The Soviet Economy and the Red Army, 1930-1945

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Preface

The first volume in a series on World War II, *Second Front Now 1943*, published in 1981, presented the thesis that the second front was possible in 1943 in Europe and advisable from the Western point of view. *Hitler's Nemesis: The Red Army, 1930-945*, published in 1994, presented the thesis that the Soviets did not need, neither did Stalin want, a second front in 1943, at least in France. The Red Army had emerged as a powerful force by early 1943, adequately trained and led, capable of defeating the German Army.

The present study, *The Soviet Economy and the Red Army, 1930-1945*, explores the method employed to equip and supply the Red Army. Once victory was assured in 1943, there is reason to believe that Stalin deliberately sought more time to drive the Germans farther west so that the Soviet Union would be in control of central Europe at the end of the war. The underlying thesis of all three books is the refutation of the charges that Franklin D. Roosevelt and George C. Marshall were toots of the Communist conspiracy in advocating the opening of the second front in 1943 and supplying the Soviet Union with huge amounts of lend-lease material. Instead, both were concerned with the speedy defeat of Germany and with saving millions of lives as well as developing a stronger Western position at the end of the war.

The purpose of the military is to kill people and destroy property, either to protect a nation from another or to pursue its national self-interest. To accomplish these goals, an entire nation, to one degree or another, is involved in creating and maintaining a complex structure to support the military. A nation must possess an efficient instrument to protect itself and carry out its national policy. The more efficient the army and its weapons, the fewer the challenges and the quicker any challenge is terminated successfully. When two evenly matched powers confront one another, a long-drawn-out war of attrition results. The war on the Eastern Front was an example. Superior numbers and equipment are especially significant in a war of attrition.

Although motivation and good morale are essential, and a highly motivated army may in time prevail over the better equipped rival, most wars are decided by material factors. Morale is not the exclusive property of one nation nor does it remain constant.

The Soviet Economy and the Red Army emphasizes institutional history almost to the exclusion of operational and personal history. Because operations were the test and battles were decided by effectiveness, frequent references have been made to battles and campaigns, but without detail. The author assumes that the reader has a working knowledge of the events of World War II and references are made to operations on that assumption. The book is organized topically rather than chronologically, resulting in a certain amount of repetition.

Enormous amounts of source information were available, but the quality varied. Soviet sources included the *Soviet Military Encyclopedia,* several multivolume histories, the *Military History Journal,* and hundreds of unit histories and memoirs.[1] Over 40 rolls (about 40,000 frames) of the captured German records microfilm dealt exclusively with the Red Army.[2]

The German information came from spies, prisoners of war, intercepts of radio transmissions by units, Soviet publications and broadcasts, and captured documents. The German level of accuracy is very high and the file is excellent from a historical point of view. The data pass the tests of historical validity inasmuch as the records were made at the time by persons familiar with the events with no motive to distort the facts and in a form that could not be altered without detection. When the German information was checked against available Soviet data, remarkably few irregularities surfaced. Most disagreements resulted from the omission of data in the Soviet publications. Gehlen, the chief of the FHO, used the data to develop forecasts of Russian intentions and potential strength, conclusions often ignored. For historians the German intelligence files have been a viable substitute for access to the Russian archives. Although far from complete, the German records provided valid data to verify or discredit Soviet publications.

Many excellent monographs have been published on various branches of the Red Army, on weapons, and on the economic development of the Soviet Union. The information in the monographs has been compared with Russian publications and German intelligence data.

The author's research for the study spanned over 15 years and followed some 40 years of study of the U.S. and European armies and weapons. The motivation for the study was a basic interest in discovering how the forces worked. Why did one army function so well and another fail? Why were some weapons more effective than others? Very often some minor technical detail was the key to unlock a puzzling situation. As a result lengthy discussions are included of minor matters that either have been overlooked by other authors or assumed to be common knowledge and passed over quickly. An example is the subject of horses. The large quantity of fodder and the incredible time and skill to care for horses absorbed hundreds of thousands of German soldiers and their Russian helpers. In contrast many Soviet breeds were raised wild in herds and survived with much less care and food. Readers a century ago would have been familiar with the animal problems, but few readers today have cared for working horses. It is hoped that a reader puzzled by the attention to seemingly minor matters will charge it off charitably to curiosity.

The author's background has offered fttst-hand experience with many of the topics in the study, including working in several automobile parts factories in Detroit, military service, living on a farm in Wisconsin, and serving as a curator at the Detroit Historical Museum and the National Museum of transport. In addition, caring few the firearms collections in the museums of the State Historical Society of Wisconsin and the Buffalo & Erie County Historical Society seasoned a curiosity in the military. Fellow workers in these experiences have given an understanding that would be difficult to acquire through other sources. A lesson not soon forgotten was a day with a crew setting a locomotive back on track with only a few heavy jacks and some tie plates because the rotten ties had given way.

Many individuals deserve recognition in completing this work. The consultations with Colonel David Glantz and Robert Volz have been invaluable. The author's many conversations with General Albert C. Wedemeyer concerning the military-political situation in 1942 and 1943 provided a unique insight. Calvin Wittmus, David McNamara, Susan Schmidt, and many others have provided information, support, and encouragement.

No scholarly work could succeed without resources. The librarians of the Memorial Library of the University of

Wisconsin were unstinting in their support. Perhaps no one has contributed as much as my wife, Jean, who has read the manuscript many times and helped turn the mass of detail into a readable piece.

NOTES

1. *Velikai Otechestvennaia Voina Entsiklopediya, 1941-1945* (Moscow: Sovetskia Entsiklopediya, 1985), *passim.*

2. OKH Generalstab des Heers, Abteilung Fremde Heer Ost (IIc), National Archives Microfilm Publication T78, *passim.*

Introduction

The Red Army was the major factor in the defeat of Germany in World War II. The Soviet Union organized and deployed a well-trained army of over 6 million men on the Eastern Front, tying up the major share of the German Army from June 1941 until 1945. Adequate supply was the second key to victory, along with organization of the army. Overwhelming quantities of weapons, munitions, rations, vehicles, uniforms, engineering and communications equipment, and all other needs of a modern army came from Soviet factories and Western lend-lease. While the German Army suffered chronic shortages of weapons, fuel, and other supplies that limited their employment, the Red Army received growing amounts of material unequaled by the combined resources of Germany and occupied Europeii How these weapons, equipment, and supplies were produced and distributed was as significant to the Soviet defeat of the German Army as the organization and training of Soviet soldiers.

The purpose of this book is to relate the Soviet economy of the 1930s to the supply of the Red Army in World War II. The study offers the apparent conclusion that by early 1943 the Red Army had the organization, leadership, and material to defeat the German Army regardless of military action by the West. Russ ian strategy from then on was dictated by politics and the position of the Soviet Union in the postwar world.

Supplying the Red Army was second only to its organization in defeating the Germans. Despite the skill of the German General Staff in conducting operations, shortages of fuel, ammunition, weapons, rations, and equipment inhibited their strategy as well as their tactics, leading to many setbacks. From 1939 to 1941, the German campaigns were brief, quickly defeating their opponents with limited consumption of supplies and equipment. German units fought much of the time with the basic loads of supplies available at the beginning of the campaign. After December 1941, the war in Russia deteriorated to a war of attrition on more or less static lines requiring both armies to create a reliable logistical system.

The Russians had a superior logistical capability based on economic development begun in the late 1920s. As early as 1942 supplies were not a serious limitation on Soviet operations. The enormous buildup for the Stalingrad offensive was the turning point in the war. By 1943 the difficulties in transporting the material to the front had been overcome, in part as a result of hundreds of thousands of U.S. trucks. The ability of the Soviet Union, with the help of American and British aid, to supply their army was as important as creating that army.

The Germans did not have such a system of supply. Neither the German economy nor that of the occupied territories was geared to total war until 1944, and the bombing offensive from 1943 on made difficult the full development of the country's war-making potential.

A Soviet military writer has outlined the factors that determined a nation's ability to win a war.[1]

1. The economic base
2. Technological competence
3. Military doctrine and tradition
4. Geographic environment
5. Ability and experience of personnel
6. The comparative power of the enemy

An advantageous position in a majority of these areas was necessary for victory. The Soviet government addressed all of these factors in the 1930s and early 1940s.

A strong economic base was created by the five-year plans that developed heavy industry and adopted mass-production techniques. In June 1941 Germany, with the addition of the economic power of occupied countries, was potentially far stronger than Russia. The loss of western Russia 1941 further depleted the Soviet economic base. However, by Draconian measures and concentrated effort, Russian military production surpassed German production by early 1943.

Industrial technological competence, the second factor, was acquired from technical assistance contracts with the United States and Germany in the 1920s and 1930s. Military technology was gained through cooperative activity with the German Army in the 1920s at air bases and tank training grounds in the Soviet Union. Battlefield competence was acquired by experience in the first two years of the war. At Kursk in July 1943 the Russians seized the initative and held it until the end of the war.

Tradition, the third factor, came from a blend of the czarist army and the revolutionary armies of the new government. During the war more and more of the prerevolutionary traditions were reintroduced to the Red Army. Doctrine was developed during the 1930s and in the first two years of the war. Soviet military leaders learned from the ideas of mobile warfare being developed in the West and from actual experience fighting the Japanese and the Finns.

The fourth factor, geographic environment, was fixed, but Soviet strategy and tactics made fullest use of the geographical advantages and compensated for the disadvantages. The ability and experience of the personnel, the fifth factor, was vastly improved through reformation of the Red Army in the 1930s, but not until 1943 did it reach equality with the Germans.

With regard to the last factor, comparative power, the Russians had begun an armaments race wiÉt the Germans in the early 1930s. After eight years of investment in heavy industry, the Russians switched to manufacturing weapons in 1937. The Germans had a significant head start and retained their superiority in quality and quantity in 1941. However, the Russians overcame their deficit by early 1943.

In early 1943, five of the six factors necessary to win a war turned in favor of the Soviet Union, leading to eventual victory. Geography was fixed, but the climate and the terrain were used to full advantage in Russian offensive operations in the last two years.

There is little doubt that the war was lost for Germany on the Eastern Front. By the end of 1943 German victory seemed hopeless, even though the Allied invasion was six months away. How did a backward country, the Soviet Union, defeat one of the greatest industrial powers of the world with probably the finest trained and equipped army of World War II? The popular theory in the West has been that masses of Russian soldiers attacked the German defenses, taking casualties of 10 to 1, until the Germans were overcome. The Red Army was viewed during World War II as a huge army of illiterate, ill-trained, ill-clad, poorly equipped, subhuman soldiers who fought only because of their fear of the NKVD machine guns threatening them at the rear. The image fostered by Adolf Hitler that victory for the Red Army came only by trading 10 Russian lives for 1 German life continues in popular Western literature.

The Soviet image of the Red Army was distorted as well. The Soviet versions often elevate the superiority of the socialist system and the heroism of the individual endowed by Communist fervor. In Communist publications the Red Army is composed of super-patriotic, idealistic young men whose acts of bravery had to be restrained to prevent wasting their young lives by needless acts of heroism. According to the Soviets, the real problem was not forcing the troops to sacrifice their lives but restraining them from doing so needlessly. The task of the officers was to instruct them to be better soldiers and to forfeit their lives for a sound reason. The Soviet position was that their soldiers were imbued with patriotic fervor based on faith in the socialist system and the Communist Party.

A third interpretation stresses that the Soviet Union with a larger economy outproduced the Germans and overwhelmed them with equipment. Was it possible for a country with less than half the steel capacity of Germany and its satellites to win the battle of production? Part of the answer was the role of lend-lease, which substituted for Russian production of trucks, locomotives, rails, and other goods that would have absorbed much of Soviet capacity.

