich. In order to conquer the USSR, Hitler planned to use his armored divisions in massive combined arms offensives much as he had in Western Europe. Once panzer divisions conquered territory, occupying soldiers would begin killing the populace, carrying out the Nazis "Final Solution" to not only the Jews of eastern Europe but to millions of other civilians. Millions more would be enslaved for labor usage. None of this would have been possible without the use of mechanized forces, which is why an overview of German tank designs as well as the leadup to Operation Barbarossa have been provided below.

By invading the USSR, the Nazis sought to gain *lebensraum*, "living space" that they felt was due to the German people, as well as conquer the Soviet agricultural and petroleum industries to continue to feed the Nazi war machine.¹ The Nazis considered the people of the Soviet Union to be subhuman and only useful as slave labor, if not eliminated outright as was often the case. To this effect, as the Wehrmacht invaded the USSR, death squads, or *Einsatzgruppen* followed to carry out the genocide. This was

¹ (Snyder 2012) 416

very different from the Nazi conquests in the West, where killing civilians other than Jews was of lesser importance and the conquered populations lived under occupation rather than being killed outright. Nevertheless, Germany's armored divisions proved essential in conquering as much territory as the Nazis were able to. The mechanization of the Axis forces enabled the Wehrmacht to conquer huge amounts of territory very quickly, leading to an unprecedented rate of advance into the Soviet heartland.

The invasion was spearheaded by three gargantuan army groups, North, Center, and South, utilizing the strategy that would come to be known as *blitzkrieg*, or lightning war.² This strategy made use of quick, deep thrusts into enemy territory by armored vehicles and mechanized infantry, supported by ground-attack aircraft to take and occupy an area quickly before pushing on. As a result, the German invasion relied on vast quantities of tanks, armored cars, half-tracks, tank destroyers, and other armored vehicles to maintain their momentum into Soviet territory. Alongside the need for huge quantities of armored vehicles, encounters with heavily armored Soviet vehicles such as the T-34 and KV-series heavy tanks gave German forces pause as they advanced towards Moscow and Ukraine. This resulted in much more intense and frequent armored engagements between German and Soviet forces and led to advances in tank design and usage that formed the basis for modern tank warfare.

Nazi Germany began planning an invasion of the Soviet Union in 1940, following the joint partitioning of Poland with the Soviet Union. The overarching motivations for the invasion involved gaining territory for the envisioned "Greater Germany", as well as

² (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) location 333

the vast arable and industrialized regions of western Russia and Ukraine.³ Accessing the oil fields south of the Caucasus range to maintain Germany's fuel supply to its armed forces was another key objective. Developed under the codename *Operation Otto*, Germany began massing panzer divisions along the Reich's eastern border in Poland after several months of preparatory training following German's victories in the West against France and the Low Countries.⁴

Aside from the overall objectives of the operation in gaining land and fuel reserves for the Reich, the planned offensives were also to be an extension of Germany's Final Solution for the Jews of Europe. As the front advanced, the death squads would enter occupied territory, killing thousands of civilians in mass shootings and other barbarous execution methods. Next, concentration and extermination camps were to be erected and millions of captured Jews and Soviet POW's were killed as the war progressed.⁵ The Hunger Plan was developed to these ends and involved the intentional mass-starvation of millions of people in the Nazi-occupied regions of the USSR, while the food they had been growing was to be sent back to Germany.⁶ Given these objectives, it is clear that Nazi German was waging a war of complete annihilation against the Soviet Union, necessitating drastic measures be taken for the survival of the Soviet peoples. Germany's rapid mechanized advance into Soviet territory would necessitate sweeping changes to Soviet armored doctrine to combat this existential threat.

³ Appendix A

⁴ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 274

⁵ (Snyder 2012) 176

⁶ (Snyder 2012) 163

The Wehrmacht's use of the panzer division formed a central component of the *blitzkrieg* strategy and arguably proved to be a fundamental change in the use of tanks in war. Additionally, this level of mass-organization of armor was the chief factor in the Wehrmacht's ability to conquer Soviet territory so quickly. When tanks first appeared on the battlefields of World War 1, the British used them to break the stalemate of trench warfare.⁷ Thinly-armored, slow, and bristling with cannons and machine guns, early tanks were essentially mobile pillboxes containing several different fighting positions that would slowly roll through enemy trenches, supported closely by infantry.⁸ After WW1 however, tanks became faster, better-armored, and most importantly, now utilized the common design familiar today, with a revolving turret carrying the main armament. Tanks were now more heavily armed, but less suited for dealing with infantry directly as their predecessors covered in machine gun emplacements. Many countries relegated tanks to a support role, to be used as more of a mobile artillery piece than a dedicated anti-infantry platform. The American M4 for example, was originally designed to be used in strikes against enemy rear areas with dedicated tank destroyers and towed anti-tank guns to be used as the primary anti-tank force.⁹

German military philosophy changed these old ideas of tank warfare dramatically. Coupled with supporting mechanized infantry, German tanks and tank destroyers were to act in massed formations as an armored spearhead, and thus the panzer division was born. A panzer division revolved around a combined-arms approach to ground warfare, coupling tanks with assault guns, mechanized infantry, artillery support, and anti-aircraft

⁷ (Littledale 1918) 1, Part IV

⁸ (Littledale 1918) 1, Part IV

⁹ (Ulio 1942) 66

batteries into a single military unit.¹⁰ Rather than having tanks spread throughout infantry units or grouped in small platoons, a panzer division would generally contain concentrated units of armored fighting vehicles and other support units. A typical panzer division circa June 1941 was roughly comprised of 100-200 tanks, an assortment of tank destroyers, towed anti-tank guns and anti-aircraft batteries, though these numbers varied widely during the war. Two battalions of mechanized infantry, and up to 200 trucks were also integrated into these units to support the tanks and occupy areas as the division advanced.¹¹ When engaging enemy positions, the tanks would quickly advance in massed formations and overwhelm the opposing forces through sheer force, followed by mechanized infantry and support vehicles. These logistics units would quickly establish an occupying force to ensure the area was pacified and leave sufficient troops to establish supply lines before pushing further into enemy territory. This method of quickly capturing an area, setting up supply lines, and pushing on enabled the Germans to capture territory at unprecedented rates and formed the core of the blitzkrieg strategy.

The crux of what became known as the *blitzkrieg* strategy was the addition of new technologies, such as tanks, mechanized infantry, and attack aircraft, to supplement prior German military thought regarding traditional *Bewegungskrieg*, or maneuver warfare.¹² This system developed from Prussian military tactics used during the Franco-Prussian War and involved utilizing superior numbers, speed, and intelligence to bypass and surround enemy strongpoints in a *Kesselschlacht*, or cauldron battle, and destroy enemy forces before they could react. The pairing of these traditional German tactics with

¹⁰ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 763

¹¹ (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt* 2014) Location 338

¹² (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt* 2014) loc. 234

mechanized forces and aircraft working in close coordination formed what Western forces labeled as *blitzkrieg*, though the German military eschewed this term except in use in propaganda. Adolf Hitler himself explicitly derided the term in 1941, calling the term “idiotic”.¹³ As such, blitzkrieg can be best described as an evolutionary step in German military doctrine, having stemmed from traditional tactics, rather than a revolutionary step that upended all prior doctrine. Nevertheless, it proved to be a highly effective strategy that devastated Soviet forces at the outset of the invasion and proved Nazi Germany to be an existential threat to the citizens of the USSR.

As the summer of 1941 approached, the Wehrmacht began preparations for the assault on Eastern Europe. In the buildup to the invasion, the Luftwaffe flew dozens of reconnaissance flights, mapping out invasion routes, important infrastructure, and the positions of various Red Army divisions.¹⁴ Meanwhile on the ground, dozens of divisions of troops were moved into position in various staging areas along what was soon to become the largest military front in history, albeit disguised as signaling troops and drilling units.¹⁵ Only on the eve of the invasion would the necessary vehicles be shipped by train to the staging areas to arm the three massive army groups massing on the Soviet border, Army Groups North, Center, and South. Once the armor arrived and all preparations were complete, on June 22, 1941, the invasion began, and 3.8 million Axis troops swarmed over the Soviet border, kickstarting one the largest military actions in history.¹⁶

¹³ (Reynolds 2014) 249

¹⁴ (Bergstrom 2007) 12

¹⁵ (D. M. Glantz 2011) Location 363

¹⁶ Appendix B

German Tank Development:

Nazi Germany utilized a great diversity of armored vehicle designs during the war. Various vehicles were used for different purposes, traditional light, medium, and heavy tanks comprised the bulk of the panzer divisions and were used to both support friendly infantry as well as combat enemy armor. Other vehicles like tank destroyers and assault guns were more specialized, utilizing howitzers or anti-tank guns in casemate-style designs to serve more specialized purposes, or as a cheaper alternative to traditional turreted tanks. Due to the arms race on this front to build more effective vehicles, significant changes in German armor design can be seen throughout the course of the war. At the outset of the conflict the bulk of Germany's armored forces were comprised of lighter vehicles such Panzer 38's, Panzer III's and Panzer IV's. as well as Sturmgeschutz assault guns. However, as the war progressed, these vehicles were supplemented with much heavier vehicles such as the Tiger 1 and Tiger 2 heavy tanks, the Panther medium tank, and the Jagdpanther and Ferdinand tank destroyers. These later vehicles boasted much thicker armor than their early-war counterparts, as well as larger guns and increased complexity, reflecting the need for better armed and armored vehicles to contend with the huge numbers of medium tanks and other vehicles being fielded by the USSR.

One of the most common types of vehicles from this period were light tanks and tankettes. Light tanks are smaller, lightly-armored vehicles that generally mount a lower-caliber gun (rifle-caliber to 45mm) and are used primarily for reconnaissance and infantry

support.¹⁷ Light tanks saw common use on the Eastern front at the beginning of the war but were gradually phased out in favor of heavier vehicles. Tank usage during this time generally revolved around the concept of infantry support or acting as a mobile artillery platform, rather than as a dedicated anti-armor fighting vehicle as would frequently become the case as the war dragged on. Vehicles in this category from the period include the German Pz. 38t, Panzer I, and Panzer II. By the time of World War 2, light tanks were the predominant armored vehicles fielded by countries across the world. A few exceptions to this rule were the French Char 1B and the Soviet KV heavy tanks, and Soviet T-34 medium tanks. Given the disastrous results of initial German light and medium tank encounters with their heavier Soviet adversaries, it became clear that these light vehicles had become antiquated in engagements with enemy armor and that the Wehrmacht needed more substantial vehicles to deal with the unexpected threat posed by Soviet tanks.

Alongside various models of light tanks, Nazi Germany also made extensive use of medium tanks during their initial push into the USSR. Medium tanks represent a compromise in tank design between the heavier armor of heavy tanks and the greater speed of light tanks. Medium tanks filled a jack-of-all-trades role, serving in both dedicated anti-armor and infantry support roles, several German examples include Pz. III, Pz. IV, and Panther tanks. It is also worth noting that the designation “medium” tank refers to a given vehicle’s role rather than strictly its physical size or weight, as the aforementioned Panther was considered a medium tank by German forces but far outweighed most medium tanks used by the Allied forces. Due to their compromise

between decent armor, armament, and increased speed over heavy tanks, medium tanks were generally the deciding force in armor engagements and one of the most numerous types of tank produced during the Second World War

Throughout the Second World War and on the Eastern Front in particular, various forays were made into large armored vehicles capable of mounting larger weapons than medium vehicles as well as additional armor protection; these were known as heavy tanks. Heavy tanks often represented the pinnacle of a country's armor development, boasting powerful guns and thick armor at the cost of speed. The primary duty of a heavy tank was engaging enemy armored vehicles using a high-caliber main gun. As the war dragged on, requirements in armor thickness and gun caliber for heavy tanks rose dramatically, as Germany and the Soviet Union raced to establish armored superiority on the battlefields of East Europe. This led to a variety of designs and armor schemes, with the Soviets and Germans developing distinct design philosophies to establish armored superiority. German heavy tanks used during World War 2 include the Tiger I and Tiger II.

Alongside traditional turreted tanks, tank destroyers were another type of armored vehicle that saw extensive use and development during the war. Tank destroyers, as the name suggests, are dedicated anti-armor vehicles designed around a powerful main gun, albeit generally without a turret.¹⁸ These turret-less tanks utilized a casemate design instead, essentially an armored box mounted on tracks, carrying a front-mounted gun with a limited angle of fire. Despite the obvious loss in gun-mobility with a casemate

design over a turreted configuration, there were several advantages to this configuration. Due to having greater interior space available as a result of the common casemate design, tank destroyers were often able to mount a more powerful gun than their turreted counterparts. The benefits of these designs extended to the manufacturing process and tank destroyers were generally much cheaper to produce than traditional tanks, leading to significant production of these types of vehicles within both Nazi Germany and the USSR.¹⁹

Out of all the designs discussed, tank destroyers arguably vary the most in design, even within a single country's military. Many different types exist from World War 2, with varying designs from small, lightly-armored vehicles built on the chassis of light tanks like the Marder series of tank destroyers, to armored behemoths such as the Jagdtiger, built on the chassis of the Tiger II heavy tank²⁰. Soviet designers took a different approach. While traditional tank destroyers such as the SU-76 and SU-100 saw service throughout the war, some of the most reliable tank destroyers fielded by the Red Army were in fact, self-propelled guns, artillery pieces designed for indirect fire as well as infantry support and mounted on tracks for mobility. These tank destroyers, namely the SU-152 and ISU-152, knocked out enemy tanks with massive non-penetrating high explosive shells, rather than high-velocity armor-piercing rounds more commonly used on anti-tank vehicles. Tank destroyers also varied widely in usage, with standard doctrine being to use ambush tactics to destroy enemy armor. Other designs however were used in a more offensive role. This subcategory of vehicles, known as assault guns, share many

¹⁹ (Bishop 2002) 9

²⁰ (Bishop 2002) 48

features with dedicated tank destroyers but are intended to be used as infantry support vehicles, using their guns to assist infantry pushes and destroy enemy strongpoints.²¹

Notable German examples include the Sturmgeschütz III, commonly known as the Stug III, as well as the Sturm-tiger. Sturm-tiger was a short-barreled tank destroyer that used a massive rocket-propelled projectile rather than a true tank shell to support infantry in confined urban areas, where a longer-barreled vehicle would have suffered difficulty moving.²²

With such a variety in tank destroyer designs, particularly among the German forces, it might be asked why so many vehicles of this type were developed. Generally, as tanks were developed in Nazi Germany, a corresponding casemate-style tank destroyer would be developed shortly after using the same chassis to save on production costs²³. Due to the lack of a turret, these vehicles were generally cheaper to produce than their turreted counterparts and expanded Germany's options for dealing with enemy vehicles. Additionally, tank destroyers excelled in ambush scenarios, making them highly suitable for the defensive situation Nazi Germany found themselves in as their offensives in the east ground to a halt and the Red Army subsequently pushed them back to Berlin. Given the situation, it is not surprising that a variety of tank destroyer designs went into production, given the wide variety of tanks used by Nazi Germany over the course of the war. Hence, the lighter Marder and Hetzer lines of tank destroyers were developed from the chassis of the Panzer 38 light tank, while the Stug III was developed from the Panzer III medium tank, the heavier Jagdpanther was developed from the Panther medium tank,

²¹ (Bishop 2002) 111

²² (Bishop 2002) 116

²³ (Bishop 2002) 42

and the mammoth Elefant and Jagdtiger tank destroyers were developed from the chassis of the Porsche Tiger and Tiger II respectively.

Now that an overview of armored vehicle types has been made, it is time to take a closer look at some specific vehicles fielded by the Wehrmacht as the war went on to better illustrate the roles that these vehicles played during the invasion. As the following will illustrate, demands for armored vehicles changed greatly as the war progressed, and pre-war designs quickly became obsolete as combat on the Eastern Front intensified. As Axis forces realized that their tanks were inadequate for dealing with newer Soviet designs, old tanks were removed from service entirely or retrofitted with additional armor and guns to keep them competitive on the battlefield.²⁴ Similarly, Soviet forces recognized both the threat posed by the invading forces and also that while their current light tanks were inadequate, some of their more recent designs were competent vehicles that could be refined and mass-produced to counter the threat posed by the Axis. The Wehrmacht in turn fielded ever-heavier vehicles to counter new designs that the Soviet Union introduced, leading to the development of massive vehicles like the Tiger 2 heavy tank in the later stages of the war. Though not a comprehensive list by any means, the vehicles included here were generally widely produced, highly effective in their designed roles, or otherwise significant to the war effort, leading the Nazi charge to annihilate the peoples of the Soviet Union. Therefore, the following vehicles will be discussed in greater detail: The Hetzer tank destroyer, Panzer III medium tank, Stug III assault gun,

²⁴ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 3530

the Panzer IV medium tank, the Panther medium tank, the Jagdpanther tank destroyer, the Tiger heavy tank, the Elefant Tank destroyer, and the Tiger II heavy tank.

The Hetzer, officially known as the *Jagdpanzer 38t*, was a tank destroyer developed from the chassis of the Panzer 38(t) light tank.²⁵ Though the Panzer 38 was an effective light tank in the early days of the war during Germany's operations in Poland, it quickly proved to be inadequate in terms of armor and armament to face down the much heavier Soviet T-34 and KV.²⁶ As such, production was halted, and these light tanks had their chassis lengthened, turrets removed, and additional sloped armor added to form the Hetzer. The new tank destroyer was compact and easily hidden, carried a reliable 75mm main gun, was well-armored, with a frontal plate 60mm thick and sloped backwards at 60 degrees, giving approximately 120mm of effective armor.²⁷ Perhaps most importantly, the Hetzer was cheap to produce. Entering service in 1944, over 1,577 units were produced, forming an important supplement to the Wehrmacht's tank destroyer arm.

Though light tanks played an important role in the opening stages of the second world war, their light armament and thin armor led to them being largely supplanted in importance by various medium tanks by the time of Operation Barbarossa. The *Panzerkampfwagen III* was a medium tank that initially formed the backbone of the Nazi Panzer Corps during the early stages of the war.^{28,29} These vehicles were widely-used, seeing action in all major theatres; from western Russia in the east, to the North African

²⁵ Appendix C

²⁶ (Bishop 2002) 10

²⁷ (Alex 2018) 1

²⁸ Appendix D

²⁹ (Bishop 2002) 12-13

deserts, to western Europe where they saw action during the D-Day operations.³⁰ During Operation Barbarossa, these tanks, equipped with 37 and 50-millimeter main guns, were more than a match for the older and more numerous T-26 and BT-7 light tanks fielded in large numbers by the Red Army. However, Pz. III crews were horrified to learn upon entering combat that their vehicles were unable to penetrate the newer T-34 and KV, at the time the most advanced tank designs in use by any nation.³¹ As a result, the Panzer III was up-armored, but its turret ring was too small to allow for significant upgrades to its armament, so it was relegated to infantry support roles in favor of the newer Panzer IV medium tank and heavier vehicles for tank combat.³² However, the chassis proved useful in developing the Stug III, which would be one of the most effective tank destroyers to be fielded by Germany during the war³³.