None of the interpretations withstands scrutiny. A picture of complex dimensions emerges from voluminous Soviet literature and German intelligence reports on the Red Army during World War II. The Russians continued fighting whereas other nations soon surrendered to the Germans. In the early months of the war the Red Army was inexperienced and to a degree untrained. When the regular divisions were destroyed by the Germans, thousands of young Communists dispatched from the cities instilled patriotic fervor and gained time through heroic action, sometimes fighting to the last man.[2] Conversely, many Russian soldiers hated the Stalinist regime and surrendered readily, believing the Germans were liberators.[3] The Germans were able, therefore, to recruit hundreds of thousands of Soviets as service troops in the rifle divisions, to fight the partisans, to work as laborers in Germany, and even to serve as soldiers in Ost battalions in France. There was widespread disaffection with the Soviet system, especially in the Baltic States, the Caucasus, and the Ukraine.

The moral integrity of the common soldier was the key. The common soldier did not have an unquenchable faith in the Communist Party and the socialist system, but he believed in his country. The events of the past few years are revealing a gentler view of Russia. As decades of distortion are being sifted, one has to be wary that the revision is not as false as the previous propaganda.

One fact that seems to emerge is that Stalin's program of purges and promotion of men with no background to high office was not a personal vendetta but rather was based on the widespread and deep-seated feelings of Russian workers and peasants.[4] The common people deeply resented the cultural elite and well educated (the intelligentsia) as well as businessmen (the bourgeoisie) who were living as well under Lenin in the 1920s as they had under the czars.

A similar class conflict was echoed in Germany in the 1930s, but Hitler drew his initial support from the middle class in their efforts to suppress the lower class, which had gained a strong voice to the Weimar Republic. Wider support for Hitler from all classes followed the revival of the economy through public works and military spending. But the loss of freedom in Germany after March 1933 could not be reversed and any widespread resistance to Hitler was therefore of a passive nature.[5]

The Soviet people did not have to be coerced. Just as many Germans supported Hitler's policies, Russians supported Stalin's policies. Stalin was not a madman who held power only through the threats of the secret police. The czar had been removed only 20 years before, and memories of starvation and suppression were still fresh in 1937. The purges and harsh measures fell heavily on those classes least popular with the poor. Many of the army officers who survived the purge were sons of farmers and workers and presumably the same situation pertained to plant managers and other officials.[6]

Given the assumption of support from the lower classes, the mystery of Stalin's reckless purge of the army and the industrial leadership in the late 1930s unravels. Until the army had been organized and the economy restored and geared for war, Stalin needed the generals and the managers. When their work neared completion in 1937-38, Stalin felt secure enough to dispense with them and carry out the long-delayed wishes expressed in thousands of letters he received in the 1920s. Replacing the management class were men in junior positions from the lower classes who had been trained by those being purged.

The Soviet soldier fought valiantly and the women and children worked long hours because they loved their country and they hated the Germans.[7] Because their fathers and mothers had suffered the repressions of the czars, eradication of the nobility, the cultured elite, the wealthy farmers, and the businessmen was not viewed as a terrible crime. The just punishment for centuries of oppression had opened opportunities for many Russians.

Hatred of the Germans was also a powerful factor. Knowledge of the German treatment of prisoners was widespread after the first few months of the war.[8] In the early months of the war the Germans captured millions of prisoners with ease. After the record of brutality and atrocities became known, the prisoner bag dropped appreciably. The brutal policies of the Germans were revealed in towns recaptured in the winter of 1941-42, instilling a desire for revenge in the Russian troops. The Red Army fought as most soldiers—not with outstanding brilliance but with persistent determination.

The key to Russian victory was efficient organization and supply. The objective was to obtain the most cost-effective method of employing men and weapons under the prevailing conditions. During the 1930s the Russian military organization and the Russian economy were in a constant state of flux, reflecting radical changes in strategic and tactical planning. Changes still under way in mid-1941 contributed a great deal to the early defeats. However weapons developed from combat experience were replicated endlessly in evacuated factories and supplied to new formations. Combat experience changed the Red Army into a professionally led, capable, trained army. By the end of the war it was equipped with the most cost-effective weapons used by any army during World War II. As a result of Western reluctance to invade France, when the war finally ended in May 1945, the Soviet Union was able to erect an iron curtain holding millions of people of Eastern Europe captive for over 40 years.

NOTES

1. K. Malanin, "Razvitie Organizatsionnik Form Sukoputhik Voisk v Velikoi Otechestvennoi Voine", *VIZh* 8 (August 1967), p. 28.

2. Alexander Werth, *Russia at War* (New York: Discus Books, 1970), p. 176. At the end of June 1941 each provincial party committee was ordered to provide from 500 to 5,000 Communists for service. A total of 95,000 party members were mobilized and 58,000 were sent to the army. In addition the first *Opolchenye* workers battalions were formed in late June and some were sent to the front.

3. Werth, p. 265.

4. This line of reasoning was opened by a talk given by Elizabeth Harry of Brandeis University at the Northern Great Plains History Conference on September 30, 1994. The paper was based on an examination of portions of a file of 30,000 unsolicited letters written to the Communist Party's Central Commitiee and its secretary, Stalin, from 1922 to 1927. The tenor of the letters from the people was that they had supported the party and served in the Red Army during the Civil War, but the best jobs were still going to the intelligentsia and the bourgeois, the same people who had benefited under the czar. They complimented Stalin on his efforts to reverse that trend.

5. Alec Nove, *An Economic History of the USSR* (New York: Penguin Books, 1982), pp. 272-75.

6. George F. Kennan, *Russia and the West under Lenin and Stalin* (Boston: Little, Brown and Company, 1961), p. 306.

7. Werth, p. 198.

8. Werth, pp. 212-13.

1 Soviet Industrial Development, 1929-1941

At the very heart of the Soviet ability to defeat the German Army was its economic capacity to produce superior numbers of weapons of all kinds. The Soviet Union outproduced the Germans and overwhelmed them with equipment; for example, the Russians produced over 109,000 tanks and SUs (self-propelled artillery) from 1941 to 1945. The Germans produced only 41,947 tanks, assault guns, and self-propelled tank destroyers from 1939 to 1945.[1]

How was it possible for the Soviet Union to win the battle of production? Germany had more than double the steel-making capacity and, in addition, the economic potential of most of Europe. Lend-lease provided Russia with trucks, locomotives, rails, and other goods that otherwise would have absorbed much of Soviet industrial capacity. The Russians manufactured the weapons, devoting their entire heavy industry (created in the 1930s with foreign assistance) to the war effort.

Despite a harsh climate, Russia possessed the elements necessary for a strong economy. European Russia was comparatively flat, and railroad construction was not difficult between the Polish border and the Ural Mountains. Canals linked the rivers and provided good north-south connections. Although the severe winters made water

transportation useless much of the year, the frozen ground made overland transport more feasible.[2] The Soviet Union had ample natural resources: oil in the Caucasus, iron ore in the Urals and the Ukraine, coal in the Don Basin, excellent farmland in the Ukraine and western Russia, and timber in Siberia.[3]

Although endowed with natural resources, Russia was historically a backward nation, partly the result of self-imposed isolation in the early modern period. In a similar fashion, China and Japan resisted change and excluded foreign ideas, considering their culture superior to others. Sharing that attitude, the Russians fell behind western Europe in technology in the 16th and 17th centuries. Not until Peter the Great in the 18th century was Russia brought rapidly forward into the early industrial revolution. After his rule, progress slowed and Russia again fell behind in the 19th century.

There was dramatic industrial growth in the late 19th and early 20th centuries in Russia, but the First World War created havoc. Russia could not provide enough rifles for its array in World War I, and despite many imports, sent men into battle unarmed. From 1914 to 1941, Russia experienced the successive traumas of World War I, foreign occupation (1917 until 1919), a civil war that lasted until 1921, and a war with Poland. In 1917 the Communist regime eliminated most professionals, including army officers, engineers, government officials, transportation specialists, and others needed to make its economy work smoothly. The party did this again with the purge that began in 1937.

Communist social and economic programs caused more dislocation after 1918 than the civil war. During the Civil War neither side bombed factories, destroyed cities, nor scorched the earth.[4] The state of economic chaos created by the late 1920s was the result of elimination of the professional classes and the kulaks (land-owning farmers). Millions died of starvation and industry was at a standstill. For example, before the Revolution there had been a well-established machine-building industry in Petrograd (Leningrad) and Moscow. In Petrograd half the machine-building plants were closed in 1923, and the remainder worked parttime. The Putilov factory in Petrograd had 6,000 worker» before 1917 but only 1,000 in 1920.[5]

The Communist leaders in 1917 did not know how to operate the economy and did not trust the professional class to do it for them. Had the Bolsheviks left the economy alone, it probably would have continued to expand rapidly. Instead, Communist mismanagement drove the country into economic chaos from 1918 to 1928.[6] In 1920 Lenin had made a decision that the Soviet Union must have a self-sufficient economy. However, to accomplish this goal, the Russians needed foreign assistance.[7] In the 1920s, the Communist government granted concessions to Western companies under the New Economic Policy (NEP). The Russians hoped that the concessions would encourage the West to make capital investments in the Soviet Union and subsequently revitalize the economy. The 1925 Party Congress decided that heavy industry must be created to increase the strength of the economy and to enhance the nation's defense capability.[8]

The Communist leadership swallowed its pride and invited foreign companies into Russia. The foreigners operated coal mines, gold mines, factories, the telegraph system, and other businesses, taking the profits out of the country. Although the system provided economic activity, the idea of giving foreign capitalists the right to exploit the country was disagreeable. From the beginning, the Russians made it difficult for foreigners to export the profits and later attempted to expropriate the assets of the concessionaires.

An example of the work of the concessions was the cotton industry. In 1914 Russia had the third largest cotton manufacturing industry in Europe, with 745 factories. The industry employed 388,000 workers spinning cotton, of which half was imported and the other half grown on irrigated land.[9] By 1917 the factories were closed and the irrigation system no longer functioned. In the 1920s, German engineers rehabilitated the textile factories, but using imported American cotton placed a heavy drain on foreign currency. The Russians needed a better solution.[10] In the 1930s they hired American engineers to reconstruct and rehabilitate the irrigation system so that domestic cotton could be produced.

On October 1, 1929, there were 162 foreign concessions in the Soviet Union. The concessions were not strengthening the economy and cancellations began in the late 1920s. The Congress of Soviets in May 1929 ended the New

Economic Policy and adopted the First Five-Year Plan to develop the Soviet economy. On December 27, 1930, the Soviet People's Commissars repealed all but a few concessions. By 1933 no manufacturing concessions remained, and by 1936 only three other concessions remained.[11]

The Great Leap Forward of the First Five-Year Plan included collectivizing the farms and developing heavy industry. On December 21, 1929, Stalin stated that the development of heavy industry must take priority because of the threat of invasion. The First Five-Year Plan assumed good harvests, efficient completion of projects, and no fear of immediate foreign aggression. Actual events progressed otherwise.[12] The intent of the First Five-Year Plan, 1928 to 1932, was to establish not a full socialist economy but a capitalist economy with socialist motivation. This objective created two contradictory planning philosophies. One approach was to proceed strictly by the rules, keeping the economy balanced with no disruption. The second was to expand and accomplish goals whatever the cost to a balanced economy. The Russians usually used the second method, but from time to time they had to delay expansion and divert resources to other sectors to restore balance. An example was the increase of fuel supplies to meet the demands of the new factories.[13]

The First Five-Year Plan had a slow start. The Russians had begun work on some projects as early as 1926, but they made little progress because of their lack of technical knowledge. Because Communist Party membership was requisite for managers, many of them lacked the appropriate technical knowledge for their positions. There were few Communist engineers. By early 1929, failure was evident by the delays in completing the new factories and starting production.[14] The railroads were unable to cope with the increased traffic. Steel production dropped from 1930 to 1931. The increases in all areas of production were slight from 1930 to 1932.[15]

To realize the goals of the plan, the Soviets negotiated contracts for technical assistance from Western companies. The achievements of American mass production in the 1920s had impressed the Communist leaders. The 1920s was the decade of Henry Ford and the Model T. The newspaper *Pravda* stated "We now have to make great efforts to assimilate West European and American techniques . . . when our own new cadres have matured ... the need for foreign specialists will decrease."[16] The Russians believed that mass production would reduce cost, raise productivity, and bring the Soviet Union abreast of other industrial nations. Huge industrial complexes were to replace the many small factories. From 1928 to 1931 larger factories absorbed the smaller plants.[17] However, the Soviets needed an entirely new industrial complex with enormous modern plants.

The modern factories that defeated the Germans in World War II had their origin in the many technical agreements signed with foreign firms—mostly American, some German, and a few British, French, Swiss, and others. In June 1944 Stalin told Averell Harriman that two-thirds of the large industrial enterprises in Russia were built with American technical assistance.[18] These agreements generally called for the American company to design, build, and equip a plant. The contract often also called for training Russians in its operation. The Russians then copied these plants with limited foreign assistance. The contracts included the provision of all requirements to make a plant operational: technology, patents, specifications, supervision of construction, installation of equipment, and initial operation. A complete plant included training the workers and supplying maintenance manuals in Russian. These projects were turnkey plants. The word turnkey meant that the new owner merely had to turn the key in the door; the contractor had done everything else.[19]

The Communist Party claimed that its leadership and philosophy advanced the Soviet economy, not foreign assistance. In fact, Western technology had produced the rapid expansion.[20] The Soviet leaders studied Western technology to select the best products to serve as models for Russian mass production. They selected the Caterpillar 15/30 tractor, the IHC (International Harvester Corporation) tractor, the Farmall (Ford) tractor, the Holt combine, the Ford Model A truck, the German DIN lathe, and the Sulzer, Deutz, and Man diesel engines as models for duplication in Soviet factories. Once the Russians selected a standard model, manufacturing began, and they made enormous runs with few if any changes to interrupt production. Mass production was ideal for an unskilled workforce because each individual learned a single activity and then repeated it endlessly.[31]

Technical assistance from abroad enabled the Soviet Union to fulfill the First and Second Five-Year Plans and to

advance technologically over a half-century in about eight years. The purpose of the First Five-Year Plan was "generally understood to compress 30 to 50 years of industrial development into five years."[3] That advance was possible in the Soviet Union because copying Western technology eliminated the need for research and development. Standardizing almost everything from blast furnaces to lathes eliminated the cost of customizing machinery for each plant, and multiple-unit construction reduced manufacturing time and cost. The danger of copying was that the machines might not be suitable for the Soviet Union because of difference in climate, natural resources, labor skills, and topography. Therefore, some machines had to be adapted, but again foreign technicians helped. The Soviets abandoned unsuitable models such as the Farmall tractor when it proved too light for the heavy Russian soil.[23]

In 1928-29, 25 technical assistance contracts were active. By March 1930, the Russians had signed 104 contracts. Of the 104, 81 were with American or German companies; see Table below. Most contracts dealt with heavy industry.[24]

Metallurgical	37
Chemical	25
Electrical	13
Minerals and fuel	12
Textiles	5
Clay and glass	3
Miscellaneous	9
TOTAL	104

Under these agreements the Russians expanded and modernized the auto, tractor, steel, chemical, heavy machinery, coal, oil, and other industries. By 1932, 6,800 foreign heavy-industry specialists were working in the Soviet Union, including 1,700 Americans. The Russians purchased a large amount of machinery in Europe. In 1932 the Soviet Union purchased 90% of all machinery exported from Britain. From September 1939 to August 1940, 85% of Czechoslovakia's exports to Russia were machines, and most of the other imports were iron and steel products.[25]

The major emphasis was on the iron and steel industry. Stalin's objective was to rebuild and expand 20 pre-1917 plants and to construct three new gigantic steel works at Magnitogorsk, Kuznetsk, and Zaporozhe between 1927 and 1932. The work was to be administered by GIPROMEZ (the State All-Union Institute for Planning of Metallurgical Works). The Freyn Engineering Company of Chicago operated GIPROMEZ, making American technology and experience available to reconstruct the old plants and build new ones. The result was a new iron and steel industry built and operated by American standards.[26]

The Freyn Company received a contract in 1927 and began general planning. On June 30, 1930, Freyn signed a contract to build the Kuznetsk plant designed to produce a million tons of pig iron annually. Over 50 American engineers supervised the work.[27] The plant was renamed the Stalin plant in 1934. The Freyn Company built the entire complex, except the coke and chemical plants, using American designs. Machinery came from Germany, the United States, and Switzerland. Over 70 American engineers worked on the project from 1929 to December 1932. When the Americans left, the plant was producing 450,000 tons of pig iron annually.[28]

The original plan for the steel plant at Magnitogorsk specified an annual capacity of .5 million tons of pig iron. Beginning in 1928 without foreign assistance, the project made little or no progress in two years. In 1929 the Russians hired Arthur G. McKee and Company of Cleveland to design the plant. McKee proposed to enlarge the Soviet idea to a plant equal to the U.S. Steel plant in Gary, Indiana. The Gary plant had an annual capacity of 2.5 million tons of finished steel products annually instead of the .5 million tons in the original Russian plan. McKee had designed the

Gary plant, then the largest in the world, and had resolved most of the problems of large-scale steel production. Over 400 American engineers made the architectural drawings for the Magnitogorsk plant, the largest project in the First Five-Year Plan.[29] The design was completed by 1929, but little construction took place.

In May 1930, McKee was hired to supervise the construction as well. By 1931, 250 American engineers were working on the project. Work began despite some interference by the Russians. McKee brought in engineers from General Electric to work on the huge electrical installation.[30] Before 1917 the Russians had assembled blast furnaces with imported machinery. No new blast furnaces were built in Russia between 1917 and 1928.[31] In 1928 the Freyn Company designed a standard blast furnace with a capacity of 1,000 tons of pig iron per day. The Russians duplicated the design in all of the Soviet steel mills, including plants at Dzherzhinsk, Zaporozhe, Voroshilov, Azovstal, and Krivoi Rog.[32] In 1934 nine more were building and 41 more were planned.[33]

New open-hearth furnaces were designed by the Freyn Company (furnace and soaking pits); the American Morgan Engineering Company (charging equipment and cranes); and the German Demag A-G (pouring equipment). The new standard furnace had a 150-ton capacity. Fifteen were built at Kuznetsk and 14 at Magnitogorsk. Three other plants had new standard furnaces—Zaporozhe, Kirov, and Dzherzhinsk. There were also three 300-ton furnaces of the Freyn type and four large German-type furnaces.[34] A standard blooming mill designed for the rolling mills could roll 1.5 million tons of pig iron annually into standard sizes for final rolling.[35] The first new blooming mills were built in 1934 using a standard design developed from American and German types. Whereas blooming mills in Germany and the United States varied and produced rolled steel from 40 to 78 inches in width, most Soviet mills rolled the steel in strips 45 inches wide. The steel plants at Kuznetsk, Magnitogorsk, and Chelyabinsk used imported Demag A-G 45-inch mills. Mills at Kirov, Dzherzhinsk, the second section of Magnitogorsk, Zaporozhe, and Zlatoust used Soviet-built copies of the Demag A-G mill.[36] While the Western countries had more flexibility, the Russians were able to build more mills in less time by adopting the standard form.[37] Using a standard mill also simplified the problem of training operators and required a shorter period to place the new mills in production.[38]

Many modern weapons included stampings formed in large presses that shaped rolled steel into the needed form. The process was far quicker and cheaper than shaping the same form by any other means. The rolled steel was made on hot or cold continuous wide-strip mills, an American development to provide inexpensive parts for the auto and appliance industry. In February 1935, the American United Engineering and Foundry signed an agreement to install strip mills in Russia. A complete mill was constructed at Zaporozhe, and plans were provided for the mill at Kramatorsk. The mills were identical with the one located in the Ford River Rouge plant with an annual capacity of 600,000 tons of 66-inch-wide hot and cold strip steel. A similar American 66-inch mill was built at Magnitogorsk.[39]

To provide increased supplies of iron ore for the new mills, the Russians called in American engineers in 1928 to study the iron mines at Krivoi Rog. The Americans developed a plan for rehabilitation, expansion, and future operation. Between 1928 and 1934, Oglebay, Norton Company of Cleveland worked on all of the Russian iron mines. They concentrated on the mines at Krivoi Rog, four mines in the Urals, and the mines supplying the Kuznetsk mill. The Americans introduced modern methods and mechanization. Despite exhaustion of some open-pit mines (the easiest method to obtain iron ore) during the period, production per worker increased. In 1913, 68% of the ore came from open pits, in 1940 only 31%.[40] In the period from 1928 to 1934, 95% of the iron ore extracted came from mines modernized by Oglebay, Norton.[41] The major mines in 1940 were at Krivoi Rog (18.9 million tons), Magnitogorsk (7.85 million tons), Kerch (1.92 million tons), and Tagil-Kushva in the Urals (1.23 million tons). Tula and Lipetsk near Moscow produced 1.12 million tons.[42]

The Soviet nonferrous mining and smelting industry was very weak in the 1920s. There were very few experienced Russian engineers familiar with the extraction and refining of copper, gold, and other rare metals. In 1930, 200 American engineers worked with only 346 Russians engineers, three-fourths of whom had less than a year's experience.[43] Between 1929 and 1933, American engineers ran the nonferrous metals industry, designed smelters and refineries, and trained Russians in the operation of the new plants.[44] From 1933 to 1936 Russians gradually replaced the foreigners.[45]

Foreign technical assistance also improved the oil industry. In 1932, 77% of the refineries, 96% of the lubricating oil plants, and 91% of the cracking plants were of foreign design and construction.[46] The Max Miller Company built the lubricating oil plant at Baku. Foster-Wheeler and Alco Products built plants at Batum and Grozny.[47]

The Soviets hired American and German consultants for the coal mines beginning in 1926. Three American companies (Stuart, James and Cooke, Roberts & Schaefer, and Allen & Garcia) worked for six years in Russia reorganizing and expanding the coal mines in the Donbas and the Urals. In 1930-31 the Soviets imported almost all of the new equipment, but in 1931 Russian copies began to appear.[48]

Allen & Garcia had built the largest coal mine in the world, the Orient, at Franklin, Illinois. This company worked on the coal mines at Kharkov and Tomsk and later in the Donbas and Siberia. In 1931 there were 2,000 foreign coal specialists in Russia, 80% of them German. The consultants opened new fields in the Urals and modernized the old fields, reducing the number of shafts and increasing the size of shafts in the old mines.[49]

The heavy-machinery construction industry played a key part in war production. Two major plants were Uralmash at Sverdlovsk, which made tanks in World War II, and the plant at Kramatorsk, southeast of Kharkov, which was overrun by the Germans in 1941. Before the war, these two plants made heavy machinery for the iron and steel industry and for the nonferrous metal industry. Western machine tools were used in both plants to build copies of the latest Western machines. During the war the Germans used the Kramatorsk plant to repair tanks and other heavy equipment. The plant employed 2,000 Russian workers under the supervision of the Krupp Company. Ironically, both plants produced tanks —Sverdlovsk for the Russians, Kramatorsk for the Germans.[50]

Other industries also benefited from foreign expertise. German and American engineers revitalized the machine tool industry. For example, the Frank Smith Company had a contract to restructure the Putilov plant in Leningrad.[51] Auto plants were built at Moscow and Nishnij-Novgorod, and chemical plants at Dneproges and Bereznikov.[52]

The Russians built new tractor factories at Kharkov, Stalingrad, and Chelyabinsk with Western assistance. All played major roles in tank production in the Second World War. Eighty American firms and a few German companies directed the construction and equipping of the Stalingrad tractor plant.[53] More than 730 American engineers worked on the project.[54] L. A. Swajian, the construction engineer of the Ford River Rouge plant, was chief engineer for the construction of the factory from 1929 to 1930. Swajian duplicated the River Rouge plant at Kharkov in 1931.[55] John Calder, who worked on the River Rouge plant and the Packard Motor plant, was the chief Soviet construction troubleshooter from 1929 to 1933. He was chief construction engineer at Chelyabinsk and later technical director of the steel works at Magnitogorsk. For his work, Calder received the Order of Lenin.[56]

A key to Soviet industrial expansion was the mass production of heavy equipment, including blast furnaces and rolling mills, using proven Western designs. The Russians were able to profit from multiple-unit construction without risk, to standardize and avoid the cost of customizing, and to avoid research and development costs by copying successful designs.[57] By the late 1930s, the Soviet Union had machinery of the latest design and the largest factories in the world, primarily copied from the best available in the United States. By 1936 most of the foreigners had left, though the Soviets continued to import machinery for their factories. After the foreigners had gone, young Soviet engineers with little experience operated the plants and produced copies, not only of machines but of entire plants.