The *Sturmgeschutz III*, commonly known as the Stug III, would become one of the most prolific and effective German tank destroyers of the second World War.³⁴ Built on the chassis of the aging Pz. III medium tank, the Stug III were originally designed to be an assault gun and used for infantry support.³⁵ The design proved to be an excellent tank destroyer as well. Old requirements for the vehicle to be no taller than an average soldier made the Stug III compact and therefore easy to hide and a difficult target for Allied gunners. Mounting a variety of guns and gradually up-armored as the war progressed, more sophisticated variants were introduced. The Stug was generally capable of penetrating all but the most heavily-armored tanks used by Allied forces. Due to its

³⁰ (Bishop 2002) 12-13

³¹ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 4715

³² (Bishop 2002) 12-13

³³ (Knight 2015) 1

³⁴ Appendix E

³⁵ (Bishop 2002) 116

effectiveness in its newfound role, over 11,000 units were constructed and used by Nazi Germany and its allied nations.³⁶

Though the Panzer III served the Axis well in the west, it was inadequate for dealing with heavier Soviet armor found on the Eastern Front. As a result, it was largely supplanted by the *Panzerkampfwagen IV*, commonly known as the Pz. IV or Panzer IV.³⁷ The Panzer IV was a German medium tank that formed the backbone of the Wehrmacht's armored fighting vehicles during World War 2 alongside the Panzer III. With over 15,000 units of the Pz. IV and its tank destroyer variants produced, it also carries the distinction of being the only German tank to remain in continuous production throughout the war.³⁸ It proved to be a more versatile platform than its younger "sibling", the Panzer III, by virtue of its larger turret ring and thicker armor allowing for much greater upgradeability.³⁹ After initial encounters with the comparatively well-armored T-34 and KV, the Panzer IV was quickly upgraded with a more powerful gun for anti-tank use, as well as additional applique armor and spaced armor for defense.⁴⁰ The Panzer IV was certainly not the only tank to use spaced armor, extra armor plates added a set distance from a tank's normal armor to shatter and reduce the energy of incoming projectiles, but it was a ubiquitous vehicle and thus a prime example of this particular armor technique. In addition to serving throughout the war as a versatile medium tank, the Panzer IV was also the basis of a number of other armored gun platforms including the Jagdpanzer IV,

³⁶ (Knight 2015) 1

³⁷ Appendix F

³⁸ (Bishop 2002) 9

³⁹ (Ogorkiewicz 2016) 1

⁴⁰ (Bishop 2002) 13-14

Brummbär, and Stug IV tank destroyers, but as combat intensified on the Eastern Front, German High Command elected to produce ever-heavier and better-armed vehicles.⁴¹

Panzerkampfwagen V Panther known colloquially as the Mark V or simply Panther, was a heavy medium tank that arguably represented the pinnacle of German medium tank development.⁴²⁴³ Armed with a more powerful gun and much heavier and more efficient armor than its predecessors Panzer III and Panzer IV, the Panther represented a hybrid design between medium and heavy tank ideologies.⁴⁴ While retaining the powerful engine mounted to the much heavier Tiger I, the Panther was a lighter vehicle and thus more mobile, as well as much cheaper to produce than Tiger I, while proving almost as effective on the battlefield. Built directly as a response to the T-34 medium tank being fielded by the Soviet Union, the Panther equipped a long-barreled 75 mm main gun capable of penetrating Soviet armor at great distances.⁴⁵ As a result, the Panther excelled in long-range engagements on open ground, but was not as effective as an infantry support vehicle due to its weak high explosive shell, which was less-suitable for use against targets such as pillboxes. Additionally, the Panther utilized a sloped armor layout similar to the Soviet T-34 and KV tanks. Besides possessing greater armor thickness by default, the heavily sloped front plates gave the Panther even more effective armor and thus excellent frontal protection, though its side armor was weaker and not

⁴¹ (Bishop 2002) 9

⁴² (Bishop 2002) 15

⁴³ Appendix G

⁴⁴ (Bishop 2002) 14-15

⁴⁵ (Bishop 2002) 14

angled.⁴⁶ This stood in sharp contrast to earlier German designs, which had relied on thicker armor rather than angling for protection.

Despite these advances, the Panther also suffered from numerous reliability issues and other problems that hindered its performance in the East. The early Panther engines suffered from sealing and ventilation issues, leading to frequent fires, and the overcomplicated suspension of interlocked roadwheels made repairs difficult and time-consuming.⁴⁷ In addition to battle damage, the bi-annual *rasputitsa*, or mud seasons, of western Russia and Ukraine wreaked havoc on the Panther and other German vehicles.⁴⁸ Mud would become wedged into the suspensions of vehicles such as the Panther and freeze overnight, forcing crews to spend hours chipping away the dirty ice with tools or a blowtorch to permit vehicle movement. Additionally, as the war dragged on, German supply shortages led to compromises in the metallurgy of tank armor.⁵⁰ The Panther in particular suffered from this as different alloys began to be used to manufacture its armor. Towards the end of the war it suffered from its armor cracking into pieces upon being struck by Soviet guns, instead of deforming or blocking the shells. In short, though the Panther was an excellent tank on paper, with thick armor and a powerful gun, its reliability issues, general overengineering, and its poor ability to support infantry, caused its performance to suffer from its inception.

⁴⁶ (Forczyk, *Tank Warfare on the Eastern Front 1943-1945: Red Steamroller* 2016) Location 5275

⁴⁷ (Bishop 2002) 15

⁴⁸ Appendix H

⁴⁹ (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt* 2014) Location 374

⁵⁰ (Forczyk, *Tank Warfare on the Eastern Front 1943-1945: Red Steamroller* 2016) Location 4618

The Jagdpanther was another example of the heavier armored vehicles being fielded by Nazi Germany post-1942.⁵¹ Introduced in 1944, the Jagdpanther was a heavy tank destroyer built to carry the highly effective 88mm KwK 43 anti-tank gun, and over 400 units were produced during the war.⁵² This gun was used by a variety of vehicles in the later stages of World War 2, but German officials struggled to come up with a suitable tank destroyer to wield this weapon up until later stages of the war. The earlier Nashorn was an effective tank destroyer with this weapon mounted, but proved too lightly armored and was knocked out by enemy vehicles and infantry with ease.⁵³ The Ferdinand however, mounted the same gun, and had excellent armor protection, but was slow, mechanically unreliable, and still highly vulnerable to infantry. The Jagdpanther provided a middle-of-the-road option, using highly sloped armor in an evolution of German armor doctrine started by its predecessor the Panther, but kept its weight down despite offering protection similar to the much heavier Ferdinand.⁵⁴ Due to the reduced weight, the Jagdpanther retained some of the mobility of its predecessor, or at least more so than many heavier tanks it served alongside. Despite its powerful armament and good protection, Jagdpanther suffered the most from the stage of the war at which it was introduced. Serving on the Eastern Front only from January of 1945 onwards, German wartime production could no longer keep up with the needs of its armed forces, and so Jagdpanther suffered from crippling supply shortages, fuel and replacement parts were simply not available.⁵⁵ As such, many of the Jagdpanthers taken out of action on the

⁵¹ Appendix I

⁵² (Forczyk, Tank Warfare on the Eastern Front 1943-1945: Red Steamroller 2016) Location 749

⁵³ (Bishop 2002) 46

⁵⁴ (Bishop 2002) 47

⁵⁵ (Bishop 2002) 47

Eastern Front were in fact often destroyed by their own crews to prevent them from falling into enemy hands.

Though Panther and Jagdpanther proved to be effective, or at least as effective as could be expected given Germany's wartime situation, they were certainly not the first of this new class of heavier vehicles fielded by the *Panzerwaffe*, Nazi Germany's armored corps. That title goes to *Panzerkampfwagen VI Tiger*, commonly known as Tiger I.⁵⁶ The Tiger I was the first armored vehicle fielded by the Wehrmacht to use the aforementioned 88mm KwK anti-tank gun, and it proved to be a devastatingly effective weapon.

Developed from an 88mm anti-aircraft gun, the 88mm KwK was Germany's response to the threat of the Soviet T-34 and KV in the opening stages of Operation Barbarossa, as the vast majority of German tanks used in this offensive could not penetrate these vehicles except at point-blank range.⁵⁷ Initially a towed anti-tank gun, it was later mounted to the Tiger I after it became apparent to German High Command that current tanks were not adequately armed.⁵⁸ As such, the *Panzerwaffe* quickly began upgrading existing Panzer IV's with spaced armor and high-velocity 75mm anti-tank guns, and a slew of new vehicles were fast-tracked for development or increased production.⁵⁹ With its large main gun and thick armor, Tiger I was destined to become Germany's first true heavy tank that was not a captured vehicle produced by another country, such as the French Char B1.⁶⁰ Tiger I entered service in 1942 and quickly established a reputation for itself with its deadly 88mm main gun. Despite not being produced in as large of number

⁵⁶ Appendix J

⁵⁷ (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014*) Location 1308

⁵⁸ (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014*) Locations 1303, 1455

⁵⁹ (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014*) Location 4392

⁶⁰ (Bishop 2002) 15

as Stug III or the Panzer III and IV, with just shy of 1400 units being produced throughout the war, Tiger 1 had a formidable reputation on the battlefield and was widely feared by Soviet and other Allied commanders.⁶¹ In fact, reports of engagements with Tigers by American armored divisions appear to have been inflated rather dramatically, as the tank had such a fearsome reputation and shared some visual similarities with its “colleagues” Pz. IV and Panther, that crews often identified German vehicles that knocked out American tanks as Tigers due to the reputation of its powerful main gun.⁶² Despite the powerful gun however, Tiger I still represented a transitional stage in German armor design. Though the Tiger borrowed some design elements, such as the wider tracks, from the Soviet T-34. It did not inherit the sloped armor as the later Panther and other designs did and instead relied on rote armor thickness for protection. Tiger 1 had up to 100mm of armor at the front to around 80mm on most upper portions of the tank, with little rounding or angling apart from the turret.⁶³ Instead, Tiger crews were instructed to angle the tank themselves against enemy vehicles to maximize their effective armor. This tactic proved effective because of the Tiger’s box-like shape but was ultimately guesswork at best on the part of the crew. This tactic was largely unnecessary with heavier later vehicles and made little difference for lightly-armored vehicles like the Panzer III or IV against any but the lowest-caliber guns. Though produced in limited numbers and suffering from similar reliability issues, “teething” early in its development, by the later stages of the war Tiger 1’s reliability had increased significantly and easily

⁶¹ (Bishop 2002) 15

⁶² (Zaloga, Armored Thunderbolt: The U.S. Army Sherman in World War II 2008) 124

⁶³ (Bishop 2002) 15

earned its reputation as an effective armored vehicle, arguably cementing its place in the minds of many as the definitive World War 2 German tank.

Though the Tiger 1 has certainly cemented its place in the mythos of the Second World War, it is not as commonly known that there were actually two competing designs for what would become the Tiger tank. While the Henschel-built design was ultimately adopted for production, Ferdinand Porsche submitted a competing design with similar specifications. Ultimately, his design failed, and once the Henschel design was selected however, these 90 hulls were instead rebuilt as a heavy tank destroyer, mounting the new 88mm *Panzerjagerkanone 43/2*, a powerful anti-tank gun that was also mounted to the Nashorn and the later Jagdpanther tank destroyers.⁶⁴ This new tank destroyer, known as *Ferdinand* after initial production and *Elefant* after a round of modifications, was capable of destroying Soviet armor before Red army tankers were within effective firing range themselves.⁶⁵ Additionally, Ferdinand was heavily armored, but like the Tiger design upon which it was based, used little angling to increase its protection. Its gun proved extremely effective, being able to knock out T-34's at ranges of over 3 kilometers, with a maximum firing range of over 9 miles. Additionally, the high velocity of its shell gave it even more killing power than the weapons of the Tiger 1 and Panther, being able to also easily penetrate heavier Soviet tanks such as the IS tank family and the tank destroyers based on the IS chassis. However, the vehicle's many downsides were showcased at the titanic Battle of Kursk, one of the largest armored engagements in history. While nearly all units of the Ferdinand were deployed here and proved effective at long range, the

⁶⁴ (Bishop 2002) 47

⁶⁵ Appendix K

vehicles shortcomings rapidly became apparent. Despite its thick armor, the vehicle had poor crew visibility and no way to defend itself against infantry, and as such when Ferdinands advanced through Soviet lines they could be easily swarmed and knocked out by infantry with grenades and anti-vehicle charges.⁶⁶ After Kursk, the surviving Ferdinands were re-fitted with anti-infantry machine guns, additional viewing ports, and anti-mine *Zimmerit* putty and re-designated *Elefant*.⁶⁷ Hereafter they continued to serve in the East, as well as in Italy, though frequent breakdowns hindered their operational capabilities for the remainder of the war. Overall, the vehicle was superseded in functionality by the later Jagdpanther, but despite its many flaws it was statistically one of the most effective tank destroyers of the Second World War, with an average kill ratio of ten enemy vehicles per *Elefant* lost.⁶⁸ Ultimately, the Ferdinand was produced in too few numbers to have a major outcome on the war in the east, but the performance of its gun was a sign to German engineers that other vehicles could use this and similar-caliber weapons to great effect, and this can be seen in the later Jagdpanther tank destroyer and Tiger II heavy tank.

The *Panzerkampfwagen Tiger Ausf B.*, or Tiger II represented the pinnacle of German heavy tank development during World War 2.⁶⁹⁷⁰ Mounting the new 88mm PaK 43 main gun shared by the Ferdinand, Nashorn, and Jagdpanther, it proved a deadly opponent on the battlefield, being able to knock out all Allied vehicles from ranges in excess of 2 km.⁷¹ Additionally, the Tiger II improved on its predecessor Tiger 1 by

⁶⁶ (Bishop 2002) 47

⁶⁷ (Bishop 2002) 47

⁶⁸ (B., Panzerjäger Tiger (P) Ferdinand 2015) 1

⁶⁹ Appendix L

⁷⁰ (Ogorkiewicz 2016) 1

⁷¹ (Bishop 2002) 16

integrating armor angling similar to that of the Panther. This increased efficiency in addition to rote thickness made the Tiger II one of the most heavily-armored vehicles of the war. Deployed in 1944 with around 492 units produced during the war, Tiger II was used to augment heavy tank battalions. It was intended to replace the Tiger I entirely but by this stage of the war Allied bombing had largely crippled Germany's ability to produce tanks in significant numbers.⁷² Additionally, the Tiger II was plagued by similar problems that effected other heavily-armored vehicles during this time. Its gas mileage was extremely poor, and thus the vehicle was expensive to run at a time when Germany was desperately in need of fuel.⁷³ Additionally, it was very slow, being powered by the same engine as the Tiger and was subject to frequent overheating. Similarly, to the Panther, compromises were made in the metallurgical composition of the armor, resulting in cracks upon shell impact and severe spalling that could destroy internal components and kill or severely injure crewmembers.⁷⁴ Spalling is a state in which an armor plate receives a non-penetrating impact that causes shards to fly off the opposite surface, causing similar destruction as an outright shell penetration. With the more brittle armor being fitted to these vehicles in the final stages of the war, hits from the massive 122mm and 152mm shells of late-war Soviet heavy tanks and tank destroyers frequently proved deadly.⁷⁵ In short, though the Tiger II represented the pinnacle of German armor design and mounted a highly effective main gun, it was ultimately hampered by its weak engine, frequent breakdowns, and compromises made to its armor construction that relegated

⁷² (Peck 2016) 1

⁷³ (Bishop 2002) 16

⁷⁴ (Peck 2016) 1

⁷⁵ (Bishop 2002) 119

other advancements like its improved thickness and angling moot in engagements against vehicles mounting large-caliber guns.

To summarize, Germany's invasion of the USSR was driven by a desire to violently expand the Reich into the Soviet Union and kill or enslave millions of people, as the Slavs and Jews of the region were considered subhuman, *untermenschen*, and did not fit into the Nazis' idealized Aryan-led social order. As the Germans invaded, they killed millions of people via the *Einsatzgruppen* death squads and later concentration camps, as well as through intentional mass starvations. Moreover, the Wehrmacht was able to accomplish this feat through their use of panzer divisions and mechanized infantry to conquer huge swaths of Soviet territory with terrifying speed. German armored vehicle construction changed considerably in the crucible of armored warfare on the Eastern Front. While lighter vehicles proved sufficient to enact the blitzkrieg strategy for the invasion of Poland, German vehicles such as the Panzer 38t and Panzer III were not sufficient to deal with the threat posed by heavier Soviet armor. As the war progressed, the Panzer III and in particular the Panzer IV were upgraded with spaced armor and improved anti-tank guns, forming the backbone of the German armored forces. Additionally, resources were poured into developing heavier vehicles such as Tiger 1 mounting various 88mm anti-tank guns, and assault guns such as Stug III were pressed into service as tank destroyers, proving effective due to their low profile and comparative ease of production. In the later stages of the war, the 88mm PaK 43 anti-tank gun was fitted to a number of vehicles, including Tiger II, Ferdinand, Jagdpanther, and Nashorn, and proved to be an effective and reliable anti-tank gun, remaining in production through the end of the war. Concurrently, German tank construction changed, incorporating traits

such as sloped armor to improve armor efficiency, and wider tracks to negotiate the terrain of the Eastern Front. Despite these improvements however, compromises in armor construction rendered some of these advancements moot, while critical fuel shortages and the lack of replacement parts led to many German vehicles being lost due to otherwise simple maintenance issues, stacking the odds against an already badly-outnumbered Wehrmacht. Meanwhile, Soviet production capabilities and tank development of their own in concert with massive offensives and bad weather eventually led to the total German defeat in this theatre.

Part 2: The Soviet Response

As millions of Axis troops rushed across the border between the Soviet Union and the Third Reich, the Red Army were caught almost completely by surprise. Not anticipating an invasion for months or years and with the Red Army largely demobilized in the west, Stalin rushed to shore up the defenses of the USSR before Germany achieved total victory. Although the Soviet Union possessed millions of troops and tens of thousands of tanks at the outset of the German invasion, most of these resources were badly out of position and lacked critical supplies and leadership due to Stalin's purges in previous years.⁷⁶ As a result, Axis forces were able to push rapidly into Soviet territory, capturing or laying siege to large cities such as Stalingrad, Leningrad, and reaching the outskirts of Moscow within 6 months of the start of the invasion. In order to halt their advance, desperate measures would have to be taken by the Soviet Union, mobilizing their population towards the war effort and producing thousands of their own armored vehicles to answer the armored fist of the Axis and preserve the Soviet peoples from extermination.

To better illustrate the dire situation the peoples of the USSR found themselves in when the Nazis invaded, this section will focus primarily on the Soviet response to the initial invasion and the methods by which they were able to turn the tide of battle. This is to illustrate the overarching point that the Soviet Union needed to make massive changes to the way they conducted armored warfare to halt the German advance and campaign of extermination. The Red Army was in a state of demobilization and disarray at the outset

⁷⁶ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 355

of the fighting, with mechanized corps in particular suffering from a lack of leadership, supplies, and training. This neglect of the armored forces led to the Soviet inability to put up meaningful resistance to the invasion and entire Red Army divisions were captured by the better-organized Germans and subsequently killed, being outmaneuvered at the strategic level by German mechanized divisions. Later in the conflict, these deficiencies would be remedied through greater tactical coordination and the distribution of communications equipment to all tank crews. Additionally, the evacuation of Soviet industry will be discussed, as the preservation of armaments factories in the face of the German advance was critical to the war effort. Finally, an overview of combat on the front and several major offensives that featured the use of armor divisions will be discussed to provide a better framework in which to discuss tank development.

Given the speed and distances at which the front moved throughout the war in the east, it is clear that mechanized warfare must have played a vital role in the outcome of combat in the theater. While the Eastern Front may appear to form a uniform front stretching north to south across eastern Europe and Russia, a closer look reveals that strategic encirclements and other complex maneuvers played an important role in combat in this theater. As a result, for the duration of the fighting the structure of the front resembled a shape closer to that of a jigsaw puzzle, with large bulges of held territory from both sides protruding into the holdings of the other.⁷⁷ This type of formation is known as a salient and became a defining characteristic of the warfare on this front. Salients were vulnerable to being pinched off from their supply lines, forming a pocket. If the troops caught in a pocket were unable to break out, they would eventually run out of

⁷⁷ (Erickson 2015) Location 1596

supplies and be forced to surrender, removing them from the battle. This was a key element of the German's strategy on the Eastern Front, entire Soviet armies would be encircled and captured, hundreds of thousands of men at a time, and they would all be put to work or starved to death in prison camps as part of Nazi Germany's Hunger Plan. Pockets on the eastern front could range in size from just a few miles to dozens. Indeed, the Kursk salient was over 150 miles wide at the time the Wehrmacht launched Operation Citadel to retake it.⁷⁸ The salients and encirclements of the Eastern Front would be one of the prime reasons the Soviets lost millions of men to capture and defeat early in the war. These huge losses caused entire divisions to vanish completely to Nazi hands and required drastically increased recruitment of men and vehicle production to replenish the losses.