The three five-year plans beginning in 1928 created 9,000 new industrial enterprises—1,500 under the first, 4,500 under the second, and 3,000 in the three years of the third.[58] The First Five-Year Plan completed in 1933 used 1.5 billion rubles in gold and grain exports to pay for foreign machines and expertise. National income grew by 60% in five years, mostly in factories, construction, and transportation. The greatest increase was in the production of iron and steel. Farming and production of consumer goods decreased, resulting in severe hardship for the people.[59] Before Stalin gained complete control in 1935, critics cast doubts on the truthfulness of the accomplishments of the five-year plans. The few consumer goods available were of poor quality.[60] The collective movement in agriculture had a

disastrous effect on life in the villages. The government removed from leadership opponents of the collective farms, the wealthy farmers (kulaks), and the most skilled farmers.

The First Five-Year Plan had sacrificed agricultural progress for industrial development. Collectivization of the farms resulted in severe drops in the harvest from 1928 to 1932. In 1929 Stalin had ordered the use of force to bring all of the farmers into collectives, but by 1930, only 23.6% of farm households were in collectives. Forcing farmers to join collectives increased the number of farm households in collectives to 89.6% in 1936. By 1935, 94.1% of cropland was in collective farms.[61]

At first, the forcible restructuring of food production by requiring farmers to enter into collectives had a negative impact on the quantity of other types of food available for market. The reduction was partially the result of inefficiency in the operation of the new collectives. Another factor was that the members of the collectives did not cooperate, and may have withheld produce from market or even sabotaged the operation. The collectives removed the profit motive for the individual and the desire for maximum production. The recorded consumption of most food types declined on the farms and in the cities from 1928 to 1932. City dwellers obtained a greater share in some of the available food. The urban diet more closely approximated the rural diet by 1932, see below:[62]

KILOGRAMS PER CAPITA PER YEAR				
Year	**Bread Grains**	**Potatoes**	**Meat & Lard**	**Butter**
Rural				
1928	250.4	141.1	24.8	1.55
1932	214.6	125.0	11.2	0.70
Urban				
1928	174.4	87.6	51.7	2.97
1932	211.3	110.0	16.9	1.75

The Soviet Union suffered a severe famine in 1932 and 1933 resulting from a poor grain crop in both years, dropping below 70 million tons.[63] The harvests remained poor through the 1930s as shown in the table below.[64]

Year	Grain Harvest (millions of tons)
1928	71.6
1929	70.1
1930	78.8
1931	66.6
1932	66.1
1933	69.3
1934	69.7
1935	74.3
1936	61.1
1937	96.3

1938	72.2
1939	76.6
1940	89.5

Assuming from the table that an average yield before 1931 was about 70 million tons, the yield exceeded that average only once from 1931 to 1936. Government procurement of grain in 1930 was only 20.4% of the crop and resulted in an average of 506 kg of grain per capita in rural areas and 469 kg in urban areas. In 1931 the government procurement rose to 33.3%, resulting in a rural average of only 347 kg of grain, while the urban average increased to 675 kg. As the yield declined, the government took more for the cities and left the fanners with little more than two-thirds of the amount of the previous year. Heavy government procurement and reduced amounts of grain for the farmers continued until 1939, with the exception of the bumper crop of 1937 when, despite heavy procurement, the 96.3 million-ton yield left the farmers with 549 kg per capita. In 1940, although the government still took 36.4%, the good yield left the farmers with 462 kg per capita, while the increasing urban population received 621 kg per capita. The grain was used primarily for food and for feeding animals. The numbers confirm that hunger on the farms until 1940 resulted from government procurement.[65]

There was not enough food for all until the late 1930s. All totals of grain production for 1933 through 1936 were below the harvests of 1928 through 1932. The number of livestock had to be reduced because of the lack of grain. That, in turn, created the severe shortage of meat in the 1930s.[66] The total amount of sugar produced had declined while daily products remained stable from 1928 to 1932, but both increased in the late 1930s as shown below:[67]

PRODUCTION OF FOOD TYPES

(millions of tons)

Food Type	1928	1932	1937	1940
Sugar	1.3	0.8	2.4	2.2
Meat	0.7	0.6	1.0	1.5
Fish	0.8	1.3	1.6	1.4
Dairy products	1.9	1.9	5.0	6.5

By the end of the 1930s, the collective farms were firmly established. There were 531,000 tractors, 228,000 motor vehicles, and 1.4 million tractor and truck drivers in the Soviet Union, a remarkable advance in 10 years.[68] On January 1, 1935, bread ration cards were eliminated in the Soviet Union. Although there was still not enough meat, rationing of meat, fish, sugar, and potatoes ended on October 1, 1935.[69]

From 1929 to 1934 the Soviet government created a great industry but at a heavy cost. Critics have pointed out that development was too fast. No government had ever demanded such sacrifices in peacetime in an advanced country. The result was a considerable amount of resistance and alienation. In reaction, deliberate suppression of opposition increased to the point that the government rejected sound advice as to alternative programs. The autocratic administrative methods led to police terrorism.[70]

The most articulate people—the educated class (the intelligentsia) and the businessmen (the bourgeoise)—who had fared well under the czars made up most of the opposition. The workers and the poor farmers resented the fact that those two classes continued to prosper under the New Economic Policy in the 1920s, while the poor suffered. This resentment grew even greater in the 1930s as Stalin demanded ever greater sacrifices for the five-year plans.

Stalin reacted to this resentment with the purge that began in 1937. Stalin assumed that he no longer needed the intelligentsia or the bourgeois who were now opposing his plans. Besides the military commanders, many industrial managers were arrested. The purge of 1937-1939 removed engineers, designers, and plant managers. The rapid promotion of a few individuals indicated that the Communists had weakened the managerial class again. Without leadership, the factories were plagued by inefficient operation. In 1936-37 production reached a plateau, and stagnation followed until 1940. The purge of industrial managers probably contributed to the slump.[71] The psychological impact of the purge was serious. The survivors were cautious, refused to take responsibility, and obeyed all orders whatever the circumstances. Stalin wanted complete control and suppressed all opposition.[72] Some replacements for the purged individuals were incompetent cronies of Stalin—for example, Kulik and Mechlis in the army.[73] In the table below, statistics for 1928 represent the Soviet economy before the five-year plans; 1932 for the end of the first, 1937 for the end of the second, and 1940 for the position before the war.[74]

PRODUCTION INCREASES FROM THE FIVE-YEAR PLANS

(millions of tons)

Product	1928	1932	1937	1940
Pig iron	3.3	6.2	14.5	14.9
Crude steel	4.3	5.9	17.7	18.3
Rolled metal	3.4	4.4	13.0	13.1
Coal	35.5	64.4	128.0	165.9
Oil	11.6	21.4	28.5	31.1
Electricity (billion KW)	5.0	13.5	36.2	48.3
Motor vehicles (thousands)	0.8	23.9	199.9	145.4

Despite criticism that the government exaggerated the achievements of the First Five-Year Plan, that the plan wasted money, and that concentration on industrial development caused famine, the impact was dramatic.[75] The five-year, plans had military and economic goals. Because of the experience of foreign intervention from 1918 to 1921, and, later, the fear of German military preparations, the Soviet government directed economic expansion in the 1930s toward arms production. The new industries had a civilian use but were adaptable to military use. For survival, the Soviet economy had to equal the power of Germany. The new civilian industries were designed to convert rapidly to weapons production in time of war.[76] Therefore, heavy industry received much of the technical assistance.

There was no real difference between peacetime and wartime planning. Heavy industry received priority with brief intervals to readjust the economy. Concentration on heavy industry was a capital investment in the economy, creating plants that produced tractors and trucks but were designed to manufacture tanks in time of war. Actual military spending was very low in 1929, however the industrial development was clearly related to defense. On February 4, 1931, Stalin said "We are fifty or a hundred years behind the advanced countries. We must make good this distance in ten years. Either we do so, or we shall go under."[77]

The fear of foreign invasion forced the decision to disrupt the established regional pattern of industry. In 1928 industry was concentrated in the western European area of the Soviet Union. The 1933 plan called for a major change. The following table shows the plan and the actual achievement.[78]

PERCENT OF TOTAL PRODUCTIVE

CAPACITY			
Region	**1928**	**Plan**	**Actual**
Leningrad	12%	8%	11%
Southwest European	26%	27%	22.5%
Central Region	30%	22%	25%
TOTAL OLD REGION	**68%**	**57%**	**58.5%**
Transcaucasus	11%	8%	5%
North Caucasus	5%	5.5%	5%
Ural Region	4%	10%	9%
TOTAL NEW REGION	**20%**	**23.5%**	**19%**

The intent was to reduce the exposed areas around Leningrad and Moscow from a total of 42% to 30% and to increase the Urals Region from 4 to 10%. The plan was partly successful; the industrial capacity of the Urals was more than doubled. Most of this increase was in crucial military-related heavy industry. By dispersing strategic factories, creating reserves of natural resources such as iron ore and oil, and developing the economy, the Russians could lose substantial amounts of territory and retain sufficient economic power to come back. A complete semiautonomous complex was built in the Urals and Western Siberia with mines, electrical capacity, factories, and transportation. In the 1930s there was steady development east of Moscow, and by 1940 the east produced nearly one-third of the iron and steel. On the other hand, most of the arms production was in the western part of the Soviet Union—for example, 74% of the tank production.[79]

There were many problems in creating the new complexes. Building the factories required transferring thousands of workers into a wilderness. The long distance from parts suppliers forced the new factories to make many parts at greater cost. The burden of moving building materials, parts, and workers was a heavy strain on the railroads.[80] As a result, the Soviets disregarded the total strategic plan and built many new factories in established industrial centers. The infrastructure and labor needed for expansion were already there. There was no need to build housing, roads, utilities, and other facilities that a new center in the Urals would require. Ironically, the war and the evacuation of industry accomplished the goals of the plan.[81]

Russia prepared for a long war, Germany for a short one.[82] The relative share of the national budget for arms grew steadily from 1933 after Hitler came to power in Germany as shown below:[83]

Year	% of Soviet Budget Allocated for Defense
1933	3.4
1934	9.1
1935	11.1
1936	16.1
1937	16.5
1938	18.7
1939	25.6

1940	32.6

To the Russians it appeared that the Western diplomacy of the 1930s was aimed at unleashing Hitler on the Soviet Union. Only in 1938 did Britain and France realize the danger to themselves and begin to rearm. The Russians had started to rearm in 1928. Soviet rearmament was more thorough and long-term than in any other nation. As the next table shows, in the years from 1933 to 1938, the Soviet Union spent almost as much money for armaments as did Germany, and far more than any other nation.[84]

Nation	**Total Expenditure for Arms 1933-1938** **(billions of pounds sterling)**
Germany	2.9
Soviet Union	2.8
Japan	1.3
United Kingdom	1.2
United States	1.2
France	1-1
Italy	0.9

The weapons produced prepared the Russians for modern warfare by 1940 as shown here:[85]

Weapon	**1930**	**1933**	**1936**	**1940**
Aircraft	899	2,952	3,770	10,565
Tanks	170	3,509	4,800	2,794
Guns and mortars	952	4,368	4,324	15,300
Rifles and carbines (in thousands)	126	241	403	1,461

The decrease it tank production in 1940 resulted from a changeover from light to medium tank production. The totals exceeded the contemporary Production of other nations. The production of 4,800 tanks in 1936 compared to a total accumulated stock of 3,200 tanks held by Germany in September 1939.[86] From January 1939 to June 22, 1941, the Red Army received 82,000 guns and mortars, 7,000 tanks, and 18,000 military aircraft.[87]

The shift from economic expansion to weapons production caused a marked slowdown in industrial growth in 1937, even in the iron and steel industry.[88] The Soviet industrial expansion had given priority to weapons production in 1930 through 1933. The second spurt in arms production came in 1936 through 1940. After 1936 the Russians slowed investment in heavy industry and shifted to arms. The iron and steel formerly used to build factories was then used to make tanks, artillery, and ships.[89]

During the early 1930s and from 1936 to 1940, the Soviets improved many of their weapons; for example, they upgraded practically the whole range of artillery pieces both times.[90] In 1930 and 1931, the Russians manufactured 1,911 guns, 860 military aircraft, and 740 tanks—far more than any other nation at the time. In 1938, production had

increased to 12,687 guns, 5,469 aircraft, and 2,270 tanks—again more than in any other nation.[91] Weapons production took 7% of the national income in 1940, and military subsistence (paying the ongoing cost of the forces) took an additional 4%. The military used 26% of the productive capacity, 16% of transportation, and 9% of farm production. In 1938, arms production absorbed one-third of the iron and steel produced and 42% of the high-grade rolled steel. The civilian economy was starved for steel as a result.[92]

The arms industry expanded rapidly at the expense of basic industry and a civilian economy that was already under stress from the five-year plans.[93] By 1938 there were serious problems in the Soviet economy. Stalin blamed sabotage, and economic slowdown was one reason for the purge to root out the guilty. In reality the slowdown resulted from a breakdown in planning and priorities. The worst problems were the lack of balance between fuel supplies and production and the loss of skilled technicians because of the purge. Voznesenskii became the leading planner in early 1938, introducing more realistic goals and developing the Third Five-Year Plan. By June 1940 the economy was again in balance, and a period of rapid growth began, lasting until June 1941.[94]

Despite all the errors, waste, and hardship, the Soviet Union had "created the industrial base for a powerful arms industry," but only at the cost of civilian consumer goods.[95] Even after the end of the Second Five-Year Plan, there was no improvement in the standard of living for the Soviet citizen. At best it remained stable.[96] However, by 1941 the new Russian managers had learned their lessons. The American-built factories and their equipment formed the basis for the Soviet war industry in World War II. These factories, far more efficient in mass production than their German counterparts, made the tanks and other weapons that defeated the Germans.

The Red Army had been the most powerful army in Europe in 1938, with an excellent leadership corps and plentiful supplies of modern weapons.[97] But the purge of the late 1930s deprived the army of its leaders and led to the disasters of 1940 in Finland and in the opening months of the war in 1941.

However, the industrial complex to replace the lost weapons remained, the true legacy of the five-year plans.

NOTES

1. Burkhart Mueller-Hillebrand, *Das Heer 1933-1945,* 3 vols. (Frankfurt am Main: E. S. Mittler & Sohn, 1959-69), III, p. 274.

2. Holland Hunter and Janusz M. Seymour, *Faulty Foundation: Soviet Economic Policies 1928-1940* (Princeton, NJ: Princeton University Press, 1992), p. 13.

3. Hunter and Seymour, pp. 14-16.

4. Vitaly Rapoport and Yuri Alexeev, *High Treason Essays on the History of the Red Army 1918-1938* (Durham: Duke University Press, 1985), p. 201.

5. Anthony C. Sutton, *Western Technology and Soviet Economic Development,* 3 vols. (Stanford: Hoover Institution Press, 1968-73), I, pp. 164-65.

6. Rapoport and Alexeev, p. 201.

7. Hunter and Seymour, p. 3.

8. A. Grechko et al., *Soviet Studies on the Second World War* (Moscow: USSR Academy of Sciences, 1976), p. 87.

9. Sutton, II, p 32.

10. Sutton, II, p. 32.

11. Sutton, II, pp. 4, 16-18; Alec Nove, *An Economic History of the USSR* (New York: Penguin Books, 1982), p. 157.

12. Hunter and Seymour, pp. 64-65; Nove, pp. 158-60.

13. Mark Harrison, *Soviet Planning in Peace and War 1938-1945* (Cambridge: Cambridge University Press, 1985), pp. 1-4.

14. Sutton. II, pp. 286-87.

15. Hunter and Seymour, pp. 75-76.

16. Sutton, II, p. 286.

17. Hunter and Seymour, p. 87.

18. Sutton, II, p. 3.

19. Sutton, II. p. 13.

20. Sutton, II, p. 4.

21. Sutton, II, pp. 294-96.

22. Sutton, II, p. 256.

23. Sutton, II, p. 316.

24. Sutton, II, pp. 10-11.

25. Sutton, II, pp. 137-38.

26. Sutton, II, pp. 61, 63.

27. Sutton, II, p. 62.

28. Sutton, II, pp. 77-78.

29. Sutton, II, pp. 62-63.

30. Sutton, II, pp. 74-76.

31. Sutton, II. p. 68.

32. Sutton, II, p. 67.

33. Sutton, II, p. 67.

34. Sutton, II, p. 69.

35. Sutton, II, pp, 64, 69.

36. Sutton, II, p. 70.

37. Sutton, II, p. 70.

38. Sutton, II, p. 71.

39. Sutton, II, pp. 71-72.

40. Sutton, II, p. 65.

41. Sutton, II, p. 66.

42. Sutton, II, p. 66.

43. Sutton, II, p. 44.

44. Sutton, II, p. 60.

45. Sutton, II, p. 47.

46. Sutton, II, p. 86.

47. Sutton, II, p. 87.

48. Sutton, II, p. 90.

49. Sutton, II, pp. 91-92.

50. Sutton, II, pp. 130, 135-37.

51. Sutton, 1, pp. 165, 184.

52. Rapoport and Alexeev, p. 197.

53. Sutton, II, p. 2; Rapoport and Alexeev, p. 197.

54. Sutton, II, p. 11.

55. Sutton, II, ft. 12.

56. Sutton, II, p. 12.

57. Sutton, II, p. 130.

58. Alexander Werth, *Russia at War* (New York: Discus Books, 1970), p. 146.

59. Harrison, pp. 5-6.

60. Rapoport and Alexeev, pp. 219-22.

61. Nove, pp. 164, 174.

62. Nove, p. 177.

63. Hunter and Seymour, pp. 94-97.

64. Hunter and Seymour, pp. 100-01.

65. Hunter and Seymour, pp. 100-01.

66. Nove, p. 240.

67. U.S.S.R, Central Statistical Board of the USSR Council of Ministers, *National Economy of the U.S.S.R. Statistical Returns* (Moscow: Foreign Languages Publishing House, 1957), pp. 54-55.

68. Viktor A. Anfilov, *Bessmertnii Podvig Issledovanie Kanuna i Pervogo Etapa Velikoi Otechestvennoi Voini* (Moscow: Nauka, 1971), p. 90.

69. Rapoport and Alexeev, p. 219.

70. Nove, p. 223.

71. Sutton, II, p. 2.

72. Nove, pp. 237-38.

73. Nove, p. 270.

74. U.S.S.R. *National Economy*, pp. 50-51; A. A. Grechko, *Liberation Mission* (Moscow: Progress Publishers, 1975), p. 24; Harrison, p. 6.

75. Rapoport and Alexeev, p. 200.

76. Harrison, pp. 47-48.

77. Nove, p. 189.

78. Hunter and Seymour, pp. 21, 21.

79. Werth, p. 146; Viktor A. Anfilov, *Krushenie Pokhoda Gitlera na Moskvu* (Moscow: Nauka, 1989), p. 48; Grechko, *Liberation Mission*, p. 24; Harrison, pp. 49-50.

80. Hunter and Seymour, p. 88.

81. Hunter and Seymour, pp. 28-30.

82. Harrison, pp. 44, 48.

83. Nove, pp. 228-29; Hunter and Seymour, p. 137.

84. Alan S. Milward, *War Economy and Society 1939-1945* (London: Lane, 1977), p. 25.

85. Harrison, p. 8.

86. Mueller Hillebrand, III, p. 274.

87. Grechko, *Liberation Mission*, p. 26.

88. Nove, p. 236.

89. Hunter and Seymour, pp. 140-41.

90. Harrison, p. 7.

91. Grechko, *Liberation Mission*, p. 25.

92. Harrison, pp. 7-9

93. Nove, p. 229.

94. Harrison, pp. 10-29.

95. Nove, p. 257.

96. Nove, p. 260.

97. Rapoport and Alexeev, p. 190.

2 The Military Economy, 1942-1945

German strategy in World War II envisaged a series of short, decisive campaigns against weaker neighbors. Hitler did not believe that Germany could afford a costly war of attrition. The German General Staff opposed Hitler's risky gambles initially and favored total economic mobilization, integration of military effort, and general coordination of resources needed to fight a long war. Nevertheless, Hitler's policy did produce quick victories from September 1939 to April 1941, using weapons and supplies available at the start of the campaign.[1]

In short campaigns, existing military productive capacity and stocks of weapons decide the issue. In a long war, on the other hand, the nation able to convert the greater economic potential to military use succeeds. Theoretically, all the economic resources of a nation could be converted to military purposes, however many months are needed to convert. The extent to which the German civilian economy could be deprived of goods and services had to be considered.[2] Hitler believed that he needed quick victories because the Nazi Party did not have the unquestioned support of the German people. He believed that he could not ask the level of sacrifice demanded from the Russians, the British, and even the Americans. Hitler did not believe his people were ready to sacrifice everything for the war effort, therefore German production of civilian goods continued.[3]

The accepted interpretation by historians is that the major reason Germany could not win a long war was the ability of Britain to cut off sources of raw materials. Despite the productive capacity of Europe, it could not be exploited fully without imports of iron ore, coal, oil, rubber, and other essential materials. In fact, these raw materials were available or could be produced synthetically in Europe. Germany ended the war with adequate stocks of all materials except oil. The loss of Roumanian oil wells and the destruction of synthetic oil factories by Allied bombing created an oil shortage only at the end of the war.

Hitler's dilemma was that compromise was unacceptable because it would include his removal from power, just as the Kaiser was removed after World War I. Basic to the idea of attrition is that the stronger party will eventually agree to a political compromise instead of continuing a costly war. The weaker party, though tempted to hold out for the best possible terms, is forced to accept terms rather than accept complete ruin. In 1918, Germany surrendered, believing that the terms were acceptable, and the Allies, tired of the war, agreed to a compromise. But Hitler could accept no compromise and remain in power, so once attrition began, his defeat was inevitable as his opponents were willing to continue. Because the Germans controlled large areas of conquered territory until the final months of the war, the Allies—the stronger party—were not likely to offer Hitler agreeable terms.[4] The declaration of unconditional surrender at Casablanca ensured continuation of the war of attrition until the final defeat of Germany. Casablanca also discouraged any hope for a coup to remove Hitler and reach a negotiated peace.