While encirclements have been a staple tactic in warfare throughout history, the sheer scale of the salients and pockets present on the front, containing several hundred square miles and hundreds of thousands of men clearly sets them apart in scope from other engagements throughout history. The scale of such formations illustrates the fact that these huge regions could only have been encircled with the mobility provided by tanks and infantry, and this proved to be the case in numerous engagements on the Eastern Front. In the early stages of the war, the rapid Axis advance led to the capture of millions of Soviet troops, often hundreds of thousands at a time. This was in large part due to the utilization of *blitzkrieg* maneuvers, where German panzer divisions and mechanized infantry would quickly sweep through an area, while regular infantry would be used to hold the new territory as the armored units pushed on. Specific examples of

⁷⁸ (Setia 1998) 1

this tactic in action include the Battle of Białystok–Minsk, where over 450,000 Soviet troops were surrounded, to the first Battle of Kiev, where a similar number of troops were encircled and subsequently captured and an additional 200,000 were killed in the fighting up to that point.⁷⁹⁸⁰ Similarly, the Red Army made use of massive encirclements in offensives like *Operation Uranus*, which sealed the fate of the German 6th Army at Stalingrad in 1942, and once more during *Operation Bagration* where the Red Army crushed Germany's Army Group Center in 1944, capturing over 500,000 Wehrmacht troops.⁸¹

Conversely, a properly-defended salient could also prove to be a boon to the forces holding it. During the interwar period, Soviet tacticians developed a military philosophy known as "Deep Battle".⁸² This philosophy emphasized the importance of not simply destroying an enemy at the main battle line, the front, but also to work the entire depth of an enemy's formation and supply lines and destroy the enemy's logistics quickly. Once multiple breakthroughs in an enemy's lines were achieved, a large force of fresh troops would wreak havoc in the enemy's lightly-defended rear areas.⁸³ Hence, during the Second World War, a well-defended salient was often used by the Red Army as a staging ground to launch sweeping offensives through the German lines and run amok in their supply areas, quickly taking back large swaths of territory. The speed and violence necessary for such a breakthrough to be made achieved fit the role of the Red Army's unique tank designs handily and was the driving factor behind the massive

⁷⁹ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1417

⁸⁰ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 2140

⁸¹ (Erickson 2015) Locations 5236-5250

⁸² (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt* 2014) Location 5945

⁸³ (Erickson 2015) Location 294

production of these vehicles that Soviet leadership demanded. Generally focusing on higher speed and thinner armor set at angles as opposed to their German counterparts, Red Army tanks would prove instrumental in achieving the USSR's victories against Hitler's Reich in the latter stages of World War 2.

Though the Soviet Deep Battle strategy proved extremely effective in the latter stages of the war, the abandonment of this strategy before Operation Barbarossa commenced coupled with the recent purges of the Red Army's officer corps by Stalin, led to severely impaired martial ability on the eve of the German invasion.⁸⁴ Soviet High Command, the *Stavka*, had to gradually re-learn and implement this strategy on a theater level as Deep Battle proponents had largely been purged by Stalin in prior years.⁸⁵ Coupled with the fact that the German invasion took the USSR completely by surprise, this mistake cost the Red Army dearly in the first years of the war. In addition to having to re-learn their principle battle strategy, critical supply shortages of vehicles, including tanks, components, ammunition, radios, and other war material led to the Red Army being all but shattered during the first six months of combat on the Eastern Front.

As the Wehrmacht poured into the USSR, Soviet troops were slow to react. Not anticipating an invasion for months or years, the Red Army was quickly pushed back despite a notable numerical advantage of 5.7 million troops and 25,000 tanks to the invading German force of 3.8 million men and 3,300-3,800 tanks.⁸⁶ This advantage was somewhat muted by the state of demobilization of the Red Army forces at the commencement of Operation Barbarossa, with only 2.8 million personnel and 11,000

⁸⁴ (Royde-Smith n.d.) 1

⁸⁵ (Erickson 2015) Location 354

⁸⁶ (D. M. Glantz 2011) Location 212-264

tanks positioned to blunt the invasion force, though these vehicles were antiquated and poorly equipped for combat.⁸⁷ Additionally, the Axis forces had made extensive disinformation efforts in the months leading up to the campaign, with troop movements carefully disguised. Soviet wire networks were also cut as the invasion began to sow confusion and maintain the element of surprise. This compounded prior Soviet communication issues, as radios were in desperate shortage at this time and Red Army units already had difficulty communicating with one another. As Soviet troops began to fall under attack, communications were muddled and incoherent. The Molotov-Ribbentrop act of Soviet-German non-aggression was still in effect and Soviet leadership was not expecting hostile action of any kind, let alone an invasion of such unprecedented scale. As communications from front-line troops under attack began to arrive, muddled responses were sent back from the Soviet leadership: “You must be insane. And why is your signal not in code?”⁸⁸

Soviet tank crews also suffered severe losses as the invasion swept through the front lines. Though the new T-34 and KV-1 were present from the outset of hostilities on the Eastern Front, the bulk of Soviet tanks present in Western Russia were T-26 and BT-series light tanks.⁸⁹ While these vehicles were on par with vehicles from the WW1 and interwar period in terms of armament and armor, they were thinly armored light tanks built to support infantry units rather than fight modern German tanks. They also utilized gasoline engines that were prone to catching fire, and thousands burned as the invasion force swept through western Russia. Many tank crews attempted counter-attacks through

⁸⁷ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 822

⁸⁸ (Braithwaite 2009) 64

⁸⁹ (Krivosheev 1997) 56

the advancing German lines, but these were unilaterally cut off from their already limited support and eliminated.

Conversely, T-34 crews and KV's fared better against German anti-tank weapons, to the point of near immunity. However, these vehicles were not present in great enough numbers at the outset of hostilities to make a significant impact on the theater for several years. Nevertheless, these new vehicles proved a nasty surprise for German tank crews, who were horrified to find they could not penetrate these new Soviet vehicles as they had so easily with the T-26's and BT-series vehicles.⁹⁰ Tanks such as Pz. 38, Pz III, and early Pz. IV's were almost completely unable to penetrate a T-34 save for point-blank shots down into the top armor and engine deck. This fact spurred rapid German development of heavier vehicles, for which the Soviets would have to answer with increased armored development of their own. In the meantime, infantry with satchel charges and incendiary grenades, or towed anti-tank guns, were used as stopgap solutions to the unexpected Soviet resistance. A key limiting factor for the new T-34's were the severe reliability issues that many new tanks suffered from during this period. The T-34 suffered from severe reliability issues with its engine and transmission, with early models becoming completely unusable after only driving around 200km cross-country.⁹¹ These vehicles were then subsequently destroyed by their crews to prevent their capture, further straining Soviet tank-production to replace these losses. Additional reliability problems with the early transmissions led to many T-34 crews driving into battle with an extra transmission tied to the rear engine deck to replace the first when it inevitably gave out.⁹² Though

⁹⁰ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 1455

⁹¹ (Zaloga, T-34/76 Medium Tank 1941-45 1994) Location 163

⁹² (Zaloga, T-34/76 Medium Tank 1941-45 2013) Location 163

these issues were gradually ironed out in later iterations of the vehicle, these problems caused numerous non-combat losses that compounded the disastrous state of the front already.

Several accounts from German forces that first encountered the T-34 attest to its near-invulnerability in 1941. One such recollection states that a single T-34 broke through the German lines and crushed a 37mm artillery piece, destroyed a pair of Panzer II light tanks, and continued to engage German forces in an 8.7-mile-long path of destruction before finally being destroyed by a howitzer at close range.⁹³ Such accounts are not unique and coincide with common Soviet policy for tanks to engage the enemy for as long as they could once behind enemy lines. Though limited amounts of destruction were achieved via these methods, overall the momentum of the front did not change significantly until the Wehrmacht finally stopped their advance at the cities of Moscow, Leningrad, Stalingrad, and Rostov, encountering fiercely determined Red Army resistance. Nevertheless, the efficacy of the T-34's advanced design for the period was proven and served as a harbinger of the huge quantities of this tank that would be produced as the war progressed.

The KV was another tank that, while only present in limited numbers at the outset of the fighting, presented significant difficulties for the rapidly-advancing German forces. Nicknamed "Russischer Koloss", or "Russian Colossus" by the Germans, this large (6.25 meter) Soviet heavy tank presented an unforeseen problem for the attacking Wehrmacht when fighting broke out.⁹⁴ With armor protection roughly equivalent to the

⁹³ (Carell 1966) 75

⁹⁴ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 1725

T-34, KV-1 and KV-2 were virtually immune to all standard anti-tank weapons fielded by the Wehrmacht during Operation Barbarossa save for the 8.8cm Flak gun, which became a staple for German heavy armor designs later in the war. One incident illustrating the KV-1's near-invulnerability comes from the account of a KV-series tank penetrating far behind enemy lines, before being engaged by four 50mm towed anti-tank guns from an anti-armor battalion. Suffering no penetrations, the KV returned fire, destroying each gun in turn. A larger 88mm gun was moved into position behind the tank but was destroyed by the KV before it could fire. Later that night infantry attacked with satchel charges, but only succeeded in immobilizing the vehicle. Another 88mm gun was moved into position, and achieved several penetrations, but the tank continued to fire back. Finally, the KV ran out of ammunition for its main gun, and German infantry advanced, only to be cut down by machine gun fire from its coaxial mount. The KV's crew were finally eliminated by several grenades thrown into the hatches by advancing German infantry.⁹⁵

Another example of the KV's legendary armor came from the account of the 6th Panzer Division.⁹⁶ The entire division, consisting mainly of Czech-built Pz. 35t light tanks, was halted by a lone KV blocking the road. Engaging the lightly-armed Panzer IIs and destroying several, the Soviet vehicle held up the German column for a full day. Sustaining several penetrations by an 88mm gun, the crew finally perished when several grenades were pushed through the holes the towed 88mm had made, as it had penetrated

⁹⁵ (Buttar 2013) 85

⁹⁶ (Raus 2003) 33

but failed to cripple the tank. The account states that the crew were buried by the Germans with full military honors.⁹⁷

Despite the failure of the early T-34's and KV's to significantly impact the German advance, the advanced designs used in their construction were a harbinger of the arms race between German and Soviet leadership to produce both more numerous and better-quality tanks than the enemy going forward. It became clear after German encounters with heavier Soviet vehicles that medium and heavy tanks with thicker armor than their light tank predecessors would be the dominant force in armored warfare going forward. Indeed, the surprise of encountering the T-34 and KV tank families directly led to the development of vehicles such as the Tiger 1 and Panther, as well as even more armed and armored vehicles that would come to define tank warfare during World War 2.

Despite these sporadic episodes of mass-destruction from individual tank crews, overall the front fared very poorly for the Soviet Union. Viewed through the lens of armored warfare, this can largely be attributed to the poor leadership and tactics of Soviet tank crews, as well as the aforementioned "teething" issues related to the mechanical reliability of new models and the general lack of radios installed on most Soviet tanks.⁹⁸ The front continued to advance eastward at an alarming rate, and many Soviet mechanized corps found themselves quickly cut off behind enemy lines. Enveloped by the enemy, they adhered to their previous orders to cause as much destruction as possible, before being neutralized by mechanical failure or enemy action. Additionally, with their marching orders to continue attacking until disabled or destroyed, Soviet tanks frequently found themselves operating alone with little to no infantry support. This left the tanks

⁹⁷ (Raus 2003) 33

⁹⁸ (D. M. Glantz 2011) Location 1067

vulnerable to infantry attack and illustrates the failure of Soviet leadership to recognize the importance of combined-arms tactics in warfare. The Wehrmacht did not make this same mistake. Armed with more mechanically reliable vehicles at the outset of hostilities, better gun optics, and perhaps most importantly, radios in nearly every vehicle, German armor spearheaded the push to Moscow, crossing vast tracts of land in Western Russia and Ukraine. Apart from sporadic encounters with Soviet mechanized corps comprised of the new T-34's and KV-1 and KV-2, German tanks shredded the older Soviet T-26's and BT's with ease. As a result, Axis forces reached the outskirts of Moscow by November 1941, coming within sight of the Kremlin's golden domes.^{99 100} However, the Germans now lacked the strength to take Moscow, having diverted their forces elsewhere and generally overextended themselves as winter set in. Indeed, by Winter of 1941 the blitzkrieg in the north and central parts of Russia had stalled, with Axis forces halted at Moscow and Leningrad and only Army Group South continuing to conquer territory through 1942.¹⁰¹ The southern city of Kharkov changed hands several times, and the German 6th Army became tied down for months at Stalingrad before being encircled and forced to surrender by the Red Army on February 2nd, 1943.

Despite the initial surprise presented by Operation Barbarossa, Stalin had anticipated an eventual German invasion for some time. As a result, plans to evacuate the western regions of the USSR had been drawn up before the onset of hostilities with Nazi Germany¹⁰². These initial preparations proved critical to the Soviet war effort, and several important weapons and vehicle factories were preserved from Nazi conquest. In the years

⁹⁹ Appendix N

¹⁰⁰ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 2366

¹⁰¹ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1941-2323

¹⁰² (Holmes 2017) 1-13

leading up to the outbreak of war, Soviet industry had gradually been shifted eastward, along with many people living in the westernmost regions of the USSR. This was certainly not done out of sympathy or concern for the people living in these regions, but rather to establish total Party control and avoid “dissident” activities taking place once the Germans attacked.¹⁰³ For example, Volga Germans, part of the German Diaspora, were deported en-masse to keep them as far-removed from the fighting as possible, as well as Crimean Tatars, a Muslim religious minority who Party leadership felt would not support the state when war broke out.¹⁰⁴ Once the invasion began, Soviet leadership began to evacuate civilians eastward. Over the course of the war, an estimated 16 million evacuees would be sent to the rear, to central and southern Russia, where they would be press-ganged into work details on collective farms and re-established factories to continue to support the war effort.¹⁰⁵

As the fighting began, the Red Army developed a scorched-earth policy to deny the Germans resources, even as they retreated across the Eurasian steppe towards their own capital.¹⁰⁶ This strategy proved effective, with the Red Army razing entire towns to the ground, destroying food, and evacuating or sometimes massacring populations to deny the oncoming Nazis access to anything that would help their war effort.¹⁰⁷ Some of the most effective facets of this strategy proved to be the deliberate destruction of Soviet railways and the evacuation of entire factories eastwards. The destruction of Russian railways and rail cars severely hampered the ability of the Germans to move troops,

¹⁰³ (Snyder 2012) 330

¹⁰⁴ (Snyder 2012) 330

¹⁰⁵ (Manley 2007) 1

¹⁰⁶ (Royde-Smith n.d.) 1

¹⁰⁷ (Snyder 2012) 137

vehicles, and supplies easily once they entered the USSR.¹⁰⁸ In addition to being built to a different gauge than was used in the rest of Europe, the Russian rail networks were sparse relative to what the Germans needed for transporting war material and tended to radiate outwards from Moscow. This left the Germans with a relative dearth of usable railways to transport their vehicles, such as tanks, long distances, and as the retreating Red Army destroyed their own infrastructure as they went the Germans were forced to rebuild and replace it in order to make the rail networks usable again.¹⁰⁹ This bought valuable time for the Soviet Union and hampered the Germans' ability to move armored vehicles by train, slowing the onslaught into Russia.

In addition to the destruction of their own rail networks to deny the Germans access to easier transport of war material, the Soviet Union undertook the process of transporting whole factories eastwards to preserve their war industry.¹¹⁰ Over the course of the fighting on the Eastern Front, over 1,500 factories were dismantled and moved east by rail across the Ural Mountains before being rebuilt in semi-permanent structures and resuming production.¹¹¹ In addition to the prior evacuations carried out before the onset of hostilities, industry in individual districts would be given the order to evacuate or continue production as the Germans advanced.¹¹² After being moved, the factory equipment would quickly be reconstructed by work crews assembled from factory workers and evacuated civilians under NKVD leadership. These crews toiled in winter weather with minimal accommodations and were frequently comprised largely of

¹⁰⁸ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1917

¹⁰⁹ (D. M. Glantz 2011) Location 254

¹¹⁰ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1870

¹¹¹ Appendix N

¹¹² (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1867

women.¹¹³ Nevertheless, the relocated factories were re-established at a remarkable pace, with some factories reaching full production again within just three months in their new locations.¹¹⁴ Despite the confusion of the relocations and evacuations, the feat of moving so much industry eastwards on short notice was remarkable in its effectiveness, keeping the Soviet war machine safely out of German hands and providing the USSR with the tools necessary for the radical increase in wartime production necessary to fuel the Red Army's later offensives. Furthermore, the relocations brought a flood of industry to the sparsely-populated Ural region, rapidly becoming the heartland of Soviet industry. The Ural city of Chelyabinsk became a hub for armored vehicle production, becoming informally known as "Tankograd" because of the tens of thousands of tanks, engines, and millions of munitions that were produced there.¹¹⁵

The relocation of Soviet war industries to the interior proved to be a vital step in replacing the huge numbers of tanks that were lost in the initial months of combat. Although thousands of tanks were lost as the Germans advanced towards Moscow, by the end of the war the Soviet Union possessed more tanks than any other nation despite also suffering the highest losses of armored units.¹¹⁶ This simple fact illustrates the ability of Soviet heavy industry to manufacture the vast quantities of armored vehicles necessary for Soviet Deep Battle philosophy and also illustrates a difference in philosophy regarding the manufacturing of tanks with other nations. While Germany for example frequently possessed tanks with more ergonomic designs and more refined controls, guns,

¹¹³ (Manley 2007) 1

¹¹⁴ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1616--1746

¹¹⁵ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1889

¹¹⁶ (Krivosheev 1997) 253

and optics compared to their Soviet counterparts, tanks of the USSR were rather barebones in design. Initially even lacking radios, Soviet tanks were generally cramped, with only the barest accommodations for the crew, and of basic build and sometimes dubious construction quality. These concessions however made Soviet designs much easier to mass-produce as they largely lacked overcomplicated components and were sufficient, if not ideal, for the battlefield conditions they found themselves in. As the concept of Deep Battle relied on having large numbers of tanks in order to achieve multiple breakthrough simultaneously, this choice proved to be essential for ultimate victory.

In addition to requirements for large numbers of tanks to be utilized against the Germans, the central tenants of armored warfare were changing rapidly as the front progressed, a fact that was not lost on Soviet leadership. Despite not having a significant impact on the movement of the front itself, the early successes of the T-34 and KV's were recognized as having been the result of the better-armored designs, whereas the more numerous light tanks had failed. As a result, the production of the T-34 and self-propelled guns built on its hull became the major priority for Soviet armor production and production of traditional light tanks was scaled back significantly. This shift in armor priorities was mirrored and expanded upon by German forces, who also began fielding heavier and better-armed vehicles like the Tiger 1 and Panther in response to the appearance of the T-34.¹¹⁷

¹¹⁷ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 314

The speed and maneuverability of armored vehicles also became a priority. As tank design progressed over the decades, a clear shift towards faster and more maneuverable tanks was been an overarching trend, and the transition towards modern designs was perhaps the most readily apparent during combat on the Eastern Front. At the start of hostilities, light tanks dominated the battlefields of western Russia by sheer numbers. These tanks were designed to keep pace with infantry on the battlefield and could generally only reach a top speed of around 20 miles per hour, with earlier designs being even slower.¹¹⁸ A notable anomaly to this trend was the Soviet BT-7, a light tank capable of reaching a top speed of 56 mph on a flat surface, a tremendous speed for the time period¹¹⁹. Though the sun was setting on the period of light tank dominance, the speed of the BT-7 would carry over in part to the later T-34, the backbone of Soviet tank forces during World War 2. The T-34 was capable of reaching a speed of 33 miles per hour even off-road, despite being a much more heavily armed and armored vehicle than the earlier BT-series.¹²⁰ This speed combined with its wide tracks gave the T-34 impressive off-road abilities compared to its many contemporaries, early engine troubles notwithstanding, and allowed for a much more aggressive use of tanks to complete the Deep Battle maneuvers that would win the front.

Armor design also underwent significant changes during the war, catalyzed by the Soviet need for manufacturing efficiency and subsequent German encounters with these vehicles. Firstly, armor thickness greatly increased over the course of the war. Early light tanks such as Panzer III or T-26 frequently had only 15mm of armor or even less on all

¹¹⁸ (Bishop 2002) 36

¹¹⁹ (B., BT-7 2014) 1

¹²⁰ (Bishop 2002) 38, 39

surfaces.¹²¹ The appearance of the T-34, a medium tank with 45mm of armor at the front and 40mm everywhere else, proved a shock for German anti-tank weapons in its battlefield debut. This trend towards thicker armor continued, with the heaviest late-war designs of both sides frequently possessing armor averaging 100mm thick, with sections reaching up to 200 mm thick around the superstructure or gun mantlet, in response to larger main armaments coming into vogue.

Additionally, the pre-angling of armor became a secondary means of obtaining more protection from armor plating besides increasing plate thickness. When armored plates are set at an angle to an incoming shot, the amount of material the incoming shell must pass through to penetrate the tank increases with a greater angle, thus providing greater protection. The greater the angle a piece of armor is set at, the more “effective armor” the tank is provided. The T-34 made excellent use of this principle. Its main armor ranged from 40-45mm in thickness, and set at an angle of 45-60 degrees, providing over 90mm of effective armor.¹²² This was the source of the T-34’s near-invulnerability to enemy fire during Operation Barbarossa. This protection also applied to the KV, which used similar principles in its armor scheme. This gave the Soviet heavy tank a decisive advantage in battle against virtually every German tank the vehicles faced in the early days of the war. As combat dragged on through 1943, new German tanks appeared that also made use of this design, such as the Panther, Tiger II, and Jagdpanther.¹²³ New Soviet vehicles would continue to use this principle both to increase their effective armor protection and to reduce material costs in production.