The Germans planned for a quick, decisive victory over the Russians, requiring only a limited economic mobilization and using existing weapons and accumulated stocks of strategic materials. Germany was in a strong position in June 1941. Until December 1941, Germany did not alter its peacetime economy because it had been at a moderate state of military focus since before 1939.[5] The German Army was well equipped and experienced. Occupied Europe provided additional capacity to produce weapons and provide supplies.[5] In 1940 Germany produced 19 million tons of steel, 14 million tons of pig iron, and 63 million kw of electricity.[7] The resources of the occupied countries tilted the economic balance sharply in favor of Germany. Including the productive capacity of the captive nations, in 1941 Germany produced 404.3 millions tons of coal, 24.3 million tons of pig iron, 31.8 million tons of steel, and 4.8 million tons of oil.[8] In comparison, the Soviet Union in 1940 produced 165.9 million tons of coal, 14.9 million tons of pig iron, 18.3 million tons of steel, and 31.1 tons of oil.[9] Only in oil production was the Soviet Union able to match the German resources.

Germany had an opportunity to win the war against the Soviet Union in the summer of 1941, based on superior technical skill and existing stocks of weapons. Hitler assumed that Russia was as weak as his previous enemies, who had collapsed after only a few weeks of intensive fighting.[10] But his failure to take Moscow in November 1941 forced Hitler to abandon the quick-war strategy and adopt a plan that marked the first step in a massive effort to produce weapons. Hitler no longer had the advantages of surprise, better stocks of weapons, and a more experienced army. Therefore, Germany's new economic plan of January 10, 1942, called for weapons production at the expense of civilian production.[11]

The long war of attrition followed the German failure to end the war in 1941. On the other hand, grandiose Soviet plans of the winter of 1941-42 to surround and destroy large forces of the enemy also failed and stifled any hope of a quick Russian victory. The Germans were not defeated by a brilliant stroke. Only a massive effort by the entire Soviet Union would drive the Germans from Soviet soil. The capability of the Soviet Union to create an army superior to the Germans, and to produce more tanks, guns, other weapons, and munitions, became the decisive factor.

Germany lost the production war because of a misappropriation of resources. The combined resources of Germany and the occupied nations far exceeded the economic potential of the Soviet Union. With skillful exploitation, the Germans should have been able to outproduce the Russians. Unfortunately for the Germans, internal economic planning was under the incompetent Hermann Goering in 1942. Exploitation of captured territories was divided among many agencies, resulting in the lack of a strong, cohesive plan to make maximum use of resources. Even the reforms imposed later by Albert Speer merely transferred the production of civilian goods to occupied countries and converted German factories to war production.

Germany wasted resources in other ways. Hitler directed a substantial amount of military assets against England in 1941 and 1942, when no serious threat existed, while large forces remained idle in France until late in 1942. The continued effort to hold North Africa merely distracted Britain and the United States, with no strategic objective.[12] The British Mediterranean route to the Far East was already severed by aircraft based on Sicily. Conquering Egypt would have left Rommel at the end of a long supply line, with thousands of miles of inhospitable territory in every direction. The resources wasted in France and North Africa might have been sufficient to sway the balance in the summer of 1941. The threat of a second front in 1942 had tied up many German divisions. Even though the decision at Casablanca to forgo an invasion in 1943 released those divisions to the Russian front, by then Russian strength had increased to a level that made German victory unattainable.

The Allied bombing offensive also diverted a considerable portion of the German economy and retarded its growth. Although German production of tanks, trucks, and other weapons continued to increase during the war, greater increases would have been achieved had it not been for British and U.S. bombing. German industry was decentralized because of the bombing. The threat of an intense attack on a plant producing all or a major share of any weapon or weapon part led the Germans to disperse the manufacture of aircraft and other weapons. But dispersal reduced efficiency and required new construction in the east, beyond the range of the British and U.S. bombers. Repairs to plants damaged by bombs also absorbed construction potential, materials, and labor. The enormous investment in antiaircraft guns and fighters to defend German cities absorbed military productive capacity that could otherwise have been used on the Eastern Front. The number of guns used to defend German skies exceeded the total number of guns on the Eastern Front.

Another factor limiting German production was the stress on quality instead of quantity because of the shortage of fuel. Germany did not have sufficient fuel supplies to operate a large fleet of military vehicles. Therefore, the philosophy was to produce weapons like the Tiger tank that would be superior to many enemy tanks. The quality versus quantity theory had validity because of the German machine tool industry, whose engineering talent made possible the improvement of weapons quicker than any other nation. However, the German qualitative advantage could not overcome the quantitative disadvantage.[13]

Thus, reluctance to deprive German civilians, diversion of military assets to unimportant areas, Allied bombing, and a manufacturing philosophy dictated by fuel shortages all combined to limit the expansion of German production. Soviet production, on the other hand, was reduced by enemy occupation of more than half its factories in 1941. By November

1941, the Russians had lost 40% of their population and much of their industry, as shown here.[14]

Coal	63%
Pig iron	68%
Steel	58%
Aluminum	60%
Railroad	41%
Sugar	84%
Grain	38%
Pigs	60%
Electricity	42%
Iron ore	71%

In the 1930s the Russians, anticipating loss of territory, had dispersed industry, developed production facilities in the Urals, and accumulated strategic reserves of raw materials. In early 1941, the Soviets believed that their rearmament program had advanced to the point that the Red Army could halt the German attack and defeat Hitler within a short time. Plans to evacuate industry were not published, even if they had been made. But the rapid German advance across western Russia in the summer of 1941 quickly deprived the Soviets of much of their economic base.[15]

A contemporary study made by the Germans based on intelligence reports presented similar data. Losses were placed at coal 42%, iron ore, 65%, pig iron 60%, steel 55%, and coke 63%.[16] A comparison of the first half of 1941 with the second half showed the catastrophic impact on Soviet production, as follows:[17]

LOSS OF PRODUCTIVE CAPACITY (millions of tons)		
Product	**January-June 1941**	**July-December 1941**
Electricity (billion kw)	27.4	19.3
Coal	91.9	59.5
Oil	17.3	15.7
Pig iron	9.0	4.8
Crude steel	11.4	6.5
Rolled steel	8.2	4.4
Iron ore	16.6	8.1

The bulk of Russia's industrial capacity and prime agricultural land was lost, but the oil industry was still safe. The comparative loss in arms-related industry was less because more of those factories were in the east. The Soviets needed time to relocate and convert the evacuated factories to war production.[18]

The enormous loss in economic potential had to be replaced if Russia were to win the war. The Soviet economy, under stress in 1941 because of the five-year plans, was already working to capacity. There was no inactive reserve in the

Soviet Union as in the United States, where many workers and plants were not employed before 1941. The slowdown in general Soviet economic growth to the late 1930s had left little unused capacity. To produce arms, civilian production had been reduced sharply. Some civilian items were eliminated entirely—for example, sewing machines and cameras. Production of shoes dropped from 211 million pairs in 1940 to only 63 million pais in 1945.[19]

The Russians had planned for wartime economic mobilization before the war, assuming that it would be a large-scale conflict. Victory demanded prewar buildup of military and economic potential and the ability to convert rapidly from a civilian to a war footing. The Soviet plans estimated the requirements of the armed forces and the industrial capacity to produce those needs, including new machines, reserves of materials and components, and labor reserves. Tractor factories at Chelyabinsk and Stalingrad, built in the 1930s for civilian tractors, were designed to be converted to tank production. The locomotive and automobile plants also were designed with tank production in mind.[20] Manufacturing plants were prepared to convert to the production of arms and ammunition. Planning began with a military industrial commission established on April 30, 1938. On July 15, 1939, representatives were appointed for each factory to develop war mobilization plans. The commission, completing its work in 1941, provided the factories with detailed plans to convert to war production.[21] The economic mobilization plan of June 30, 1941, was probably an update of a previous plan.

The program anticipated the need to evacuate both factories and workers from the western Soviet Union, but concrete evacuation plans were never published for political reasons. Calling for deep withdrawal and evacuation of industry would have been interpreted as defeatist. The accepted doctrine was that the enemy would be forced to retreat into its own territory after a brief period.[22] Therefore, when the Germans penetrated the Soviet defenses, hasty plans were made for evacuation.[23] But pre-war planning had not anticipated an evacuation of the size that occurred. The government improvised under enormous pressure, and that ability was one of its greatest strengths. Although imperfect, the evacuation did buy time for more balanced planning.[24] The magnitude of the task exceeded any advanced planning, but as the actual movement developed, impromptu decisions produced many benefits.[25]

On June 24, 1941, the Council for Evacuation was appointed. On July 4, 1941, the council ordered Voznesenskii, director of five-year planning, to organize the movement of industry and workers to the east. Local committees used the five-year plan structure with 3,000 agents controlling the movement.[26] Evacuation of industrial plants began in August 1941 and continued until end of the year. But evidence shows that evacuation began much earlier, or at least the transfer of machine tools and skilled workers to "shadow factories" in the east. The U.S. military attache reported significant transfers of machines and men from the Moscow area to the east in late 1940 and early 1941. The rapid growth in production early in 1942 suggested that the evacuation had started in 1940. The tempo increased in August 1941.[27]

Evacuation began with a recommendation from a local agency to the commissaries of the appropriate industry. After investigation, the recommendation was approved by the Evacuation Council and placed on a schedule giving the date, method of transport, and relocation site. In addition, unapproved evacuations took place on the initiative of local authorities.[28]

Evacuation was well under way in the first week of August 1941. Sacrificing immediate production, many factories closed in August, packed up, and moved to the Ural Mountains. But because their products were needed, some plants remained in production until too late to be moved. Only 17 of the 64 iron and steel plants in the Donbas were evacuated between October and December 1941. The Kharkov tank factory was being dismantled when the Germans arrived.[29]

The railroad made evacuation possible. As the railroads moved 2.5 million men to the front in June, July, and August, they moved industrial machinery on their return. For example, on August 7, 1941, 3,000 rail cars per day evacuated iron and steel manufacturing equipment from the Dnieper area—1,000 cars per day for the electrical industry, 400 cars per day for the chemical industry, and others. From August 8 to August 15, 1941, 26,000 rail cars evacuated industries in the Ukraine.[30] In Moscow, 80,000 cars transported 498 factories, including 75,000 lathes, leaving only 21,000.

Production by many factories resumed by December.

The pressure on the railroads was massive. A total of 914,000 carloads were evacuated by November 20, 1941.[32] Half the available cars were used for evacuation. Of the 700,000 cars available 350,000 would have been used.[33] The average turnaround time for cars in late 1941 was estimated to be 15 days, but using this estimate, 700,000 cars could have moved six loads in three months or a total of 4.2 million carloads. If the 350,000 cars moved only 914,000 carloads, the turnaround time must have been well over 30 days for evacuation trains. The remainder of the cars in use may have had much shorter turnarounds times bringing the average down, but this is unlikely. These numbers suggest that the evacuation had serious planning problems. The evacuation used half the cars, but moved less than one-fourth the potential cargo during the three months from mid-August to mid-November. Not enough cars were available and some equipment was left behind. One planned move in the Donbas needed 13,000 cars, but only 3,460 cars were available.[34] The operation was not always orderly. Other indications that planning was not complete and that turnaround time was longer than average were anecdotes of equipment having been dumped beside the tracks to empty the cars for a return journey. Of the 700 plants evacuated in the first months, only 270 arrived at planned destinations fully equipped, and 110 arrived with only part of their equipment.[35] The other 320 factories presumably were scattered.

Finding buildings to house the evacuated factories was a major problem. The central accounting office made an inventory of available space and GOSPLAN, the planning staff for the five-year plans, organized the resettle- ment. GOSPLAN sent parts of some factories to different locations and combined others into a new enterprise. Some factories were expanded or used to rebuild an existing factory—for example, the tank factories. The factory at Magnitogorsk received machinery from 34 evacuated factories. Other factories relocated in theaters and cultural centers. Despite all efforts, much material and machinery remained in warehouses by the spring of 1942.[36]

At times, inadequate planning resulted in trains having been loaded with materials and dispatched with no destination to prevent capture by the Germans, these orphan trains moved around the country for long periods because there were no plans to use the equipment and no one knew what to do with them.

The average time to load, move, and unload a car increased from six days in May to 16 by November 1941, indicating a major breakdown in efficiency. The average distance traveled per day by each car dropped from 160 km in May to 84 km by November, another indication of loss of control. By November, 58,000 cars were stranded on main lines leading to the Volga, the Urals, and the Caucasus.[37]

The evacuation of the factories was an immense undertaking. In the last three months of 1941, GOSPLAN moved 1,360 factories: 455 to the Urals, 210 to western Siberia, and 250 to Central Asia and Kazahkstan.[38] By the end of 1941, 1,523 large factories were moved. A few went to the Far East. The total was only a small portion of the 32,000 factories captured by the Germans, but arms-related factories, representing 12% of the industrial potential in the occupied zone, were evacuated.[39]

Even before the evacuation began, the government announced the first wartime plan for the economy on June 30, 1941, for the third quarter of 1941. The program called for an increase of 26% in arms production over the peacetime level, curtailment of construction to provide steel for weapons, allocation of two-thirds of new machine tools to arms production, relocation of new plant construction to the east, and a cut of 12% in production of consumer goods.[40] The plan was realistic. Reducing output in some areas made capacity available for arms production. The production plans were strong in detail concerning individual plants, but planning was complicated by changing circumstances, technology, doctrine, and the German advances. Seriously underestimated were the losses that the Red Army would endure as well as the loss of productive capacity to the Germans.

The government approved a plan for the second half of 1941 on August 16, 1941, calling for priority production of artillery, small arms, ammunition, aircraft, and tanks. The plan also called for new coal mines and the completion of iron and steel works in the east to replace capacity taken by the Germans. New agricultural land was to be developed in the east as well.[41]

Creating a new industrial base in the east required new sources of raw materials. The loss of the Donets Basin, a major source of coal, caused a national shortage, In the fall of 1941, the Germans overran the Moscow coal basin. The occupied areas had produced 63% of the country's coal. In December 1941 the government ordered increased coal production in the Urals, Kuznetsk Basin, and Karaganda. Oil refineries were expanded in the Volga River region, Kazahkstan, and Central Asia. New power stations in Siberia replaced electrical capacity lost to the Germans.[42] To develop the Volga, Ural, and western Siberian areas, the Russians planned to build 5 new blast furnaces, 27 open-hearth furnaces, a blooming mill, and 5 coke ovens and to open 59 coal mines in the final months of 1941 and in early 1942.[43] Compared to 1940, production in 1942 increased 900% in the Volga district, 500% in the Urals, and 2,700% in western Siberia.[44] Despite this effort, the program in the Urals and western Siberia began slowly. In January 1942 the annual production rate was only 1 million tons of pig iron and 770,000 tons of steel.[45]

By September 1941, the Soviet economy was in crisis. Although small arms and artillery production had expanded, the munitions industry failed and a shell "famine" developed. Compared to a goal of 6 million shells in the third quarter, fewer than 2 million were produced. The Germans had overrun plants with an annual capacity of 13 million shells.[46] Tank production was a fraction of the number required to replace losses. Production did not recover quickly in 1942; the decline in production in 1941 was difficult to reverse. The invasion had reduced the supply of all fuels, basic iron, and steel, and it had dislocated the transportation network, straining the system.

Russia's need for immediate production of large numbers of weapons, the problem of converting factories to war production, and the evacuation of many factories added further pressure« The Soviets abandoned any attempt to maintain a balanced economy. As a result, the available capacity to manufacture arms was not fully used in 1942 because of shortages of metal, fuel, transportation, and labor.[47] The capacity was far short of 1940 because of the loss of territory and the evacuation of factories. In the last six months of 1941, the Germans occupied many factories, and the evacuated factories were not yet producing. The planners reduced construction of new factories sharply. Even by the end of 1942, productive capacity was little more than half of what it had been in 1940.[48]

The shock to Soviet heavy industries that was inflicted by the campaigns of 1941 and 1942 affected all areas. There were sharp decreases in the manufac- ture of machine tools, motor vehicles and tractors, and light manufacturing, resulting from shortages in production. These shortages resulted when the Germans captured metal, coal, and electrical facilities. Evacuation, military use, and the German advances also disrupted transportation. The total impact was a loss of coordination, poor morale, and deteriorating working conditions. The downward trend in total production did not end until 1943.[49]

On the bright side for the Russians, the first stage was over by the end of 1941. During 1941, emergency decrees on an ad hoc basis had governed the mobilization of the economy for war, including the evacuation, conversion of civilian production, and development of new production facilities. Improvisation replaced central planning. Emergency decrees had dealt with each crisis and resulted in haphazard mobilization.[50] A gradual change to more balanced long-range planning was begun late in 1941; however the emergency measures continued through 1942. GOSPLAN received more power to develop a master plan for the economy. Departments were created for the production of tanks, aircraft, artillery, and other weapons. A department of GOSPLAN controlled all factories involved in, the manufacture of a given type of weapon. GOSPLAN set supply plans for the 120 major factories for each quarter to guarantee their performance. Central control was returning after a period of chaos.[51]

Economic mobilization was under way, the evacuation was complete, and the conversion from civilian to military production was well on the way. The Red Army stopped the German onslaught, and the winter 1941 offensive inflicted the first major defeat on the German Army in World War II.[52] The change was evident in the planning for 1942. Whereas in 1941 arms production had overwhelming priority at the expense of all else, in 1942 arms were merely first on a list of priorities. In a healthy second place were the basic indus- tries—iron and steel, fuel, electricity, and transportation. In 1942, 59% of investment in new industry was devoted to arms and heavy industry, compared to only 30% before 1940.[53] Light industry, agriculture, residential construc- tion, and service industries received very little investment. Agriculture received only one-tenth the number of trucks and tractors provided from 1938 to 1941 and

only 1% of the combines.[54] The emphasis in 1942 was on restoring balance to the economy, restarting construction projects stopped in 1941, and installing equipment to begin production in completed plants. The only new projects approved were small operations offering the advantage of quick completion and early production.[55]

Because of the heavy strain on the transportation system, primarily the railroads, factories became more regionally self-sufficient. In 1939 the Stalingrad tractor plant obtained only 3.5% of its supplies from the Volga region; in 1942 the factory had to find suppliers closer to Stalingrad or make the part itself. When the railroads could not bring in materials, factory managers resorted to extreme measures to meet their production quotas. Factory agents broke into warehouses and robbed passing trains for parts and material. Some plants began manufacturing parts previously obtained elsewhere; but this practice was uneconomical, owing to the loss in cost savings of mass production. In 1942 regional industrial complexes emerged. The Urals became a semi- autonomous region, providing coal and iron ore to the steel works and steel to the tank factories.[56]

Economic mobilization was only starting in 1942. The loss of industrial centers to German occupation disrupted the mobilization plan seriously. The difficulty in restarting the evacuated factories further delayed mobilization. The loss of manpower to the armed forces required the recruitment and training of a new labor force. All of these factors delayed the shift from peacetime production to military production and curtailed output in the last six months of 1941. Further delay in full scale military production resulted from the loss of industrial capacity and the source of raw materials deluding coal and iron ore when the Germans overran the Ukraine in the summer of 1942. The Don Basin was a major source of coal and iron ore. Many of the iron and steel plants were located there, close to the source of basic materials. The Ukraine was also a major source of electric power from dams located on rivers leading into the Black Sea. The magnitude of the task can be gauged by comparing the last year of peacetime production, 1940, with 1941 and 1942, as follows:[57]

COMPARISON OF PRODUCTION 1940-42

(millions of tons)

Product	1940	1941	1942
Pig iron	14.9	13.8	4.8
Crude steel	18.3	17.9	8.1
Rolled steel	13.1	12.6	5.4
Coal	165.9	151.4	75.5
Oil	31.1	33.0	22.0
Electricity (billion kw)	48.3	46.6	29.1

Restoring the basic industries was a much longer process than increasing arms production. As the following table shows, the comparison of the reduced output of the second half of 1941 to the first half of 1942 was not encouraging.[58]

PRODUCTION: SECOND HALF OF 1941 AND FIRST HALF OF 1942

(millions of tons)

Product	Second Half 1941	First Half 1942
Electricity (billion kw)	19.4	14.1
Coal	59.5	35.7

Oil	15.7	11.7
Iron	4.8	2.3
Steel	6.5	4.0
Rolled metal	4.4	2.6
Iron ore	8.1	4.6

Oil was the strongest link in the Soviet economy and the weakest link in the German system. Most of the Russian oil came from the Caucasus—86% of the 1940 production of 31 million tons. The Red Army used only 4.5 million tons in 1941. Still, the Russians worried about the safety of the supply. The oil fields in the upper Volga and Kazan had produced 14% of the total before the war. Rapid expansion of oil production began in 1942, with the intent that the supplies would be sufficient even if the Germans took the Caucasus.[59] The major problem for the Soviets was distribution. Before the war most of the oil moved by pipeline to the Black Sea ports, while 9 million tons moved by barge up the Volga. The Germans cut the pipeline routes in 1942 and placed the entire burden on the barges and railroads. The railroads carried most of the oil.[60]

Throughout 1942 there was a severe fuel shortage. Many coal mines and miners were lost with the occupation of the Ukraine and some coalfields near Moscow. Transportation problems prevented the oil from leaving the Caucasus, and the Germans occupied the large oil fields near Maikop. The loss of the major power dams in the Ukraine reduced the amount of electrical power.[61]

Industrial evacuation and increased production by existing facilities in the east replaced some losses to the Germans. Although the Germans captured 57% of the rolled steel capacity, output in 1942 in the remaining factories was 41% of prewar production. As the following table shows, despite determined effort, heavy industry did not return to the level of 1940 until after the war.[62]

ANNUAL PRODUCTION 1940-45

(millions of tons)

Product	**1940**	**1941**	**1942**	**1943**	**1944**	**1945**
Electricity (billion kw)	48.3	46.6	29.1	32.3	39.2	43.3
Coal	165.9	151.4	75.5	93.1	121.5	149.3
Oil	31.1	33.0	22.0	18.0	18.3	19.4
Pig iron	14.9	13.8	4.8	5.6	7.3	8.8
Crude steel	18.3	17.9	8.1	8.5	10.9	12.3
Rolled steel	13.1	12.6	5.4	5.7	7.9	8.5

The German offensive in the summer of 1942 caused further disruption of the Soviet economy. The Russians in 1942 had not learned from the 1941 evacuation. Stalin formed a commission on June 22, 1942, to plan the evacuation of factories and other assets at Stalingrad. However, most of the machinery was lost because Stalin later ordered that no evacuation take place from Stalingrad; the factories would continue to produce until the Germans came. The tank factory was making tanks as the Germans approached.[63]

Although the Germans were not able to obtain much oil from their campaign, they did disrupt Soviet supplies. The Germans blocked the Volga at Stalingrad. Cutting the railroads east of the Volga and the military demands on the railroads west of Stalingrad left little capacity to move the oil by rail. Production in the new areas was still expanding. Thus, severe shortages of oil in 1942 resulted from distribution problems, not the availability of supplies. The second

half of 1942 witnessed a minor increase in oil productive capacity over the first half of 1942 reversing the downward trend in Soviet oil production, even though the Germans had taken some wells in the south.[64]