¹²¹ (Bishop 2002) 12-13, 36

¹²² (Bishop 2002) 39

¹²³ (Bishop 2002) 14, 16, 47

Besides the new angling of tank armor, it was independently discovered by the main combatants in World War 2 that old methods of riveting tanks together presented serious liabilities for the crew. As rounds struck the vehicle, the rivets could become dislodged as the armor deformed under the stress of the shot. This caused rivets to fly around the inside of the tank as deadly pieces of shrapnel, frequently injuring or even killing crewmembers, even if the original enemy round had not penetrated the vehicle. This is a form of armor spalling and presented a significant risk to poorly-constructed vehicles. As a result, welding or casting became the primary methods by which tanks were constructed. Additionally, as heavier classes of vehicles became commonplace on the battlefield, Soviet and German vehicles in turn became increasingly bulky in a race to provide adequate armor to brunt the impacts of high-caliber main gun rounds.

As combat on the front progressed, the average caliber of main guns increased dramatically, for both the Soviets and German vehicles. German vehicles such as the Pz. III and Pz. IV were generally armed with guns in the 37-50mm range of calibers with the occasional low-velocity 75mm howitzer being found as well, most commonly on Stug III assault guns.¹²⁴ The numerous Soviet light tanks meanwhile were armed almost solely with 37mm guns. After encounters with the T-34, German High Command realized that their current tanks were not adequately armed to fight the T-34, and that the T-34 and KV were more than a match for German vehicles currently deployed on the front. As a result, designs were put into production for heavier tanks that could carry the 88mm KwK-36 main gun or similar heavy armament, such as the Tiger 1.¹²⁵ This weapon was derived

¹²⁴ (Bishop 2002) 116

¹²⁵ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 4026

from the 8.8 cm Flak 18 anti-aircraft gun the Germans had begun using in a direct-fire role as it was the only weapon they possessed in the early stages of combat on the Eastern Front that could reliably penetrate the new Soviet vehicles.¹²⁶ These new German tanks also boasted much thicker armor, increasing their overall size.

Soviet designers were somewhat slow to react by comparison, with the T-34 remaining in use as the primary Soviet tank, despite its armor being far from invulnerable and its gun no longer capable of penetrating heavy German vehicles from the front. In February of 1944 it was finally upgraded to the T-34-85, now utilizing an 85mm main gun that gave the tank new fighting potential against heavy German vehicles.¹²⁷ Additionally, new Soviet tank destroyers and heavy tanks such as IS-2, SU-152, ISU-152, and SU-100 carrying main guns in the 100mm-152mm range were deployed to counteract the heaviest German vehicles, with great success.¹²⁸ These vehicles were vastly better armed and armored than their earlier counterparts such as ZIS-3 or SU-76. Boasting massive guns utilizing high-explosive shells to destroy German vehicles via shock wave rather than direct penetration, these vehicles were much easier to produce in large numbers than their German counterparts. Their relative lack of specialized components and simple designs derived from vehicles with similar design principles made these self-propelled guns relatively cheap and easily mass-produced, while remaining combat-effective.

In addition to standards for armor, mobility, and armament for tanks increasing greatly as the Second World War progressed, so too did the role of tanks themselves

¹²⁶ (Forczyk, *Tank Warfare on the Eastern Front 1941-1942*: Schwerpunkt 2014) Location 6627

¹²⁷ (Forczyk, *Tank Warfare on the Eastern Front 1943-1945*: Red Steamroller 2016) Location 60

¹²⁸ (Bishop 2002) 41, 119

change. One marked difference in immediate post-war tank design is the movement away from a great diversity of types of tank “classes” of light, medium, and heavy tanks towards the concept of the modern main battle tank. Main battle tanks combine the elements of superior firepower, mobility, and armored protection into a single vehicle, shying away from the various tank classes that defined tank combat during the interwar and WW2 eras.¹²⁹ A close examination of tank combat on the Eastern Front can provide an explanation as to why this is so. Given the advancements in tank development made during this time, from increasing firepower, to angling armor to increase protection, and equipping medium and heavy tanks with newer engines that gave them greater speed, it gradually became possible to design tanks such as the T-34 that combined these characteristics into a single vehicle. This process simplified vehicle production considerably, and while other models of tanks and tank destroyers still saw heavy usage, the T-34 formed the bulk of the USSR’ tank forces by the end of the war, despite also taking the heaviest losses.¹³⁰ The increased armament and firepower of the T-34 without sacrificing speeds previously relegated to light tanks proved to be trend-setting. As heavier German vehicles became the norm, the T-34 was upgraded to the T-34-85 with a new 85mm main armament, a radical increase in caliber from the 37mm guns found on most pre-war tanks while maintaining its original speed, an important first step towards contemporary tank design.

Heavy tanks saw a similar trend towards increased armor protection without sacrificing speed. The KV tanks that fought alongside the T-34 in the early years of

¹²⁹ (Ogorkiewicz 2016) 1

¹³⁰ (Krivosheev 1997) 253

fighting were phased out of production by 1943, as their similar armor protection to the T-34 was not justified in the eyes of Soviet High Command by their increased cost of production. Instead, the *Iosef Stalin*, or IS class of heavy tanks entered service.¹³¹ These vehicles boasted far superior mobility to the KV-class, as well as increased armor protection, despite weighing less than their KV predecessors. This was accomplished by the IS-2's smaller physical profile than the KV-2, as well as shifting much of the armor to the front of the vehicle where the most enemy fire was expected.¹³² Simultaneously, the IS-2 carried a powerful 122mm main armament, continuing the trend of tanks boasting increased firepower over the course of the war.¹³³ This trend of single-purpose heavy tanks becoming obsolete in favor of more mobile vehicles boasting heavy tank-equivalent firepower continued long after the fighting on the Eastern Front ended and heralded the arrival of the main battle tank as the principal armored vehicle in modern warfare. The Soviet Union in particular encouraged this trend by making use of a select group of versatile vehicles to form the bulk of production, encouraging simplified, easy-to-maintain designs that balanced speed, armor, and firepower into a single weapons platform that could be easily mass-produced.

As tank development and production was refined and streamlined, the tide of war on the Eastern Front gradually shifted to the Soviet's favor, despite the appearances of increasingly heavier enemy armor on the battlefield. The T-34 and KV were no longer the invulnerable steel behemoths that had caught the Wehrmacht by surprise during Operation Barbarossa, but the USSR was now producing tanks at a rapid pace and was

¹³¹ (Zaloga, *IS-2 Heavy Tank 1944-73* 2011) Location 13

¹³² (Bishop 2002) 41

¹³³ (Bishop 2002) 41

able to bolster their armored forces despite the massive losses suffered in the early stages of the war. Further, production became focused almost exclusively on the T-34, with this single vehicle comprising over 55% of Soviet armored vehicles by the end of the war.¹³⁴ Even as the Red Army was repeatedly defeated and pushed back to the gates of Moscow and Stalingrad, Soviet tank development was continually refined and iterated on, as the light tanks that dominated the Soviet mechanized corps in the early days of fighting gave way to thousands of T-34's. These medium tanks were supplemented by heavier vehicles such as KV-1's and 2's, SU-series self-propelled guns, and ultimately the IS-series heavy tank. Additionally, Soviet tactics changed dramatically with the introduction of radios and more reliable equipment for their vehicles. Taking advantage of their superior numbers and ability to replenish combat losses, Soviet Deep Battle philosophy became an essential component of the war effort and led to the total defeat of the Germans' Army Group Center and ultimately Nazi Germany.

Overview of Major Engagements in the Eastern Theatre:

This next section will cover the general flow of combat in the east post-1941. Although Axis powers were able to take over huge swaths of Soviet territory, their offensives ground to a halt at Leningrad, Moscow, and Stalingrad. After heavy fighting through 1942, the tide of war changed to favor the Soviet Union and the momentum of the front was firmly in their favor by 1943. With this newfound fervor, massively increased vehicle production, and new tank designs, the Red Army was able to halt the German advance in the north by winter of 1941 and in the south around the Volga in the

¹³⁴ (Zaloga, T-34-85 Medium Tank 1944-94 2013) Location 304

winter of 1942. Hereafter, German forces would largely be on the defensive, though they continued to field increasingly heavy armored vehicles to stem the veritable tidal wave of T-34 medium tanks being fielded by Soviet forces. Nevertheless, the Soviet Union continued to refine their own armor designs, resulting in the T-34-85 medium tank, IS-2 heavy tank, and SU-152 and ISU-152 tank destroyers being fielded from 1943 onwards, paving the way for the ultimate victory in the theater against the existential threat posed by Nazi Germany.

In the aftermath of Operation Barbarossa and the subsequent Operation Typhoon, the German advance ground to a halt. This led to the formation of a massive front characterized by brutal combat, encirclements, and tank usage in unprecedented numbers. As winter set in, the Wehrmacht's assault on Moscow stopped short just 30 kilometers from the Kremlin, and similarly in the south as Germany took control of Rostov in the south but was unable to hold the city due to overextended supply lines.¹³⁵ The Germans encountered the T-34 and similar heavy Soviet vehicles in significant at the Battle of Brody, one of the largest tank battles in history.¹³⁶ Despite the ultimate Soviet defeat, the unexpected appearance of Soviet vehicles virtually immune to German fire kickstarted development in Germany on heavier vehicles that would characterize armored engagements in later years. The direct threat to Moscow was eliminated as fresh units were transferred in from far eastern Russia, upon Japan's declaration of neutrality towards the USSR.¹³⁷ Additionally, the successful evacuation of Soviet industry to the Urals ensured that the Soviet war machine would be able to maintain production levels

¹³⁵ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 2408

¹³⁶ (Forczyk, *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt* 2014) Location 1432

¹³⁷ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 446

and supply the Red Army for years to come. Meanwhile, the Stavka launched the Winter Offensive of 1941-42, seeking to rout Army Group North with offensives led by battalions of ski-troops as well as airborne infantry, meant to drop behind enemy lines and encircle their foes.¹³⁸ The parachute actions largely failed, but overall the situation of the fighting in the north improved slightly, with Soviet forces advancing 70-100 km into territory previously held by Army Group North, securing the northern section of the front and Moscow for the immediate future.¹³⁹

Even as Moscow was secured against the Nazi threat, Axis troops continued to advance south towards the Caucasus during 1942. This offensive, known as Case Blue, was to be a further advancement of the progress made during Operation Barbarossa the previous year. Two objectives were to be completed, with Army Group South being subdivided into Army Group A and Army Group B.¹⁴⁰ The first objective was to secure the Baku oilfields and cross the Caucasus, while the second was to secure this advance by controlling the Volga river and the important industrial city of Stalingrad. The oilfields were of immense importance to Nazi Germany because of the heavy level of mechanization of its armed forces.¹⁴¹ The Luftwaffe, Kriegsmarine, and Panzerwaffe all demanded enormous amounts of oil in order to function, and at the outbreak of war Germany imported 85% of its oil, primarily from the United States, Venezuela, and Iran. The blockade that came into effect after the invasion of Poland largely cut off Germany from these resources, leaving them dependent on synthetic oil and the oilfields of

¹³⁸ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 1804

¹³⁹ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 2626

¹⁴⁰ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 2913-2934

¹⁴¹ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 2887

Romania.¹⁴² As Romanian supplies began to dwindle in late 1941, the need for the supplies of the Caucasus became critical to the German war effort. Additionally, taking the Baku oilfields would deprive the Soviet Union of approximately 80% of its own oil, dealing a severe blow to the USSR's logistics and mechanized corps.¹⁴³ Luckily for the USSR this would never occur, the panzer divisions were unable to push on to Baku when faced with heavy Soviet resistance and the limited range of their aircraft to provide cover. Upon reaching the outskirts of Ordzhonikidze, the Germans were finally forced to retreat and the offensive halted.¹⁴⁴ With the totality of Army Group South stopped in the south at Ordzhonikidze and Stalingrad respectively, the German advance was largely halted, and would not hold out long-term in the face of increasing Soviet opposition.

As Army Group A attempted to take the Caucasus region, Army Group B moved to secure the city of Stalingrad to the north. In addition to serving as an important manufacturing hub, Stalingrad had a significant amount of propaganda value attached to it as a symbol of its namesake, Josef Stalin. As such, Stalingrad became the site of the largest battle in human history, with over 1.1 million Soviet casualties and as many as 800,000 Axis casualties over the five months of combat.¹⁴⁵ The Battle of Stalingrad was marked by intense urban fighting and the use of snipers, with the traditional roles of tanks largely being supplanted by infantry in close-quarters engagements. Armored vehicles were often used as roadblocks and stationary fighting positions instead.¹⁴⁶ However, a key plant in Stalingrad that produced T-34's continued to do so despite German forces

¹⁴² (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 4833

¹⁴³ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 4836

¹⁴⁴ (D. Glantz, When Titans Clashed: How the Red Army Stopped Hitler 2015) Location 3173

¹⁴⁵ (Limbach 1998) 1

¹⁴⁶ (Mironovich 2014) 1

closing to within several blocks, sending T-34's fresh off the assembly line directly into combat without paint or extensive testing of the vehicles' systems.¹⁴⁷ In November 1942, after months of intense fighting, the Soviets launched Operation Uranus, a pair of armored spearheads across the Don river in flanking maneuvers that surrounded the city, leaving the German 6th army trapped inside. The 6th Army was unable to break out and ran critically low on supplies after a failed airlift attempt, leading to their surrender in January of 1943. Due to the massive scale of Stalingrad and the fact that the Volga offensive was one of the last launched by Germany on this front, the Battle of Stalingrad is considered to be a critical turning point in the war as a whole. With Stalingrad surrounded, the Red Army was able to march westwards towards Kursk and Kharkov. After intense combat, a well-fortified salient was established at Kursk but Kharkov's key factories fell once more into German hands in the face of a stiff counterattack by SS Tiger battalions.¹⁴⁸

As the summer of 1943 arrived, Hitler grew desperate to make a last great offensive in the east to buy time to pivot his forces against the encroaching Western Allies. It was decided that Operation Citadel, an offensive to cut off the Soviet's salient at Kursk, should be launched to secure the southern portion of the front.¹⁴⁹ However, armed with intercepted German communications provided by British intelligence, the USSR has adequate time to prepare defenses.¹⁵⁰ These consisted of deep belts of interlocking anti-tank guns and minefields designed specifically to slow an advance by German armor.

¹⁴⁷ (Zaloga, T-34/76 Medium Tank 1941–45 1994) Location 305

¹⁴⁸ (Forczyk, Tank Warfare on the Eastern Front 1943-1945: Red Steamroller 2016) Location 1905

¹⁴⁹ Appendix P

¹⁵⁰ (D. Glantz 2015) Location 4234

German forces in turn delayed beginning the offensive in favor of waiting for new heavier armored vehicles like the then-new Panther medium tank and Elefant tank destroyer, as well as additional Tigers. After several days of fighting, Soviet forces had lost over 5,000 tanks and taken over 300,000 casualties, with many of these occurring at Prokhorovka, where a major armored engagement occurred.¹⁵¹ Despite these losses, the German offensive was repulsed and the salient remained in Soviet hands. This engagement proved to be the last strategic-level offensive the Wehrmacht was able to mount in the East; the Battle of Kursk and subsequent offensives placed the momentum of the front for the remainder of the war firmly on the side of the Soviet Union. Moreover, new German armor designs were unable to overcome the superior numbers of Soviet armored vehicles present, while they also proved vulnerable to new Soviet self-propelled guns such as the SU-152. This became a common trend as the war progressed from 1943 to 1945, though Germany continued to field increasingly well-armed and armored vehicles, the Soviet Union countered with increasing numbers of tanks that were competent enough for their roles, if not ideal, and much cheaper to produce.

By the summer of 1944 Germany was fully on the defensive, with weakened units being forced to retreat further and further through conquered territory towards Berlin.¹⁵² Despite continuing to suffer heavy losses on Soviet forces, the Red Army was consistently able to provide new reserves and material for the war effort to replenish their forces. By June of 1944, Army Group Center was the lone holdout in the front holding eastern territory, stubbornly defending Belorussia. Despite this massive salient, German

¹⁵¹ (Erickson 2015) Location 2679

¹⁵² (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 5071

High Command thought that any further Soviet offensives would occur in the south, where routes to Berlin and the Romanian oil fields would be more direct. Additionally, the Western Allies' landings at Normandy had diverted German troops to defend the new Western front in France.

Meanwhile, Soviet forces were allowing the Germans to believe that this was the case, while secretly moving dozens of divisions north in preparation to enter modern-day Belarus. This technique, known as *maskirovka*, was codified Russian doctrine utilizing military deception techniques to hide the movements of friendly forces and upcoming plans to inflict maximum surprise on the enemy.¹⁵³ After all 120 Soviet divisions were in place, they swept through the German lines with Operation Bagration, liberating Belorussia and shattering Germany's Army Group Center.¹⁵⁴ The overwhelming forces that the Soviets were able to bring to bear in this engagement was a prime example of "Deep Battle", where Soviet forces created huge breakthroughs in the German lines before pouring fresh units through the breaches to completely dismantle the enemy's logistics networks, as well as encircling their front lines and removing the enemy forces from the battle space.¹⁵⁵ Tanks were an essential component of these breakthrough units, as highly mobile heavy weapons were critical for disrupting enemy supply chains and surround vast numbers of German infantry. With over 4,000 tank and assault guns committed to this offensive, the Red Army was able to quickly surround entire armies and overwhelm German tanks present through sheer numbers. With this action completed, the Soviet Union regained huge amounts of territory from German control,

¹⁵³ (D. Glantz, When Titans Clashed: How the Red Army Stopped Hitler 2015) Location 4197

¹⁵⁴ (D. Glantz, When Titans Clashed: How the Red Army Stopped Hitler 2015) Location 5083

¹⁵⁵ (D. Glantz 2015) Location 294

and with the severe losses suffered Germany was forced to transfer units from the Italian front to the East to bolster their lines.

By April of 1945, Nazi Germany's fate was sealed but the forces of the Third Reich fought practically to the last man to defend Berlin, the capitol. As Soviet forces approached the city, heavy fighting took place at the Seelow Heights, known as the gates of Berlin the Red Army committed hundreds of thousands of men to single-handedly taking the capitol and suffered enormous casualties in men and armor.¹⁵⁶ With the outer suburbs captured, the Red Army proceeded to surround the city, completely cutting Berlin off from the outside world. Throughout the battle, huge amounts of shelling took place, with the Red Army dropping more ordnance on the city than the Western Allies had in their bombing campaigns the two previous years. The main goals were to disrupt German defensive lines and remove critical enemy strongholds like the massive flak towers that had been repurposed for use against Soviet ground forces, but German forces offered stiff resistance, nonetheless. Despite the significant breakdown in military structure at this point in the war, German forces comprised mainly of *Volkssturm* and *Hitlerjugend* militia forces armed with Panzerfausts and any military surplus available held off the final defeat for nine days.¹⁵⁷ In addition to the militia forces, Wehrmacht and scattered groups of tanks participated in the fighting. With many units drastically reduced in size from previous fights, haphazard groups of tanks and infantry were assigned to defend various sectors. Nearly every German armored vehicle then in production saw combat in some degree at Berlin, from early-model Tiger 1's that fought near the

¹⁵⁶ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015) Location 6574

¹⁵⁷ (Erickson 2015) Location 13736

Brandenburg Gate to Panther medium tanks dug into the ground as fixed emplacements. In an interesting historical twist, a pair of destroyed Mark V British WW1-era tanks were found in the city center. While it is unclear to what extent if any they participated in the battle, it seems that they were originally captured from the White Russian Army by the victorious Red Army during the Communist Revolution in Russia. This pair of vehicles were in turn captured by German troops in Smolensk during their advance into the USSR years later, before being sent back to Berlin and eventually being destroyed in the fighting in 1945.

Meanwhile, Soviet forces advanced into the city, with units of submachinegun troops covering tank's vulnerable flanks and tops from *Panzerfaust* attacks from defending *Volkssturm* troops. These cheap disposable antitank weapons inflicted many Soviet armored casualties during the fighting in previous engagements, so having ground troops to make up for the tanks' limited visibility in dense urban environments was of prime importance. Tanks and tank destroyers of all kinds saw combat, with primary contributing vehicles consisting of the T-34-85, IS-2, and ISU-152 due to their enclosed nature, powerful armaments, and comparatively safer use in urban environments. The ISU-152 in particular saw heavy use destroying enemy-held buildings, its original purpose before being pressed into service as a heavy tank destroyer. As the Red Army continued to push into the city, their armored units' advance was stalled in places by Berlin's flak towers, massive concrete fortifications fitted with anti-aircraft guns originally designed to protect the city from bombing raids. Now they turned their 128mm main armaments towards the ground, halting the Soviet tank advance towards the city

center.¹⁵⁸ Despite the immense Soviet bombardment of the city, these fortifications were able to withstand direct 203mm mortar fire, and thus were not captured until their garrisons surrendered at the end of the battle¹⁵⁹. Meanwhile, Soviet troops captured significant installations such as the Reichstag and Tempelhof Airport, at great cost, and pressed German civilians into service clearing the runways for use by the Red Air Force. After several days of fighting, the German defenders were split in half, then gradually reduced to small isolated pockets of only the most fanatical troops, who were eliminated from strongpoints after the German surrender by simply reducing their buildings to rubble.

With Hitler dead and the Wehrmacht shattered, VE day arrived on May 2nd, 1945, ending years of fighting that devastated Europe, and leaving Imperial Japan as the sole Axis power to face the combined might of the Allied forces. As the fighting in Berlin came to a close, surviving German civilians were fed at Red Army soup kitchens, while any uniformed services, from fire-fighters to military and *Volkssturm* were rounded up and sent to the east as prisoners of war.¹⁶⁰ Though the fighting was over, widespread looting and rapes were reported as the vengeful Red Army took what they felt was their right as the spoils of war after years of fighting across thousands of miles and the devastation to their homeland suffered at German hands. Stalin was reported as having stated in response to the allegations, “I understand it if a soldier who has crossed

¹⁵⁸ (Tissier 2005) 207

¹⁵⁹ (Tissier 2005) 208

¹⁶⁰ (Erickson 2015) Location 14392

thousands of kilometers through blood and fire and death has fun with a woman or takes some trifle.”¹⁶¹

¹⁶¹ (Djilas 2014) 95

Part 3: Soviet Tank Development

While tanks proved to be a critical component of many countries' ground forces during the war, their designs changed significantly as the war progressed. Design differences between nations are also readily apparent, based on aesthetic decisions, differing manufacturing methods, and battlefield priorities. As opposed to their German counterparts who prioritized crew ergonomics and manufacturing quality in their tank designs, the Soviet Union focused primarily on making tanks that were cheap to produce and easy to manufacture. In addition, the Soviet Union always prioritized having large numbers of tanks in its inventory once armored vehicles became a battlefield mainstay. Throughout the war the Soviet Union generally possessed between 4 and ten times the number of armored vehicles that Nazi Germany did on the Eastern Front.¹⁶² This was especially important for enacting the "Deep Battle" strategy developed by Soviet strategists, as large numbers of fresh combat units would be called upon to exploit the multiple breakthroughs made by the initial wave of troops. Despite this strategy being largely sidelined in the aftermath of Stalin's purges and only gradually being re-learned in the latter half of the war, the large numbers of tanks produced for such a strategy arguably helped elevate the USSR's manufacturing ability in the pre-war period. This experience proved vital to the massive rebuild of the USSR's industrial capacity post-evacuation, as many factories in western sectors had to be broken down and moved east to preserve the Soviet Union's war material.¹⁶³

¹⁶² (D. M. Glantz 2011) Location 2779

¹⁶³ (D. Glantz, *When Titans Clashed: How the Red Army Stopped Hitler* 2015)

With the stated goals of tanks needing to be competent, cheap, and reliable, some common trends among Soviet armor design become apparent. Contrasting with their German counterparts, Soviet armored vehicles commonly utilized features such as rough construction with rather “lenient” quality assurance, cast turrets, angled armor, wider tracks, cramped crew compartments, and larger-caliber guns. These features made Soviet tanks visually distinct from their German counterparts and also highlight the USSR’s goals of manufacturing their vehicles cheaply and in great quantities. Rudimentary manufacturing techniques compared to the Germans, as well as the severe reliability issues experienced by early Soviet designs also highlight the relative youth of the Soviet Union’s industrial and manufacturing sector compared to Western Europe and Germany at the time. Nevertheless, as the war progressed, Soviet tanks became more refined in their construction, as well as better armed and armored, leading to the USSR possessing the largest and most heavily-armed tank forces in the world at the end of the war.

To better understand the influence of Soviet tank design on the outcome of the war, several vehicles of various types from throughout the war will be examined in greater detail to illustrate how Soviet priorities in armor design evolved over the course of the fighting. The Nazis began fielding significantly heavier armored vehicles from 1942 onwards that existing Soviet designs could not effectively engage. Additionally, older designs rapidly became obsolete and required updated parts or outright replacement, necessitating the development of new vehicles. To this end, the following tanks will be examined in greater detail: The T-34 medium tank, the KV heavy tank family, the SU-76 self-propelled gun, the SU-152 and ISU-152 self-propelled guns, the SU-100 tank destroyer, and the IS-2 heavy tank. These vehicles, particularly the T-34,

epitomize Soviet design ideals during the war, and were produced in massive quantities to repel the might of the Wehrmacht.

The T-34 Medium Tank:

There is perhaps no other tank that epitomizes Soviet armor during the Second World War as much as the T-34 medium tank. The T-34 and its variants comprised over 55% of all armored vehicles being fielded by the Soviet Union by the end of the war, becoming by far the most ubiquitous Soviet vehicle on the battlefields of the Eastern Front.¹⁶⁴¹⁶⁵ Notably well-armed and armored by the standards of the day, the T-34's rugged and cheap manufacturing allowed this highly versatile medium tank's design to be gradually upgraded over the course of the war to both save costs and improve its effectiveness as a fighting vehicle. Bringing an unprecedented level of firepower, speed, and armor in a single package to the battlefield, the T-34 has frequently been cited as one of the most effective and versatile designs of the war and proved to be a revolutionary step in tank design that spurred development towards the "universal tank". Additionally, the T-34 was one of the longest-serving armored vehicles of the Soviet Union, remaining in continuous service from the initial German invasion through the end of the war in Europe in May 1945 and well into the Cold War. In practically every major armored engagement of the Eastern Front, the T-34 comprised the bulk of Soviet armored forces on the field, serving as a versatile armored vehicle for a variety of offensive operations. In addition, the T-34's base hull design was converted into variant vehicles to serve more niche purposes as the war progressed, from the casemate-style SU-85 and SU-100 tank

¹⁶⁴ Appendix S

¹⁶⁵ (Krivosheev 1997) 250

destroyers to the OT-34 flamethrower tank. Though by the end of the war the T-34 was no longer the nigh-invincible fighting machine it was in 1941 and tens of thousands had been lost to enemy fire, the T-34 was undoubtedly a pivotal vehicle that influenced tank design for decades to come.

When the T-34 first entered service one of its most remarkable features was its speed, particularly for a tank of its size. Its speed however was unprecedented for a medium tank. When tanks were first introduced to the battlefield during World War 1, they were pushing the limits of mechanical technology of the day with the engines they equipped. This was not considered a major disadvantage however, as tanks were initially conceived as only moving with infantry to provide cover and fire support and so speed was not a major priority. This philosophy changed with tanks of the late war and interwar periods as engine technology improved and the revolutionary French tank Renault FT entered service. This was one of the first tank to use a modern configuration of placing the main armament in a fully-traversable turret rather than the hull, and this new gun mobility as well as the Renault's speed changed tank design forever. With improving engine technology tanks could now reach a much greater top speed than World War 1-era designs, though high mobility was still limited to lightweight vehicles. In the Soviet Union, this led to large numbers of light tanks being produced in the pre-war period, slower-moving T-26 infantry tanks to support ground troops, and much faster BT-series tanks. The speed of the latter was due to the use of the Christie suspension, of American design, which permitted the use of large roadwheels working in concert with tank treads to propel a tank to much greater speeds; the BT-7 was able to reach 86 kilometers per hour on roads, and 50 km/h when traveling cross-country.

The T-34 kept this suspension system but used the powerful Model V-2-34 engine to maintain a relatively high speed of 53 km/h despite its considerable weight increase compared to earlier Soviet armored vehicles.¹⁶⁶ As the war progressed, this engine was optimized to produce more power in order to maintain the vehicle's mobility as additional armor and other components were added with versions such as the T-34-85. With this engine, the T-34 was now able to traverse the battlefield at speeds once only achievable by lighter scouting vehicles. This dramatic shift in engine power enabled the Soviet Union to pivot tank production almost exclusively towards the T-34, as vehicles that would have once been used to fill niche roles like scouting were now superfluous. Additionally, the T-34 used a diesel engine with a pneumatic starting system, which allowed it to operate much more reliably in the cold Russian winters and made the vehicle more resistant to catching fire.¹⁶⁷ The T-34 also utilized wide treads that helped it travel cross-country as well as "float" to some degree above mud and snow, preventing it from being bogged down in the bi-annual *rasputitsa*, or mud season, like its narrow-tracked German counterparts.¹⁶⁸

In addition to its unprecedented speed for a vehicle of its size, the T-34 also used an innovative armor layout that granted it dramatically better protection than other vehicles in its class. The T-34's armor gave the tank a distinct trapezoidal appearance due to its significant angling. Despite the alien look compared to other tanks of the day, this armor scheme provided excellent protection due to the angling, the T-34 model 1941 had effectively 60mm or greater of armor on all sides due to this unique scheme. After the

¹⁶⁶ (Bishop 2002) 39

¹⁶⁷ (Zaloga, T-34/76 Medium Tank 1941–45 2013) Location 62

¹⁶⁸ (Zaloga, T-34/76 Medium Tank 1941–45 2013) Location 375

initial shock of encountering the T-34 in combat, new German tanks began to incorporate similar designs to take advantage of the additional protection without increasing armor thickness. In addition to providing greater protection, the tank's trapezoidal appearance reduced the vehicle's surface area, simultaneously creating a smaller target for enemy gunners, cutting the cost of materials needed to construct the vehicle, and streamlining production due to the simple overall shape. The downside to this was that the reduced surface area also reduced the internal volume of the vehicle, contributing to cramped conditions for crewmembers.¹⁶⁹ Additionally, the welded construction rather than riveting of the armored plates together removed one source of spalling, a frequent cause of crew injury to tanks of the period. Upon being struck by enemy fire, riveted armor plates tend to bulge inwards, such that even if the enemy projectile does not penetrate the vehicle rivets and fragments can fly off the plate and cause severe injury or death to the crew inside the vehicle.¹⁷⁰

The T-34 lost much of its initial invulnerability as the war progressed, as upgrades to its armor layout generally occurred more slowly than the opposing Germans were able to field more heavily-armed tanks. Additionally, Soviet industry was able to replenish losses and so improving the tank's armor at the expense of its mobility was not considered to be a high priority. Indeed, despite taking heavy losses during the years of combat, the T-34 emerged from World War 2 as the most-produced tank of the war, with over 56,000 vehicles produced. The T-34 was by May 1945 the most numerous tank by far in the Soviet inventory, an astonishing feat due to their high losses. Almost 40% of all

¹⁶⁹ (Fedorovich 2010) 1

¹⁷⁰ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 3571

T-34's produced during the war were lost, either due to combat, breakdown, or intentional destruction by their crews to prevent them from falling into enemy hands.¹⁷¹

Nevertheless, the T-34 evolved significantly from its original 1941 configuration over the following years. Throughout its life the T-34 received numerous upgrades to its main armament and crew ergonomics, as well as its armor. Though upgrades to the hull were incremental through 1943, the upgraded T-34-85 entered full production it boasted significant changes. The new version included 90mm equivalent of frontal hull armor as well as a newly expanded turret.¹⁷² This housed both the new 85mm main gun and provided additional protection for the crew, with additional armor added to the turret on all sides as well as an upgraded gun mantlet. Additionally, quality control and metallurgy improved significantly over the course of the war; while many early model T-34's had cracks and gaps in their armor, as well as weak turret castings, general armor quality improved significantly in the later stages of the war.¹⁷³ Finally, some T-34's received additional armor by way of *applique* armor plates, steel plates attached to the tank once the vehicles were in the field.¹⁷⁴

In addition to its revolutionary mobility and armor schemes, the T-34's main armament was also notable. At the outset of the war, standard armaments on tanks were much lower caliber than by the end of the war. 37mm was a standard caliber used on many tanks of the day, notably among German vehicles serving on the Eastern Front such as the Panzer III. Despite the anticipation that many of their tanks would need to be

¹⁷¹ (Krivosheev 1997) page 258

¹⁷² (Bishop 2002) 39

¹⁷³ ([Redacted] 1951) 8

¹⁷⁴ (Zaloga, T-34-85 Medium Tank 1944–94 2013) Location 725

upgraded with heavier weapons eventually, the presence of the T-34 prioritized this size increase. In addition to its armor, the T-34 used a comparatively large 76mm main cannon, more than adequate for knocking out any armored vehicle the Germans were fielding at this stage of the war. To better combat these new vehicles, the Panzer III's planned upgrade was accelerated as it was fitted with a 50mm main gun, and the Panzer IV was refitted with the L75 75mm main gun.¹⁷⁵ New German tanks and tank destroyers would be fitted with 75 and 88mm guns, as 75/76mm armament became a new battlefield standard. Though the T-34's 76mm gun was reasonably accurate, it suffered when penetrating later German tanks such as the Tiger and Panther.

In the later stages of the war as encounters with heavier German armor became more often, the 76mm gun the T-34 was equipped with was determined to be inadequate for the needs of the Red Army.¹⁷⁶ The T-34 was completely unable to penetrate vehicles such as Tiger 1, Panther, and Ferdinand from the front, and only at close range from the sides and rear.¹⁷⁷ This compromised Soviet tankers' ability to engage targets effectively at long ranges as these heavier vehicles became commonplace on the battlefield. After research and experimentation, the T-34 was equipped with a new 85mm gun and redesignated T-34-85.¹⁷⁸ This new gun gave the T-34 a much-needed boost in firepower, enabling it to engage heavy German armor with much greater effectiveness than with the old gun. The larger faster round was capable of penetrating the Tiger 1 through its thickest frontal armor from 500 meters, putting the T-34-85 on more equal footing with

¹⁷⁵ (Bishop 2002) 13

¹⁷⁶ (Zaloga, T-34-85 Medium Tank 1944-94 2013) Location 15

¹⁷⁷ (Zaloga, T-34-85 Medium Tank 1944-94 2013) Location 15

¹⁷⁸ Appendix T

its heavier opponent though the T-34-85's armor still could not match the sheer thickness of the Tiger.¹⁷⁹ Due to its larger size, the new 85mm cannon necessitated a larger turret be developed for the T-34-85, physically distinguishing the tank from its predecessors. This new turret provided a key logistics improvement for the operation of the tank in the form of space for an extra crewmember, as well as some additional armor. This extra crewmember took on some of the gun-loading duties from the previously overburdened tank commander, greatly increasing operational efficiency.¹⁸⁰

Though the T-34 was a highly influential tank design and undoubtedly helped the Soviet Union beat the Axis powers, the tank was not a perfect machine. In the early days of deployment, the tank faced numerous issues relating to its general unreliability, poor internal layout, issues with gun handling and optics, and general cheap construction negatively impacted the vehicle's performance. As the war progressed many of these issues would be addressed through improved construction methods that both reduced the cost of production while gradually improving the T-34 and other vehicles in the Soviet arsenal. Major upgrades such as the transition from the base T-34 to the T-34-85 also greatly improved the tank's usability and battlefield performance.

When the T-34 first entered service, it used a much narrower, 2-man turret than its later iteration the T-34-85. While minor variances in cast versus riveted construction existed alongside cosmetic differences between factories, the interior structure and operation of the early T-34 turrets remained the same. This proved to be a critical weakness that severely hindered the tank's ability to operate effectively. With the two-

¹⁷⁹ (Forczyk, *Tank Warfare on the Eastern Front 1943-1945: Red Steamroller* 2016) Location 5407

¹⁸⁰ (Zaloga, *T-34-85 Medium Tank 1944-94* 2013) Location 103

man configuration, the commander of a given vehicle was forced to aim and fire the gun, in addition to coordinating the rest of the crew and acquiring targets.¹⁸¹ German tank crews noticed this deficiency and slow rate of fire of the T-34' gun, due to the multitasking by the commander.¹⁸² In addition, the small turret was a physically cramped space, and so the later 3-man turret of the T-34-85 greatly increased operational efficiency as well as mounting a larger weapon. The addition of an extra crewmember to serve as a dedicated gunner relieved the overburdened commander and allowed targets to be engaged more quickly.

Operational deficiencies with the T-34's turret extended further than it's cramped interior space. The various T-34 and T-34-85 models also lacked a turret basket, a key feature of modern tanks.¹⁸³ A turret basket is a section of the floor of the tank that rotates with the turret as it turns, providing a stable platform from which to man the gun in any direction. The T-34 and later T-34 -85 lacked this feature, as a result the tank's loader was at serious risk of injury if the turret were to turn expectedly and at speed.¹⁸⁴ This problem was further compounded by the storage of much of the tank's ammunition in boxes under mats on the floor of the vehicle, creating the surface on which the crew stood and fought. Once a T-34 in combat expended its "ready" ammunition stored in racks on the insides of the turret and hull, more ammunition would need to be brought up from these boxes. This created a mess of open ammunition containers, grease, rubber matting and spent shell casings that further increased the risk of injury to standing crewmembers

¹⁸¹ (Zaloga, T-34-85 Medium Tank 1944–94 2013) Location 41

¹⁸² (Zaloga, T-34/76 Medium Tank 1941–45 2013) Location 520

¹⁸³ (Zaloga, T-34-85 Medium Tank 1944–94 2013) Location 389

¹⁸⁴ ([Redacted] 1951) 8

and slowed operations of the vehicle during combat. This problem was never fully addressed apart from the gunner and commander's seats being attached to the turret, the loaders of the T-34 and later T-34-85 were forced to remain light on their feet in the heat of battle and contort themselves around the rotating gun breech.

Another critical weakness of the T-34 was its lack of a radio in the early production models.¹⁸⁵ At the outset of combat on the Eastern Front, radios had become a standard feature of practically all German tanks, a necessity for the close coordination *blitzkrieg* tactics required, however this was not the case for Soviet vehicles.¹⁸⁶ Radios were rare, even for command tanks in 1941, and so crews communicated instead with signal flags and by staying within visual and auditory range of one another, or by using pre-planned patrol routes.¹⁸⁷ These limited the range of the T-34 severely, shortening the distances at which they could operate from command centers, and these issues were compounded by the vehicle's other reliability issues. Later in the war radios became standard issue, but at the outset of hostilities the lack of communication equipment severely hampered coordination between individual units and Soviet leadership. This was noted by German troops in early T-34 encounters who remarked on the vehicle's notable armor, but also stated that the T-34's fired slowly and rarely concentrated their firepower on a single vehicle.¹⁸⁸ Instead Soviet commanders were searching for targets independently, which was made even more difficult due to the vehicle's mediocre optics and viewports.¹⁸⁹ At the command level, Soviet tank battalions were poorly coordinated

¹⁸⁵ (Zaloga, T-34/76 Medium Tank 1941–45 2013) Location 352

¹⁸⁶ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) location 422

¹⁸⁷ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 997

¹⁸⁸ (Merc 2013) 1

¹⁸⁹ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 621

due to incompetent leadership and poor tactics, both of which were exacerbated by the lack of radios and led to poor coordination of armor and the loss of hundreds of vehicles in the face of the well-organized German onslaught.

Finally, a discussion of the issues with early model T-34's would not be complete without mentioning the engine. Despite the innovative wide tracks that allowed the T-34 to ride over mud and snow without becoming bogged down, the early models suffered from engine reliability issues that caused hundreds of vehicle losses and severely hindered the T-34's operational effectiveness at the outset of the war.¹⁹⁰ Shifting gears was difficult, as one American report noted, and transmissions were unreliable with early models.¹⁹¹ The transmission was so prone to failure in fact that several T-34's drove to engage the Germans during Operation Barbarossa with extra transmissions cabled to their engine decks, to replace the installed one when it failed.¹⁹² Additionally, the engine filters on early T-34's were totally ineffective. Examined Soviet vehicles at the Aberdeen proving ground revealed that the dust filters on the T-34 tested permitted large amounts of particulates into the engine, quickly and irreparably damaging various components.¹⁹³ Later Cyclone and Multi-Cyclone filters on later T-34 and T-34-85 models solved these issues and led to much greater engine reliability despite the huge cost cuts achieved as the manufacturing process was refined. Finally, the all-steel tracks of the T-34 were also unreliable upon initial deployment. Despite being made of steel, the tracks were of quite light construction and were prone to tearing on sharp turns.¹⁹⁴ Additionally, the pins that

¹⁹⁰ (B. 2014) 1

¹⁹¹ ([Redacted] 1951) 8

¹⁹² (Zaloga, T-34/76 Medium Tank 1941–45 1994) Location 152

¹⁹³ ([Redacted] 1951) 9

¹⁹⁴ (Fedorovich 2010) 1

held the segments together could easily come loose and lead to the vehicle becoming immobilized. These issues would be fixed via improved metallurgy and a small metal plate welded to the exterior of the tank that would force the pins back into place as they rotated past.

In summary, the T-34 was a highly innovative, if imperfect medium tank of the Second World War. Despite its shortcomings, the tank introduced many novel design features including high speed for a tank of its size, a high caliber gun, wider tracks, sloped armor, and the extensive use of cast components in its construction, that would have a dramatic impact on future tank design. Though the tank was plagued by poor crew training, ergonomics, engine issues, and a critical lack of communication equipment, the T-34 gave the Germans serious pause upon their first encounters. Its revolutionary armor layout for its size and high gun caliber set a new standard for future armored vehicles, and the T-34 quickly reached record production numbers to become the principle Soviet battle tank of the second World War. Playing a critical role in ground operations throughout the fighting on the Eastern Front, the T-34 gave the Soviet Union a rugged and easy-to-produce solution to the country's need for modern armored fighting vehicles. While not a perfect tank, the T-34 made up for its deficiencies via sheer numbers, as well as incremental upgrades that turned a revolutionary design into a competent fighting vehicle, the T-34-85, capable of going toe-to-toe with late-war German armor.

KV-Series Heavy Tanks:

In addition to the T-34, another key tank family of the early war period was the Kliment Voroshilov, or KV series heavy tanks. The KV-1 was the T-34's new companion

tank, developed and entered service during the same timeframe.¹⁹⁵ The KV-1 was more heavily armored than the T-34 and designed to further the concept of a “breakthrough tank” that had been popularized by the first tanks during World War 1. When tanks first emerged on the battlefield, their main objective was to break through enemy defenses and put an end to the stalemate of trench warfare. To this end tanks were built to be very large and utilize multiple weapon emplacements, while speed was not a priority to allow infantry to keep up with the lumbering vehicles. After World War 1 new tanks were designed to be smaller and faster, but the concept of the breakthrough tank remained popular and thus the KV was born. Utilizing much thicker sloped armor and a heavier 76mm gun than its predecessors, the Soviet Union designed the KV with similar features to the T-34 but on a larger scale. Weighing 45 tons and measuring almost 7 meters long, the KV undoubtedly earned its German nickname, the “*Russischer Koloss*”, or Russian Colossus from the Wehrmacht troops who faced it.¹⁹⁶

Like the T-34, the KV-1 made use of angled armor, which increased effective armor protection, the same 76mm main gun, and wide tracks that enabled the vehicle to traverse difficult terrain such as swamps and snow without becoming bogged down. Though its armor was not set at as shallow an angle as the T-34, the KV’s armor plating was thicker, at up to 90mm thick in places, granting it similar, if not greater levels of protection.¹⁹⁷ Finally, the KV possessed a larger three-man turret from the outset of production that gave the vehicle similar levels of firepower and greater operating efficiency. In addition to the 76mm-armed version, the KV-1, other variants of the vehicle were also put into

¹⁹⁵ Appendix U

¹⁹⁶ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 1306

¹⁹⁷ (Zaloga, KV-1 & 2 Heavy Tanks 1939–45 1996) Location 554

production to meet various needs of the battlefield. The KV-1 was the default configuration and most common variant produced, with over 3,000 units produced.¹⁹⁸ At the outset of Operation Barbarossa it was an effective battlefield weapon, though numerous vehicles were lost due to poor deployment, communication, and poor strategic-level maneuvers¹⁹⁹. As the Germans advanced into the USSR, several reports emerged of lone KV's halting the advance of entire divisions and bouncing dozens of rounds off their thick armor, coining their nickname.²⁰⁰ Nevertheless, the KV-1 was unable to halt the German advance by a significant degree and Soviet forces were rapidly pushed back in 1941.

As the war progressed however, upgraded German guns began to take a toll on existing KV's, whose armor was no longer invincible. To compensate, post-production applique armor kits were circulated, with extra armor plates to be welded onto existing hulls.²⁰¹ This extra weight slowed the tank down and rendered the KV incompatible with the realities of the rapidly shifting front. Similarly, the 76mm main gun was no longer as effective as it once was, and the 300% cost increase of KV production over that of a T-34, for less speed and similar combat performance led to the cancellation of this vehicle's mass production.²⁰² Another contributing factor was the German advance into the districts where these heavy tanks were produced. Finally, the vehicle's difficult handling led to reduced combat performance, several accounts exist of the KV's transmission being so difficult to manipulate that drivers frequently resorted to hitting it into position

¹⁹⁸ (Fleischer 1999) 170

¹⁹⁹ (Forczyk, Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt 2014) Location 1369,

²⁰⁰ (Zaloga, KV-1 & 2 Heavy Tanks 1939-45 1996) Location 343

²⁰¹ (Zaloga, KV-1 & 2 Heavy Tanks 1939-45 1996) Location 197

²⁰² (Zaloga, KV-1 & 2 Heavy Tanks 1939-45 1996) Location 665

with a sledgehammer.²⁰³ Despite production being halted, KV's would continue to serve in various capacities through the end of the war on every front the Soviet Union participated in, and the legacy of this massive tank would lead to the development of improved Soviet armored vehicles.

In addition to the KV-1, several other variants of the vehicle were constructed, and contributed significantly to Soviet armored doctrine later in the war. In addition to KV-1, initial production of the tank called for a version with a 152mm howitzer mounted instead of the 76mm main gun, for anti-fortification use. This "Heavy Turret KV", or KV-2, mounted the requisite gun in a massive cuboid turret, giving it a markedly different silhouette over the KV-1.²⁰⁴ While effective in its bunker-busting role, the KV-2 was ultimately a victim of its mechanical shortcomings and lack of purpose in the defensive war that characterized Soviet strategy during the early 1940's. The KV-2 was very slow, and the enormous weight of the howitzer and custom turret caused turret traverse issues except on level ground.²⁰⁵ The gun was also difficult to load and handle, and transmission problems from the KV-1 persisted. Nevertheless, the Red Army's need for direct-fire bunker-busting capability persisted throughout the war, and experience with the KV-2 led to the development of massive late-war Soviet self-propelled guns such as the SU-152 and ISU-152. Besides the KV-1 and 2, other variants were introduced that attempted to reduce the vehicle's weight and experiment with new main guns to effectively engage heavier German armor like the Tiger and Panther. To this effect, the KV-85 and KV-1S were developed.²⁰⁶ Mounting a new low-profile turret and the 85mm gun shared with the

²⁰³ (Sewell 1998) 24

²⁰⁴ Appendix U

²⁰⁵ (Bishop 2002) 40

²⁰⁶ (Zaloga, KV-1 & 2 Heavy Tanks 1939–45 1996) Location 679

T-34-85, these new heavy tanks improved greatly on their predecessors with more reliable shifting systems, and much better visibility for their commanders in the form of a dedicated cupola. However, these new heavy tanks failed to improve performance significantly over the then-prototype T-34-85 while remaining expensive to produce, and so both vehicles were short-lived. Several of their key features however, including the use of a higher-caliber gun and the new turret profile, would live on in the late-war IS family of heavy tanks, the culmination of Soviet heavy armor design. Finally, another prototype, the KV-14, experimented with a low-profile casemate design mounting a massive 152mm howitzer. This tank would go on to be renamed SU-152 and play an extremely important direct-fire role against the heaviest German armor in the latter half of the war.

In summary, while the KV was an extraordinarily well-armed and armored tank when it first entered service, but poor strategy and organization hampered its strengths in the fast-moving theater of the Eastern Front in 1941. As the war progressed, the tank was incrementally improved, but ultimately became obsolete compared to the equally effective but cheaper-to-produce T-34. Ultimately, developments made within the KV tank family would go on to influence later Soviet designs such as SU-152 and IS-2 and it remains a prime example of early war heavy tank design.

The SU-76 Self-Propelled Gun:

Even as the T-34 made light tanks largely obsolete with Soviet forces, the need for mobile artillery that could support fast-moving infantry remained. To this effect, the SU-76²⁰⁷ was put into mass production, becoming the second-most-produced armored vehicle

²⁰⁷ Appendix V

in the Soviet arsenal after the T-34.²⁰⁸ A versatile self-propelled gun, the SU-76 was used as an infantry support weapon, tank destroyer, and indirect-fire support roles depending on the needs of the battlefield. Utilizing a casemate-style superstructure and the chassis of the T-70 light tank, this lightweight armored vehicle was cheap to produce, and reasonably effective in its designated roles, if lacking in armor protection. The vehicle was well-received by the infantry it accompanied due to its speed and ease of communication with the crew through the open crew compartment, but the vehicle's steering was a frequent cause of complaint by its crews. The vehicle's characteristics coined the nicknames "suchka" (Little Bitch) and "Golozhopy Ferdinand" (Naked Ferdinand), due to the vehicle's steering and similarity in shape but dearth of armor compared to the German heavy tank destroyer respectively.²⁰⁹

Produced from 1942 through the end of the war, the vehicle became a mainstay in the Red Army, serving alongside infantry units through many major campaigns, including Operation Bagration. Here the SU-76 proved highly useful, being able to effectively navigate the swampy terrain of Belarus to bypass German fortifications and launch surprise attacks from behind their lines.²¹⁰ Its utility was highlighted in such environments as it was the only Soviet armored vehicle able to operate effectively under such conditions due to its low ground pressure and light weight. Though the 76mm gun it carried could not penetrate the heaviest German tanks, the vehicle remained in use throughout the war and effectively engaged other German light and medium vehicles. Further, the SU-76 possessed a variety of ammunition types that greatly increased the

²⁰⁸ (B., SU-76 2014) 1

²⁰⁹ (Zaloga, *Armored Champion: The Top Tanks of World War 2* 2015) 218

²¹⁰ (Forczyk, *Tank Warfare on the Eastern Front 1943-1945: Red Steamroller* 2016) Location 4908

vehicle's utility, including armor piercing for engaging enemy vehicles, high explosive and incendiary rounds for leveling fortifications, as well as fragmentation projectiles for indirect fire.²¹¹ After the war, production was halted and the vehicle gradually phased out, having been made obsolete by more advanced designs. Nevertheless, the SU-76 exemplifies the Soviet doctrine of large numbers of cheap to produce, utilitarian vehicles that were able to accomplish their battlefield objectives at a low cost.

SU-152 and ISU-152 Heavy Assault Guns:

Though the T-34, SU-76, and other vehicles formed the backbone of the Soviet arsenal, the Red Army was faced with a persistent need for vehicles capable of destroying German fortifications and heavy tanks, particularly in the aftermath of the Battle of Stalingrad.²¹² Towed artillery was insufficient due to the danger the crew faced operating exposed, and so the idea for a new armored self-propelled gun was born. Based on the Chassis of the KV-1 heavy tank, the KV-14 prototype, now known as the SU-152.²¹³ mounted a massive 152mm howitzer protected by 70mm of frontal armor in a casemate configuration. With the crew protected within an enclosed fighting compartment, the SU-152 had a marked advantage over towed artillery, the vehicle could advance alongside tanks and infantry to directly engage enemy positions even with a rapidly moving front line. Additionally, the vehicle's wide body and tracks inherited from the KV-1 enabled the SU-152 to ride over deep mud and snow more effectively than their wheeled towed counterparts. Perhaps most importantly, the SU-152 was cheaper to produce than its ancestor, the pre-war howitzer-wielding KV-2 heavy tank, an important factor when

²¹¹ (Bishop 2002) 118

²¹² (Zaloga, KV-1 & 2 Heavy Tanks 1939–45 1996) Location 776

²¹³ Appendix W

constructing the vehicles in recently rebuilt factories in Chelyabinsk.²¹⁴ After additional rounds of testing, SU-152 was deemed fit for combat and the first regiments were deployed to reinforce the Soviet positions at Kursk in the summer of 1943.²¹⁵

Upon joining the heavy combat at Kursk, it was discovered that the SU-152 was a highly effective heavy tank destroyer despite not being designed for this purpose. The heavy high explosive shells fired by its massive main gun dealt catastrophic damage to any German tank the vehicle faced. The massive concussive blast from the 152mm shell would kill the enemy crew through sheer blast effect and spalling damage despite not penetrating the hulls of the tanks themselves.²¹⁶ Additionally, the blast effect from the shell would frequently rip the turrets off the tanks hit, including heavy tanks such as the Tiger 1 and the new Panther medium tank. This reputation earned the vehicle, as well as its successor the ISU-152, the nickname *zveroboy*, or “beast killer” from its crews for its habit of knocking out the heaviest German tanks, commonly named after wild animals.²¹⁷²¹⁸The SU-152 was even capable of knocking out the Ferdinand tank destroyer in a single hit, albeit with slightly less success.²¹⁹ Ferdinands struck by the SU-152 were frequently able to be pulled off the field at Kursk and returned to service the next day, leading to standard Soviet policy for SU-152 crews to continue firing at enemy vehicles until they were completely totaled and/or the turret stripped away.

Despite the destructive potential of the gun it wielded, SU-152 was by no means invincible. Its 70mm of frontal armor protected the crew from shrapnel, most infantry

²¹⁴ (Steven J. Zaloga 1984) 165

²¹⁵ (Forczyk, Tank Warfare on the Eastern Front 1943-1945: Red Steamroller 2016) Location 2544

²¹⁶ (Forczyk, Tank Warfare on the Eastern Front 1943-1945: Red Steamroller 2016) Location 2712

²¹⁷ Appendix X

²¹⁸ (Green and Brown 2008) 104

²¹⁹ (Forczyk, Tank Warfare on the Eastern Front 1943-1945: Red Steamroller 2016) Location 2577

weapons, and low-caliber anti-tank weapons, but SU-152 was still vulnerable to the 88mm gun of the Tiger 1 as well as the long 75mm gun wielded by the Panther medium tank. Additionally, the crew compartment was cramped due to the large gun breach and the fire rate was quite slow due to the bulky ammunition.²²⁰ As a result, only around 700 SU-152's were produced, with its successor the ISU-152 improving on the vehicle's shortcomings and improving the armor.²²¹ Nevertheless, surviving SU-152s would continue to serve until the end of the war, and the accidental discovery of the vehicle's effectiveness as a heavy tank destroyer would prove immensely valuable to the Soviet war effort. Furthermore, the SU-152 performed its primary intended role of fortification assault admirably and served throughout the Eastern Front and most notably during Operation Bagration, providing valuable anti-tank and artillery support to the divisions retaking Belarus from Axis control.

The ISU-152 improved on its predecessor SU-152 in many ways. Built around the IS heavy tank chassis rather than that of the KV, the ISU-152 inherited the SU-152's main armament and multirole tasks of self-propelled artillery support as well as destroying enemy heavy tanks and tank destroyers. Additionally, some versions of the tank were equipped with the experimental long-barreled BL-10 152mm gun. Perhaps most notably, the ISU-152 featured improved armor that gave it total frontal protection from the most commonly encountered Panzer 4s and Stugs fielded by German forces, and forced even larger tanks such as the Tiger and Jagdpanther to approach within killing range if they were to penetrate the tank reliably.²²² The vehicle also inherited the destructive 152 mm

²²⁰ (Bishop 2002) 119

²²¹ (Bishop 2002) 119

²²² (Bishop 2002) 119

main armament as well as the nickname *zveroboy* from its predecessor, for its habit of ripping the turrets off the tanks struck by its massive shells.

In addition to its vaunted anti-tank capabilities, the ISU-152 performed exceedingly well in urban environments that became more common as the Red Army went on the offensive and pushed the Germans back. Participating in heavy urban combat in Vienna, Berlin, and elsewhere, the ISU-152 was used to both bombard cities from a distance as well as work in close coordination with infantry to level occupied buildings.²²³ Though effective, care had to be taken to avoid injuring friendly troops nearby. One account from a Soviet tank commander mentions an ISU-152 being given permission to fire on an enemy position in Vienna, and the blast from the gun being such that not only was the enemy position annihilated, but several of other buildings on the street suffered damage and practically every window within several dozen meters was shattered, the broken glass causing numerous minor injuries to friendly troops.²²⁴ Nevertheless, when proper care was taken the ISU-152 proved to be a highly effective solution to the Red Army's need for multipurpose assault guns, filling both support and direct fire roles admirably and improving on its predecessor's novel approach to destroying heavy tanks.

Due to the vehicle's versatility, ISU-152 capitalized on the effectiveness of the Su-152 and was produced in massive numbers, underlining its importance to Soviet commanders. With 1,800 units produced over the course of the war, the roles of support artillery, assault gun, and heavy tank destroyer combined into a single vehicle was an attractive option for Soviet leadership, giving the ISU-152 a versatility advantage over

²²³ (Fedorovich 2010) 1

²²⁴ (Fedorovich 2010) 1

dedicated tank destroyers such as the SU-100.²²⁵ However, the vehicle did have some drawbacks, the vehicle inherited the low ammunition store of 20 rounds²²⁶ from its predecessor, and spare ammunition needed to be carried exposed on the back of the tank. The rounds were also extremely heavy and divided into two parts, shell and charge, which made loading the gun difficult and reduced the fire rate. This aside however, the ISU-152 was the only vehicle that remained in production through the end of the war capable of reliably knocking out the heaviest German armor with a single shot, making it immensely valuable to the Soviet armored divisions as the Axis produced ever-heavier tanks to combat the tidal wave of Soviet armor.

The SU-100 Tank Destroyer:

In addition to the heavy assault guns such as SU-152 and ISU-152, the Soviet Union also produced a few dedicated tank destroyers wielding high-velocity mid-caliber main guns, in the traditional tank destroyer style. The first of these was the SU-85, a casemate-style tank destroyer utilizing an 85mm gun erected on the chassis of the T-34.²²⁷ However, this design quickly became obsolete as the T-34-85 entered production and heavier German armor became more common on the battlefield, leading to the development of the SU-100 instead. Mounting a powerful 100mm main gun and protected by 75mm of frontal armor set at a steep angle, the SU-100 tank destroyer saw extensive service in the final year of the war and proved to be a formidable foe to late-war German tanks.²²⁸ Bearing many visual similarities to the German Jagdpanther tank destroyer, the SU-100 filled a similar role on the battlefield, knocking out late-war

²²⁵ (Bishop 2002) 119

²²⁶ (Bishop 2002) 119

²²⁷ (B., SU-100 2014)

²²⁸ (B., SU-100 2014)

medium tanks such as the Panther reliably and filling a niche as a powerful dedicated tank destroyer in the Soviet Union's forces. Improving on its predecessors, the SU-100 features a commander's cupola and 360-degree vision blocks, giving the commander excellent visibility compared to other contemporary Soviet tank destroyers.²²⁹ As the war came to a close, some SU-100's began serving as assault guns alongside their 152mm-armed cousins, participating in street fighting in Berlin working alongside Red Army infantry. Being a new design, the SU-100's production and usage continued long after the Second World War came to a close, but the vehicle is immortalized due to its contributions in hastening the end of the war and its popularity with its crews.

The IS-2 Heavy Tank:

After encountering the Tiger 1 on the battlefield in 1942, work began on a new Soviet heavy tank to replace the KV, which was no longer adequate to deal with this new threat.²³⁰ After a number of KV prototypes experimented with new guns and turrets as stopgap solutions to emerging German armor designs, an entirely new heavy tank, the IS, or *Iosef Stalin* tank, entered production. Boasting marked advantages over the older KV, the IS was to be the Soviets' new breakthrough tank, wielding thick armor, relatively high speed for a heavy tank, and a massive gun that would enable it to go toe-to-toe with Germany's latest heavy tanks, Tiger 1 and Tiger 2. This vehicle would enter mass production as the IS-2 after several prototype stages.²³¹ The IS-2 carried the 122mm D-25T main gun, capable of penetrating the frontal armor of the Panther from 1.5 kilometers, as well as causing heavy spalling in heavier tanks.²³² Furthermore, due to the

²²⁹ (B., SU-100 2014)

²³⁰ (Forczyk, Tank Warfare on the Eastern Front 1943-1945: Red Steamroller 2016) 770

²³¹ Appendix Z

²³² (Bishop 2002) 41

high caliber this gun possessed an effective high explosive shell, expanding the tank's usefulness to include destroying bunkers and other fortifications, as well as enemy infantry and armor.

In addition to the powerful main weapon, improvements in the armor of the IS-2 over the older KV series were critically important to ensuring survivability against late-war German tanks and tank destroyers. However, weight reduction was also prioritized, as the IS-2 was slated to work in conjunction with the T-34 and other lighter vehicles, so maintaining reasonable speed was important. To this end most of the armor protection was shifted to the front of the vehicle where the most hits would be received, creating a thick front glacis plate 100mm thick and angled at 60 degrees.²³³ The vehicle was further protected by 90mm thick side armor and a cast turret of the same thickness, giving the vehicle excellent protection from the front, and acceptable armor elsewhere.²³⁴ This improved protection was achieved by reducing the heavier armor at the back of the vehicle and improving the overall angling and profile, giving IS-2 much greater protection from enemy fire than preceding designs. The armor was improved further by modifying the "stepped" profile on early vehicles and shifting to a uniformly angled front plate instead.²³⁵ Despite its improved armor protection, the IS-2 maintained a somewhat small profile, being shorter than Tiger I or Tiger II and slightly lighter than the Panther, the most comparable tanks of the day.

In combat the IS performed admirably, as it was able to knock out Tiger Is and Tiger IIs and occasionally caused them to jettison their turrets in the manner of IS-2's cousins,

²³³ (Bishop 2002) 41

²³⁴ (Bishop 2002) 41

²³⁵ (Bishop 2002) 41

the SU-152 and ISU-152 heavy tank destroyers.²³⁶ Even when its 122mm shells were unable to penetrate the tanks they faced, the target vehicles would often be disabled with their tracks destroyed and experience massive spalling, causing any surviving crew to abandon their vehicles before the next shot landed. The IS-2's fire rate was admittedly slow due to its heavy 2-part ammunition but was still accepted into service by Soviet leadership regardless for its massive blast effect. The gun's performance was further improved by deficiencies in German alloys by this point in the war, nickel was being used as a substitute for manganese in tank armor and this comparatively brittle construction caused many tanks hit by the IS-2 and other Soviet heavy vehicles to crack apart upon being struck.²³⁷

Arguably representing the pinnacle of Soviet heavy tank design, the IS-2 was an effective machine that served alongside the T-34 and other vehicles in Red Army tank battalions from its inception in 1944 through the end of the war, seeing combat in all major operations on the Eastern Front upon entering service. Although the IS-2 was not invincible to the heaviest German guns, its unique armor scheme gave it good frontal protection while its main 122mm gun provided a firm answer to the Tiger I, Tiger II, and Elefant. After creating breakthroughs in German front lines, IS-2 would work more closely with more mobile vehicles to exploit the gap in the defenses, following Soviet Deep Battle philosophy. Though the heavy tank concept would become obsolete shortly after the end of the war, the IS-2 served the Soviet Union well and gave the Germans a powerful reminder of Soviet military might.

²³⁶ (Bishop 2002) 41

²³⁷ (Riffin 1945) 2

To summarize Soviet tank development during the Second World war, tanks designed from this period were characterized by several innovations including large main guns, cast components, angled armor, and rugged construction. These features capitalized on the massive Soviet wartime industry and readily available supplies of steel and workers to create thousands of rugged vehicles that could be cast at German lines en-masse to bring about the strategic breakthroughs called for by the Deep Battle philosophy. Though casualty rates were extremely high for Soviet tank crews, their vehicles were effective, and often innovative, introducing new, cheap methods of construction and combat that could be readily mass-produced. Furthermore, Soviet vehicles were characterized by their generally higher top speed than their German opponents, and lack of creature comforts and general polish. This decision was made due to the incessant need for more tanks on the Eastern front and low survivability of many light vehicles and the T-34 in combat. Many Soviet vehicles of the early war period used innovative designs, such as T-34 and KV-1, but were severely hampered by poor crew training, maintenance, ineffective leadership and strategic level planning, and a serious dearth of communications equipment. As a result, they were unable to significantly halt the German invasion during Operation Barbarossa. Additionally, Germany developed heavier vehicles to counter the T-34 and KV, the Soviet Union had no real answer or dedicated anti-heavy tank destroyer until the SU-152, which was pressed into this role after discovering its capability largely by accident. However, the ability to destroy the heaviest German tanks with a comparatively cheap and easy-to-produce vehicle would not go unnoticed, and the ISU-152 was produced in greater numbers and served as an effective heavy tank killer through the end of the war. Finally, Soviet tank design culminated with the IS-2 heavy tank,

reducing the weight from the archaic KV in favor of an optimized heavy tank design capable of going toe-to-toe with Nazi Germany's heaviest vehicles.

Conclusion:

To conclude, it is clear that the Axis invasion of the Soviet Union presented an existential threat to the Soviet peoples due to their rapid mechanized advance and the gusto with which the Nazis carried out their campaign of genocide. After sweeping through lightly defended Soviet lands, the Nazis set about killing or enslaving any civilians or Red Army troops caught in their path in their efforts to expand the Third Reich. Soviet forces meanwhile were poorly organized and put up only token resistance, despite suffering millions of men and thousands of vehicles as casualties. After finally halting the Nazi advance during the winters of 1941 and 1942, the Soviet Union gradually began making critical changes to their armored doctrine that allowed them to push the Nazis back. The Soviet Union refocused their tank design from interwar light tanks to the heavier and better-armored T-34, producing massive quantities of these jack-of-all-trades vehicle from factories evacuated from western districts of the USSR. Additionally, the rediscovery of Deep Battle doctrine allowed the USSR to coordinate better at the strategic level and put their massive numbers of tanks to effective use. Alongside the T-34, cost-effective, multipurpose vehicles such as the SU-76, SU-152, ISU-152, and IS-2 provided the arms and armor necessary to conduct effective armored assaults against the might of the Wehrmacht. The need for heavier vehicles for both sides intensified throughout the conflict as both Nazi Germany and the Soviet Union raced to establish armored supremacy on the battlefield. The Wehrmacht placed the emphasis of their armored vehicles primarily upon thicker armor and extremely accurate 88mm main armaments, but these vehicles suffered severe mechanical issues due to overburdened engines and collapsing supply lines. Meanwhile, the Soviet Union focused their

production efforts on armored vehicles that were simple to produce and provided moderately effective, low-cost solutions to the issues presented by Nazi Germany's sophisticated tanks designs. Additionally, the extensive use of the radio in Soviet vehicles gave them the coordinating ability necessary to operate armored vehicles in coordination in battle. Communication was a severe problem for Soviet tank crews in the beginning of the war that was largely rectified with later vehicle models. Finally, the extensive use of the medium tank and maneuverable heavy vehicles by the Soviet Union proved to be an important step towards the development of the modern main battle tank. The T-34-85 proved that a single vehicle could combine effective armor, weaponry, and speed into a single platform, signaling the end of tank classes as universal tanks became a battlefield norm in the postwar period. Further, the extensive use of angled armor in Soviet vehicles provided a cost-effective way to improve a vehicle's protection without adding material and this technique is still in use in the modern era. Though the Soviet Union suffered tens millions of casualties as a result of the war, it is clear that their armored forces provided the muscle the Red Army needed to beat back Nazi Germany and end the reign of Hitler's panzers on the battlefields of Europe.

Further, the extensive developments to tank design and doctrine had long-lasting effects in the postwar period that still resonate today. The shift in tank doctrine away from heavy tanks and towards medium/universal vehicles via machines like the T-34-85 and Panther was an important step towards the development of the modern main battle tank. Additionally, Nazi Germany's largest vehicles used so much steel armor that they became impractical to drive for any distance, namely machines like the Tiger II, Jagdtiger, and Maus super heavy tanks. The fact that there was a clear upper limit on how

much armor could be applied to a tank before the engine to move such weight could no longer be mounted within the vehicle despite ever-advancing gun technology indicated that rolled homogenous steel armor was not a viable solution for future vehicles. This led to the development of modern composite armors used on battle tanks today, which provide the equivalent of hundreds of millimeters thick protection that World War 2-era tankers could only dream of.

Finally, the Soviet Union's massive industrial capacity geared squarely towards armored vehicle development played a critical role in the superpower's military strategy in the early Cold War, namely the assumed supremacy of their ground forces due to the sheer number of tanks the USSR could produce and field. This was a centerpiece of Soviet defense/standoff doctrine until the USSR developed their own nuclear weapons. Nevertheless, a proud legacy of tank development exists in the Russian Federation today, with cutting-edge designs such as the T-90 carrying on the legacy of their T-34 forebears.

Bibliography

- [Redacted]. 1951. *Engineering Analysis of the T-34/85 Tank*. CIA Information Report, Langley: Central Intelligence Agency.
- Alex, Dan. 2018. *Jagdpanzer 38(t) Hetzer Tank Destroyer*. March 12. Accessed February 2019. https://www.militaryfactory.com/armor/detail.asp?armor_id=240.
- B., David. 2014. *BT-7*. June 30. http://www.tanks-encyclopedia.com/ww2/soviet/soviet_BT-7.php.
- . 2015. *Panzerjäger Tiger (P) Ferdinand*. February 24. Accessed 22, 2019. http://www.tanks-encyclopedia.com/ww2/nazi_germany/Panzerjager_Tiger-P_Elefant.php.
- . 2014. *SU-100*. June 30. Accessed 12, 2019. http://www.tanks-encyclopedia.com/ww2/soviet/soviet_SU-100.php.
- . 2014. *SU-76*. June 30. Accessed 16, 2019. http://www.tanks-encyclopedia.com/ww2/soviet/soviet_SU-76.php.
- . 2014. *T-34/76*. June 30. Accessed February 2, 2019. http://www.tanks-encyclopedia.com/ww2/soviet/soviet_T34-76.php.
- Bergstrom, Chris. 2007. *Barbarossa: The Air Battle July-December 1941*. Classic Publications.
- Bishop, Chris. 2002. "The Encyclopedia of Weapons of WWII: The Comprehensive Guide to over 1,500 Weapons Systems, Including Tanks, Small Arms, Warplanes, Artillery, Ships, and Submarines." In *1,500 Weapons Systems, Including Tanks, Small Arms, Warplanes, Artillery, Ships, and Submarines*, by Chris Bishop, 540.
- Braithwaite, Rodric. 2009. *Moscow 1941: A City and Its People at War*. Vintage.
- Buttar, Prit. 2013. *Between Giants: The Battle for the Baltics in World War II*. Osprey Publishing.
- Carell, Paul. 1966. *Hitler Moves East, 1941-1943*. Bantam Books.
- Djilas, Milovan. 2014. *Conversations with Stalin*. Mariner Books.
- Erickson, John. 2015. *The Road to Berlin*. Weidenfeld & Nicolson.
- Fedorovich, Dmitriy. 2010. *Dmitriy Loza* (September 21). <https://iremember.ru/en/memoirs/tankers/dmitriy-loza/>.
- Fleischer, Wolfgang. 1999. *Russian tanks and Armoured Vehicles 1917-1945*. Schiffer Publishing.
- Forczyk, Robert. 2014. *Tank Warfare on the Eastern Front 1941-1942: Schwerpunkt*. Pen and Sword Military.

- . 2016. *Tank Warfare on the Eastern Front 1943-1945: Red Steamroller*. Pen and Sword Military.
- Glantz, David M. 2011. *Barbarossa: Hitler's invasion of Russia 1941*. The History Press.
- Glantz, David. 2015. *When Titans Clashed: How the Red Army Stopped Hitler*. University of Kansas Press.
- Green, Michael, and James D. Brown. 2008. *Tiger Tanks at War*. Zenith Press.
- Holmes, Larry. 2017. *Stalin's World War II Evacuations: Triumph and Troubles in Kirov*. University Press of Kansas.
- Knight, Jack. 2015. *Battlefield Relics: The Stug III recovered in Russia*. May 20. <https://www.warhistoryonline.com/military-vehicle-news/battlefield-relics-the-stug-iii-recovered-in-russia.html>.
- Krivosheev, G.F. 1997. *Soviet Casualties and Combat Losses in the Twentieth Century*. Greenhill Books.
- Limbach, Raymond. 1998. *Battle of Stalingrad*. July 20. <https://www.britannica.com/event/Battle-of-Stalingrad>.
- Littledale, Harold A. 1918. "With the Tanks." *The Atlantic*, December: 1. <https://jfredmacdonald.com/worldwarone1914-1918/science-18gwith-tanks-part1.html>.
- Manley, Rebecca. 2007. "Manley, Rebecca. "The Perils of Displacement: The Soviet Evacuee between Refugee and Deportee." *Contemporary European History*, vol. 16,." *Contemporary European History* (Cambridge University Press) 16 (4). <https://www.cambridge.org/core/journals/contemporary-european-history/article/perils-of-displacement-the-soviet-evacuee-between-refugee-and-deportee/C2C0227D5B76D95C4CC82EAABCB12436>.
- Merc, Steve. 2013. *The T34 in World War 2: The Legend vs The Performance*. February 26. globeatwar.com.
- Michael Green, James D. Brown. 2008. *Tiger Tanks at War*. Zenith Press.
- Mironovich, Yampolsky Joseph. 2014. *Yampolsky Joseph Mironovich* (January 22). <https://iremember.ru/en/memoirs/tankers/yampolsky-joseph-mironovich/>.
- Ogorkiewicz, Richard Marian. 2016. *Tank*. December 18. <https://www.britannica.com/technology/tank-military-vehicle#ref521311>.
- Peck, Michael. 2016. *Nazi Germany's King Tiger Tank : Super Weapon or Super Myth?* August 12. <https://nationalinterest.org/feature/nazi-germanys-king-tiger-tank-super-weapon-or-super-myth-17332>.

- Raus, Erhard. 2003. *Panzer operations: the Eastern Front memoir of General Raus, 1941-1945*.
- Reynolds, David. 2014. *The Long Shadow: The Legacies of the Great War in the Twentieth Century*. W. W. Norton & Company.
- Riffin, P.V. 1945. *Metallurgical Examination from a 3 & 1/4 inch Thick Armor Plate from a German PzKw V (Panther) Tank*. Metallurgical Examination, Unclassified, Watertown, Mass: Watertown Arsenal Laboratory.
- Royde-Smith, John Graham. n.d. "Operation Barbarossa." *Encyclopaedia Britannica*. Accessed September 9, 2018. <https://www.britannica.com/event/Operation-Barbarossa>.
- Setia, Veenu. 1998. *Battle of Kursk*. <https://www.britannica.com/event/Battle-of-Kursk>.
- Sewell, Stephen. 1998. "Why 3 Tanks?" *ARMOR*, July/August: 9.
- Snyder, Timothy. 2012. *Bloodlands: Europe Between Hitler and Stalin*. Basic Books.
- Steven J. Zaloga, James Grandsen. 1984. *Soviet Tanks and Combat Vehicles of World War 2*. London: Arms and Armor Press.
- Tissier, Tony Le. 2005. *With Our Backs to Berlin: The German Army in Retreat 1945*. Sutton.
- Ulio, J.A. 1942. *Armored Force Field Manual: The Armored Battalion, Light and Medium*. United States Government Printing Office.
<http://www.ibiblio.org/hyperwar/USA/ref/FM/PDFs/FM17-33.PDF>.
- Zaloga, Steven J. 2015. *Armored Champion: The Top Tanks of World War 2*. Mechanicsburg, PA: Stackpole Books.
- . 2008. *Armored Thunderbolt: The U.S. Army Sherman in World War II*. Stackpole Books.
- . 2011. *IS-2 Heavy Tank 1944-73*. Osprey Publishing.
- . 1996. *KV-1 & 2 Heavy Tanks 1939-45*.
- . 1994. *T-34/76 Medium Tank 1941-45*. Osprey Publishing.
- . 2013. *T-34/76 Medium Tank 1941-45*. Osprey Publishing.
- . 2013. *T-34-85 Medium Tank 1944-94*. Osprey Publishing.

Appendices:

Appendix A: Hitler's planned "Greater Germanic Reich"



Retrieved from:

<https://gcocs.org/europe-map-1939/europe-map-1939-elegant-best-s-europe-map-1939-3/>

Appendix B

Plan for Operation Barbarossa

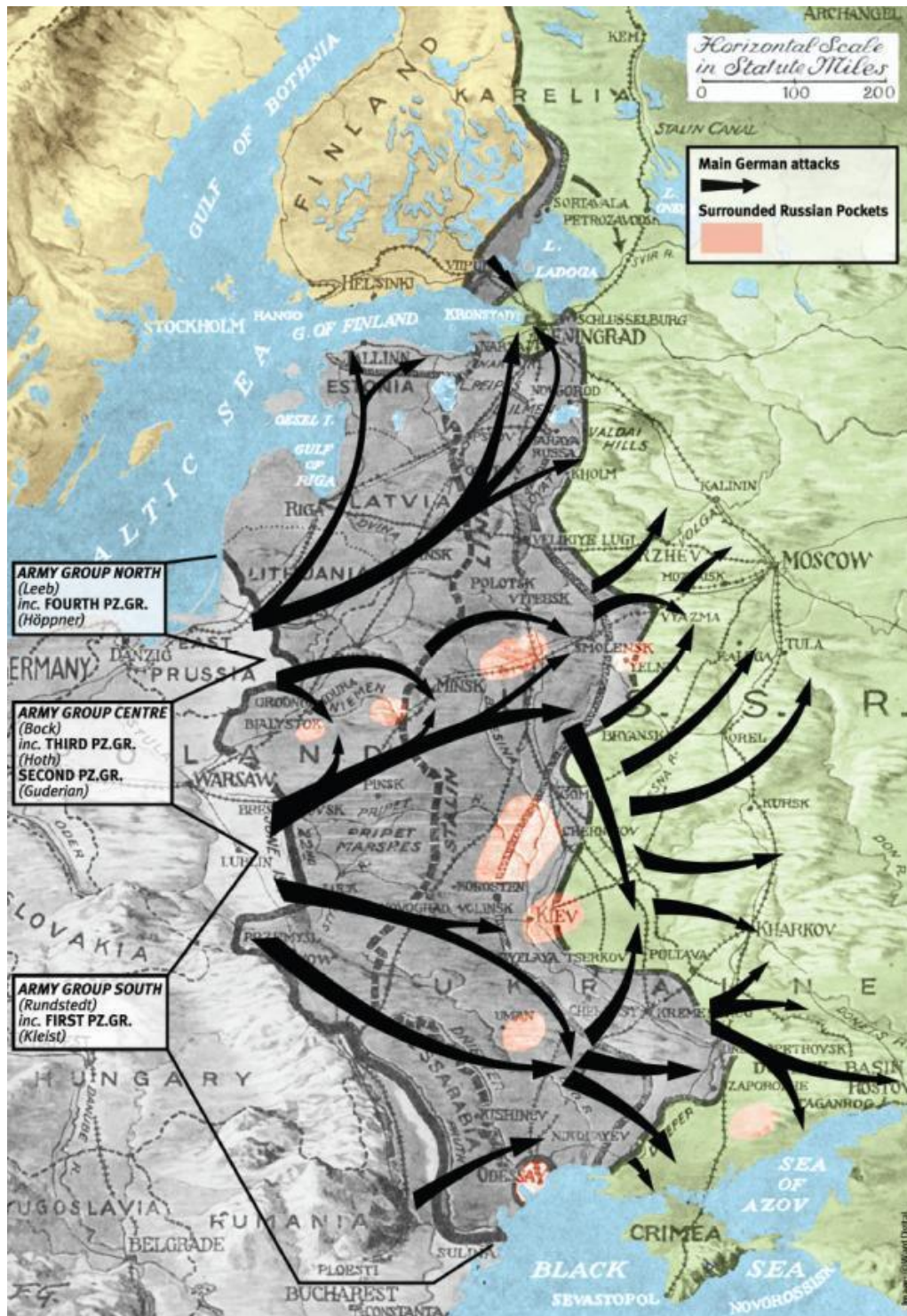


Image retrieved from: <https://i2.wp.com/www.military-history.org/wp-content/uploads/2011/05/Operation-Barbarossa.jpg?resize=600%2C86>

Appendix C

Hetzer Tank Destroyer



Retrieved from: <http://www.rowanpix.com/reenactments/images/wHetzerII.jpg>

Appendix D

Panzer III Medium Tank



Retrieved from:

https://en.wikipedia.org/wiki/Panzer_III#/media/File:PzKpfwIIIH.Saumur.000a1y8q.jpeg

Appendix E:
Stug III Assault Gun



Bundesarchiv, B 145 Bild-F016202-23A
Foto: o. Ang. | 2. September 1941

Retrieved from: [https://www.bild.bundesarchiv.de/cross-search/search/_1551155760/?search\[view\]=detail&search\[focus\]=20](https://www.bild.bundesarchiv.de/cross-search/search/_1551155760/?search[view]=detail&search[focus]=20)

Appendix F

Panzer IV Medium Tank with short-barreled 75mm howitzer



Bundesarchiv, Bild 1011-124-0250-39
Foto: Hinz | 10. Mai 1940

Retrieved from: [https://www.bild.bundesarchiv.de/cross-search/search/1551155681/?search\[view\]=detail&search\[focus\]=61](https://www.bild.bundesarchiv.de/cross-search/search/1551155681/?search[view]=detail&search[focus]=61)

Appendix G
Panther Medium Tank



Retrieved from: https://www.worldwarphotos.info/wp-content/gallery/germany/tanks/panther-tank/Panther_Ausf_D_Medium_Tank.jpg

Appendix H

Wehrmacht Soldiers struggling to free a car during the rasputitsa



Bundesarchiv, Bild 146-1981-149-34A
Foto: o. Ang. | November 1941

Retrieved from:

https://zeitgeschichteonline.de/sites/default/files/styles/startteaser/public/bundesarchiv_bild_146-1981-149-34a_russland_herausziehen_eines_autos.jpg?itok=HXjC-4zS

Appendix I
Jagdpanther Tank Destroyer



Retrieved from: https://www.militaryfactory.com/armor/detail.asp?armor_id=236

Appendix J

Tiger I Heavy Tank with crew



Retrieved from: https://i2.wp.com/militaryhistorynow.com/wp-content/uploads/2015/02/Tiger_Tracks.jpg?fit=1000%2C753&ssl=1

Appendix K

Ferdinand Heavy Tank Destroyer



Retrieved from

<https://warfarehistorynetwork.com/wp-content/uploads/Ferdinand-Porsches-%E2%80%98Elefant%E2%80%99-Tank-Destroyer-3.jpg>

Appendix L

Tiger II tanks in formation for newsreel

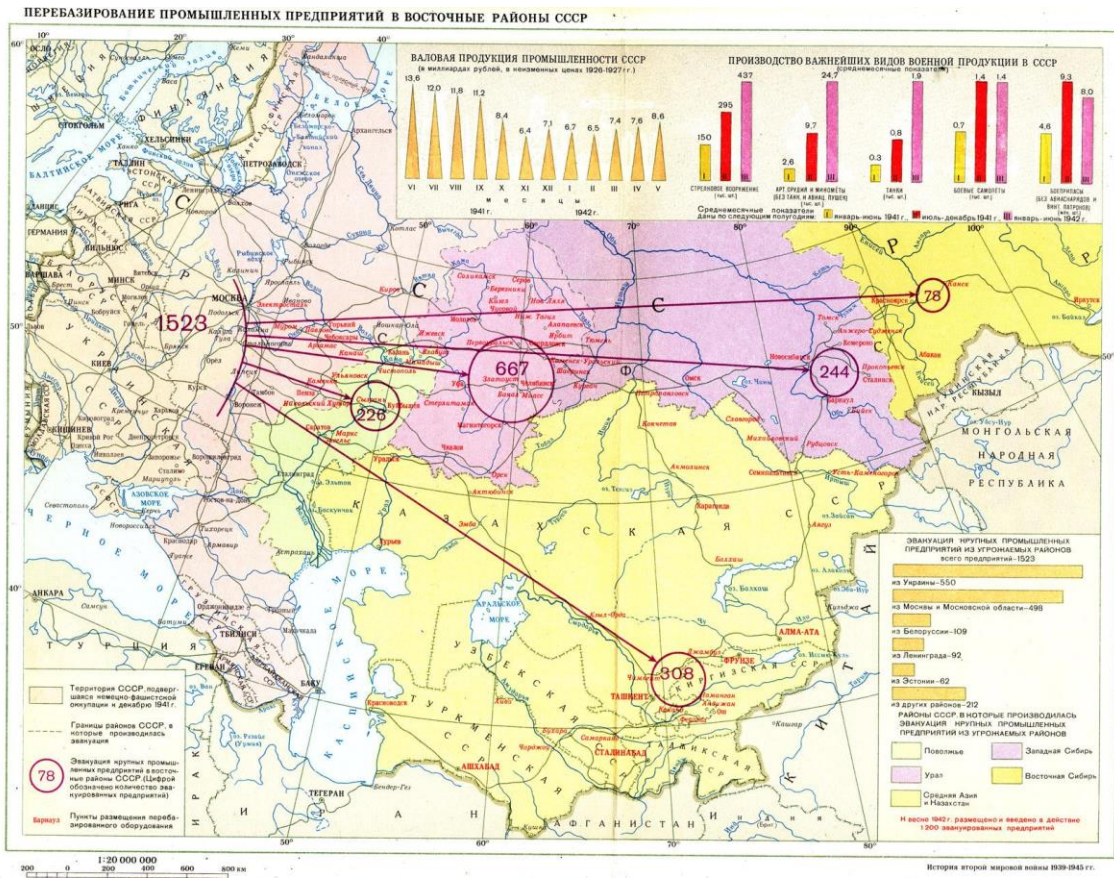


Bundesarchiv, Bild 146-1975-102-14A
Foto: Hamann | 1944/1945 ca.

https://www.bild.bundesarchiv.de/dev02/barchpic/2007/06-29/49/39/af/athene-5di7p4kb85cqqlrnuo_layout.jpg

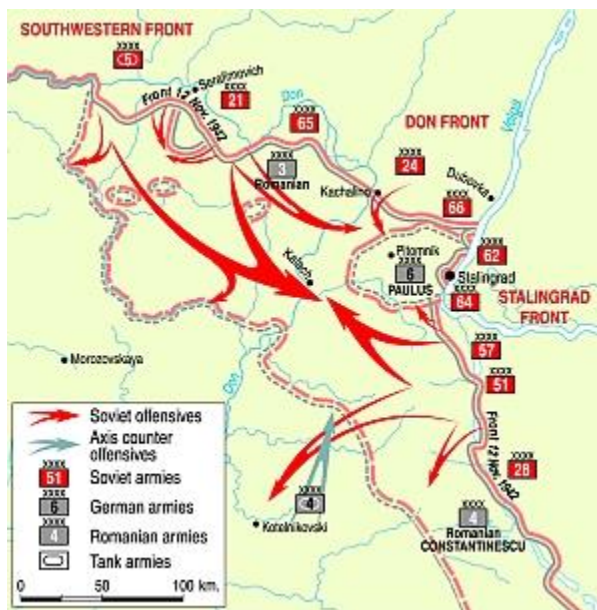
Appendix N

Map of the Evacuation of Soviet Industry



Retrieved from: <https://i.redd.it/pke4m7pvo3u01.jpg>

Appendix O
Operation Uranus map

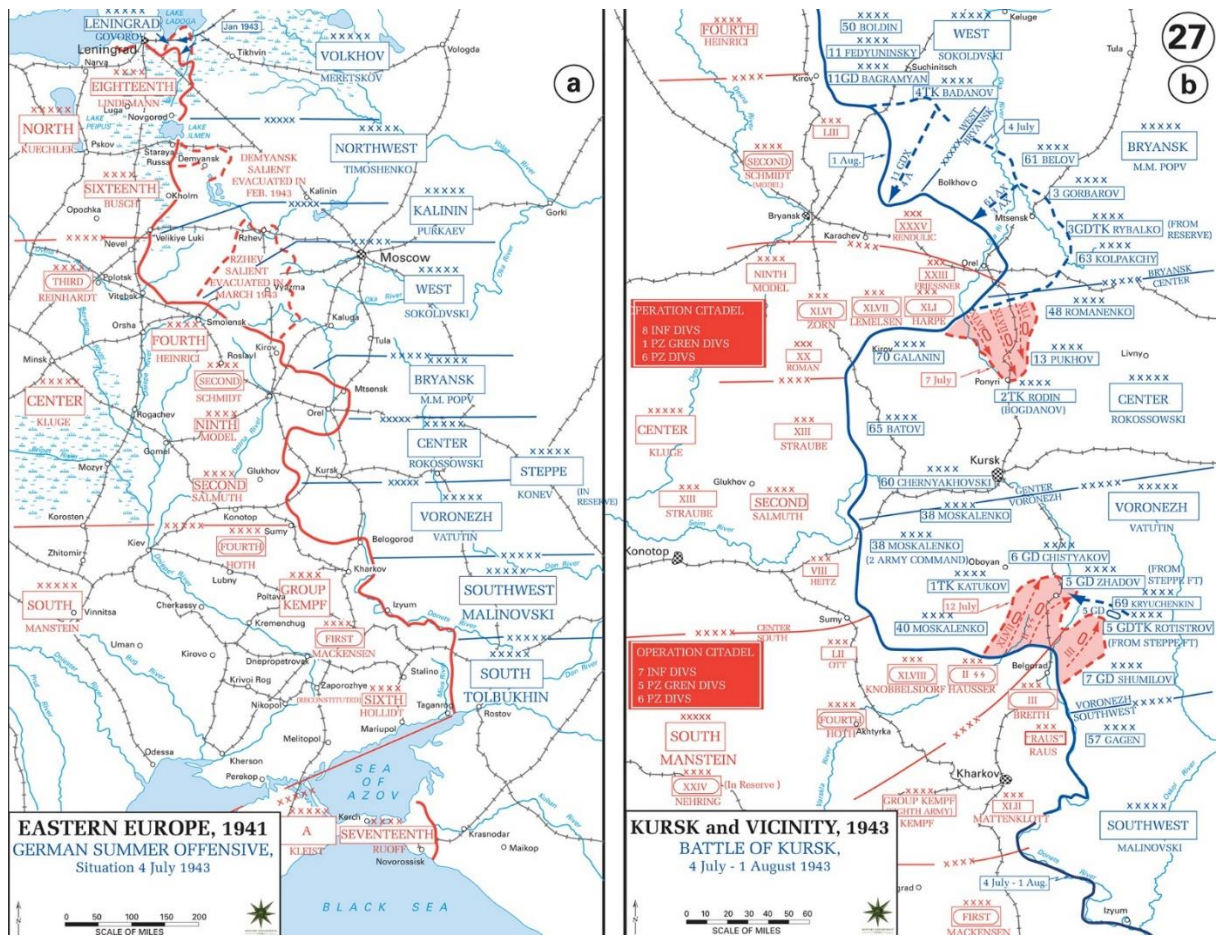


Retrieved from:

<https://warfarehistorynetwork.com/daily/wwii/trapped-in-stalingrad-marshal-georgi-zhukovs-operation-uranus/>

Appendix P

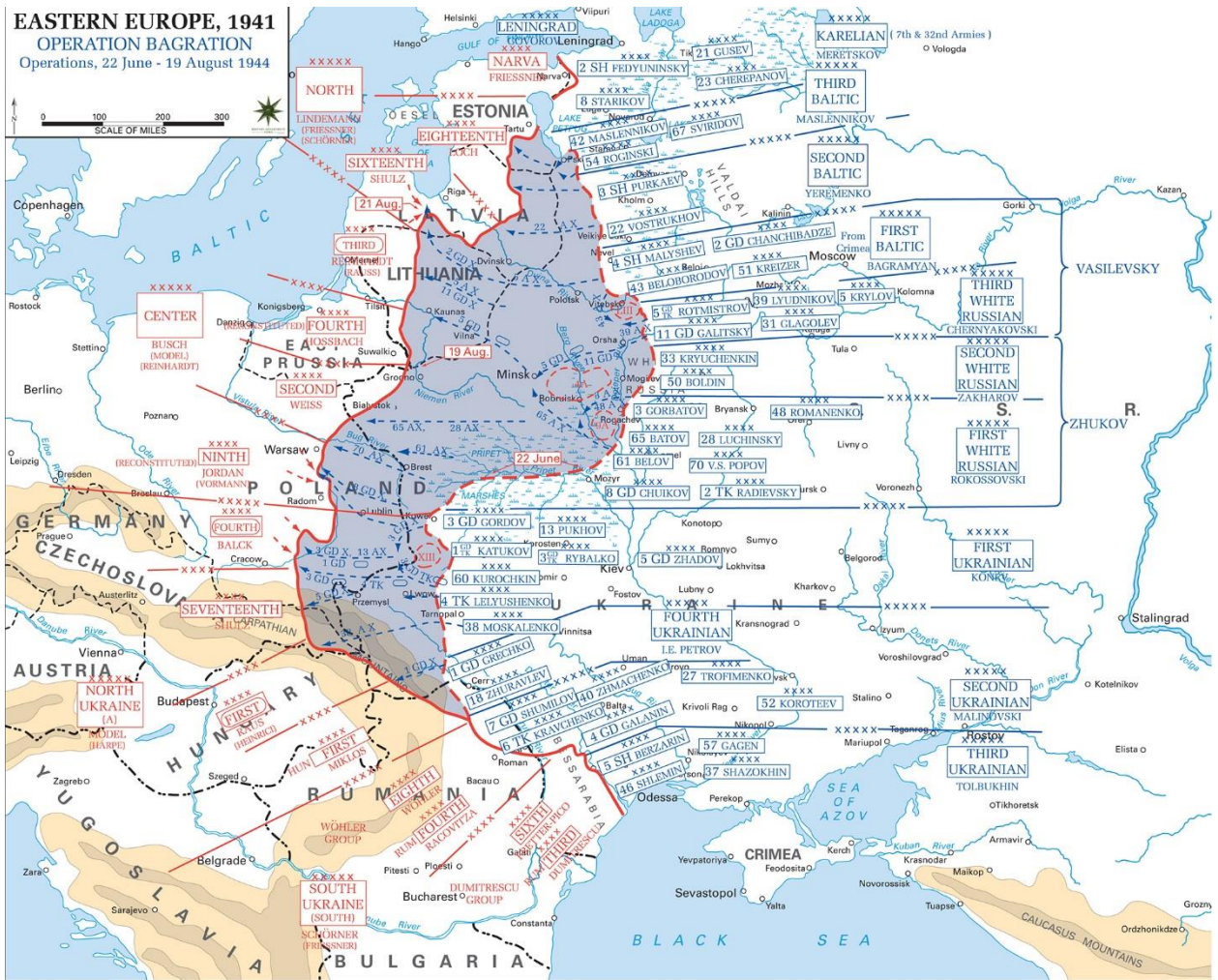
Map of the Summer offensive of 1943 and the Battle of Kursk



Retrieved from: http://www.emersonkent.com/map_archive/kursk_1943.htm

Appendix Q

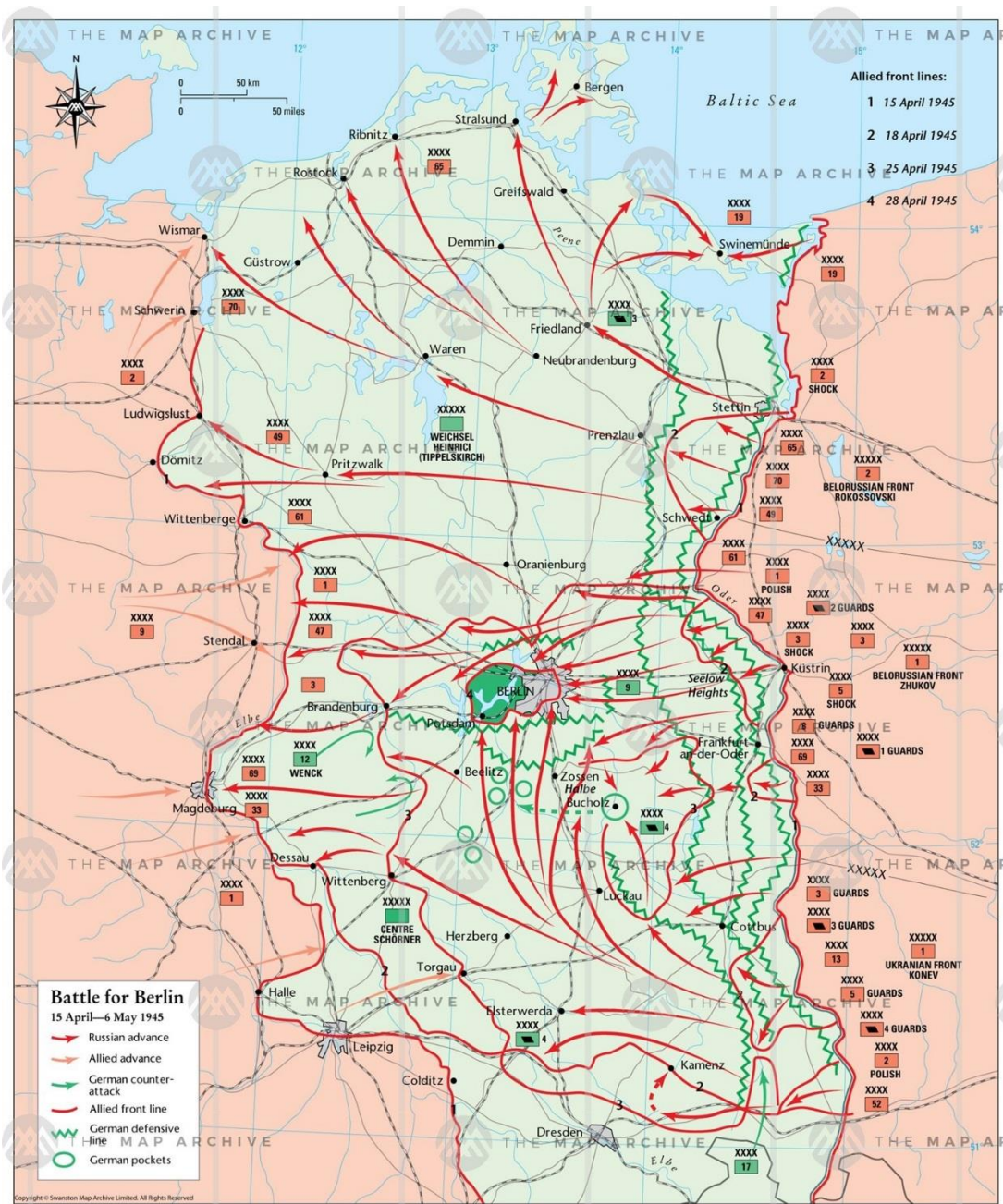
Operation Bagration map



Retrieved from: http://www.emersonkent.com/map_archive/russia_bagration_1944.htm

Appendix R

Map of the Battle of Berlin



Retrieved from <https://www.themaparchive.com/battle-of-berlin-15-april6-may-1945.html>

Appendix S
Early-war T-34 medium tanks



Retrieved from http://www.tanks-encyclopedia.com/ww2/soviet/soviet_T34-76.php

Appendix T

T-34-85 medium tank



Retrieved from: https://i1.wp.com/militaryhistorynow.com/wp-content/uploads/2015/03/T-34_85.jpg?resize=700%2C468&ssl=1

Appendix U

KV-1 and KV-2 Soviet Heavy Tanks



Retrieved from: <http://wio.ru/tank/tank-kv.htm> (KV-1) and <http://www.tanks-encyclopedia.com/wp-content/uploads/2015/04/german-inspect-kv2.jpg> (KV-2)

Appendix V
SU-76 self-propelled gun



Retrieved from: https://commons.wikimedia.org/wiki/File:Su76_nn.jpg

Appendix W
SU-152 Heavy Assault Gun



Bundesarchiv, Bild 101I-154-1064-28
Foto: Dreyer | 1943 August - September

Retrieved from:

https://www.bild.bundesarchiv.de/archives/barchpic/search/_1551166868/?search%5Bform%5D%5BSIGNATUR%5D=Bild+101I-154-1964-28

Appendix X

ISU-152 Heavy Assault Gun with experimental BL-10 armament



Retrieved from:

<http://www.tanks-encyclopedia.com/wp-content/uploads/2016/09/Object-247.jpg>

Appendix Y
SU-100 Tank Destroyer



Retrieved from: <https://wwiiafterwwii.files.wordpress.com/2016/07/wwii.jpg?w=809>

Appendix Z
IS-2 Heavy Tank



Retrieved from: http://www.tanks-encyclopedia.com/ww2/soviet/soviet_IS-II.php