Even with the reduction in basic industry, the Soviets expanded arms production, quickly exceeding German production. Some factories were in production six to eight weeks after evacuation. Assembly operations resumed rapidly, but major industries such as iron and steel took far longer. By June 1942, only 54 of the 94 evacuated iron and steel plants were producing.[65] Slow growth in iron and steel production during the war was an indication of the difficulty of moving heavy industry. Yet despite all their problems, the Russians manufactured 25,436 aircraft and 24,680 tanks in 1942.[66]

The Soviets made weapons at the expense of the civilian economy and long- term investment. Soviet consumer goods were in shorter supply in 1942 than in any other year. There was a slight improvement in 1943 through 1945, but in 1942 the government sacrificed the welfare of the consumer for war production—agricultural production fell over 60% from prewar levels. Though the German occupation reduced the number of people to feed by 30%, the decline in food production meant inadequate supplies for those who remained.[67] A comparison of the allocation of all resources among the military, the civilian sector, and reserves between 1940 and 1942 exposes the sacrifices made by the civilian population and indicates the heavy drain on reserve stocks as shown here:[68]

Resource Allocation	1940	1942
Accumulation of reserve stocks	19%	4%
Civilian subsistence	70%	56%
Military subsistence	4%	13%
Military equipment	7%	27%

The military share increased from 11 to 40%, while the civilian sector received only 56% compared to 70% in 1940, a loss of 16%. Percentages do not tell the entire story, as the total resources available also sharply declined by 33% from 1940 to 1942. A 16% loss compounded by the 33% overall loss resulted in a reduction to an amount equal to 37.5% of the 1940 amount. Even though the 30% reduction in the number of people alleviated the problem, reduced production cut the individual consumer share of the economy by 25 % of the 1940 total.[69] A net cut of 25% per individual was far more serious than the 14% cut one would assume from the chart, or the 12% cut mentioned in the 1941 economic plan. One authority estimated that the government spent 15% of national income on the military in 1940 and 55% in 1942.[70] Another authority estimated that civilian subsistence shrank to only 41% of the 1940 amount.[71] These statistics point to one conclusion: the average Russian had substantially less food, fewer clothes, and less fuel in 1942 than in 1940. The standard of living in 1940 was poor by Western standards, and the 25% reduction was therefore significant.

Postwar Soviet claims of a superior ability to convert rapidly to war production must be balanced by the realization that the Soviets had no choice other than to build a new military economy, because the Germans had taken over one-half of their prewar civilian economy. In the first six months there was little long-range planning—only emergency decrees to solve the immediate problems of evacuation and increased production of weapons.[72] In the comprehensive plans made in 1941, the Soviets accomplished what the Germans failed to do: concentrate their entire productive capacity on winning the war. Slogans developed the. theme "Everything for the front." By May 1942 results were already evident. In that month, production of medium and heavy tanks reached 500, light tanks 350, aircraft 650, and artillery shells 1.2 million.[73] But not all programs were successful. The plan for steel production was 28 million tons, but only 12.5 million were produced and over 65% of that was made in the last six months. Nevertheless, concentration on war production had brought better results than the Germans had achieved. Germany produced 30 million tons of steel in 1942, but used only 8 million tons for military purposes.[74]

Some indication of the Soviet concentration on war production can be gained by comparing the number of tanks

produced by the four major powers in 1942 per million tons of crude steel produced. Germany, excluding the steel production of captured nations, produced 453 tanks per million tons of steel, the United States 306, Britain 666, and Russia 3,083. The comparison is misleading, however, because the Russians built very few ships while the other three had significant naval and merchant shipbuilding programs.[75]

A major component of Soviet industrial capacity was the supply of labor. Few civilians left the Baltic States, but over a million left White Russia, 400,000 from Leningrad and 1.4 million from the Moscow area. The movement was not well planned. Thousands of people arrived in areas where no provisions had been made to receive them. Stalingrad, with a population of 450,000, had received 400,000 refugees by March 1942. Estimates of the total number of refugees range from 7.5 million to 25 million. The occupied area had a prewar population of 77.6 million and the unoccupied area increased in population from 113.5 million to 130 million. Therefore, a total of about 16.5 million refugees was a close estimate.[76]

Labor discipline had been growing more severe since the late 1930s, when the government assessed penalties for absenteeism and for moving from job to job. The penalties included fines and loss of housing and insurance. The rules had a positive effect, making labor more efficient. On June 26, 1940, after the fall of France, a decree placed Soviet industry on a war footing. Moscow passed additional labor laws in October 1940. The laws required longer hours, made absenteeism a crime, and conscripted young people for labor. The

standard workday increased from seven to eight hours, and the work week increased from five of each six day period to six of each seven day period. As a result, the number of days off in a year was reduced from 61 to 52. The laws required that employees stay with their current jobs unless they received a permit to move.

Under the 1940 Soviet laws, absenteeism was punishable by six months of hard labor. Two infractions—as minor as arriving at work 20 minutes late—constituted absenteeism. Presented as a necessity for the country's defense, the decree reduced absenteeism. The laws were enforced rigorously. Judges, managers, and other responsible leaders were punished if they did not enforce the laws.[77]

In 1941 the demands of the military and the occupation of the western provinces sharply reduced the total labor force. Only 10 million workers—30 to 40% of the labor force—had moved east with the factories.[78] The others went into the army, became partisans, or simply remained in their homes.[79] These people were not easily replaced. The economy needed about 11 to 12 million additional workers In 1942 to operate the evacuated factories and to replace men called into the army. The number of nonfarm workers shrank from 27 million in Jung 1941 to only 19 million in January 1942.[80]

To replace the civilian losses, Russian workers were mobilized practically on the same footing as the army. The government drafted workers from the cities and farms to provide for construction and the war industries. On February 13, 1942, a decree was issued, On Mobilization of Abie-Bodied Town Dwellers for Work in Industry and Construction for the Duration of Hostilities. The entire adult urban population, including women, was subject to compulsory defense work. (The law exempted persons in training or solely responsible for the care of a child.) Local committees carried out the plan. The law of December 26, 1941, prohibited defense workers from leaving their jobs and considered absence as desertion.[82]

As following, table shows, the labor situation remained serious throughout 1942. The government redistributed the available labor to provide a workforce for the essential industries, but that was not enough. Losses to German occupation and to the armed forces still left the economy short of labor. In the second half of 1941, 800,000 housewives, students, and elderly joined the workforce. In this period 59,000 were workers moved to the armaments factories.[83] Millions of men were inducted into the armed services to replace the losses in 1941 and to create new units. All categories of workers were reduced from 1940 to 1942 with the greatest reductions in farm workers and nonindustrial workers. Even essential industry was short of workers. The number of workers in industry declined.[84]

LABOR SUPPLY 1940-42 (millions of

workers)		
Type of Worker	**1940**	**1942**
Armed forces	4.2	10.9
State employees	31.2	18.4
Industrial workers	11.0	7.2
Nonindustrial workers	20.2	11.2
Collective farm workers	35.4	154

The work week was seven days, and the factories worked around the clock, either with three 8-hour shifts or two 12-hour shifts. The decree of June 26, 1941, abolished normal holidays and leave and required up to three hours of overtime per day. From 1940 to 1942, the hours worked increased by 22% and productivity per hour increased by 7%, resulting in a gain of 30% in output per worker.[85] In non-manufacturing areas, however, the impact of unskilled workers reduced productivity. In the construction field and in transport, output per worker declined throughout the war.[86]

After 1941 the government moved workers about under compulsory laws. In 1942, 750,000 workers were transferred to industry, construction, and transport. In the early months of 1942, 69,000 workers were moved from light to heavy industry. And women and old men filled much of the workforce. Small boys stood on boxes and operated lathes. The percentage of women in the labor force grew from 40% in 1940 to 53% in 1943. In 1942, women made up 70% of the labor force in light industry and 38% in heavy industry. During the entire war, women performed 50% of the labor in industry, adult males 25%, children 8.5%, and the elderly the remainder.[87] By the end of 1942, all the labor reserves were exhausted. The farms needed workers instead of providing additions to the industrial labor force. Transport workers were exempt from military service, and were discharged to return to the railroad.[88]

The labor crisis ended in early 1943. Men released from the army because of wounds, people gained in reconquered territory, and the availability of German prisoners all eased the situation. Military losses were far fewer than in the previous year. Laws still required that all adults either enter the armed forces or work where needed, but the demands of industry received consider- ation. In 1943 and 1944, the government moved more than a million workers per year, most into defense-related occupations. Centralized control made the best possible use of the workforce. The army deferred some occupations and limited the number of men conscripted to allow sufficient labor for industry.[89]

The shortage of farm labor and the Nazi advance created crises in the Russian food supply, in the labor supply, and in the manufacturing sector of the economy. Farming suffered most from the shortage of labor. The number of workdays per farm worker in 1942 increased by 40% and each worker farmed more land. Nevertheless, the drastic reduction in the number of farm workers resulted in a reduction of more than 60% in the food supply.[90] The food shortage was all the more serious because it affected a very weak segment of the Soviet economy; food had been scarce even before the war.

Indeed, the German invasion, the loss of occupied land, and the shortage of farm labor created a drastic food shortage, as this table shows:[91]

FOOD PRODUCTION 1940-42 **(millions of tons)**			
Food Product	**1940**	**1941**	**1942**
Grain	95.6	56.4	26.7

Potatoes	76.1	26.6	23.8
Sugar beets	18.0	2.0	2.2
Meats and fats	4.7	4.1	1.8

The occupation also reduced the number of animals sharply.

SUPPLY OF FARM ANIMALS 1940-45 (millions)				
Animals	**1940**	**1942**	**1943**	**1945**
Cows	27.8	13.9	16.4	22.9
Horses	21.0	8.2	7.8	10.7
Pigs	27.5	6.1	5.5	10.6

By November 1941, 47% of the Soviet cropland was in German hands. The Germans had 38% of the grain farmland, 84% of the sugar land, 38% of the area devoted to beef and dairy cattle, and 60% of the land used to produce hogs. The Russians turned to the east and brought more land into cultivation. In the fall of 1941, the autumn and winter crops increased sharply in the eastern area. But despite all efforts, farm yield dropped from 95.5 million tons of grain in 1940 to 29.7 million tons in 1942. Production of cattle and horses dropped to less than half prewar levels and hogs to one-fifth. By 1942 meat and dairy production shrank to half the 1940 totals and sugar to only 5%.[93] Farm production in 1942 and 1943 dropped to 38% and 37% of 1940 totals.[94]

A food rationing program apportioned the smaller harvest among the people, but the shortage of food meant that the old and infirm faced starvation.[95] The rations in Moscow in 1943 were very sparse and varied according to occupation —Class I for heavy workers, Class II for ordinary workers. Class III for office workers, Class IV for dependents, and Class V for children under 12. The quantities were monthly allotments except for bread, where the following table gives the daily amount. A 550 gram portion of bread per day (a little more than a 1-pound loaf) would have provided most of the calories needed by the average worker. A diet of 70 grams (less than 2 ounces) of meat or fish per day was very short on protein. All amounts are in grams.[96]

Category	**Bread (daily)**	**Grain**	**Meat & Fish**	**Fats**	**Sugar**
I	650	2,000	2,200	800	500
II	550	2,000	2,200	800	500
III	450	1,500	1,200	400	300
IV	300	1,000	600	200	200
V	300	1,200	600	400	300

The demands of the army and industry were especially hard on the farms and continued to be heavy throughout the war. In 1942, 23% of the people mobilized by manpower committees for industry came from the farms. The others were urban dwellers or doing nonessential work. In 1943, 59% of those mobilized for industry came from the farms and in 1944, 62%.[97] The result was a continuing shortage of food, partly alleviated by the import of U.S. and Canadian food under lend-lease. The West shipped nearly 4.5 million tons of food to Russia, much of it canned meat and processed food. Food rationing continued in Russia even after the war.

Although the food crisis was not resolved, military production made a significant turnaround in 1943. A 1944 German

analysis of Soviet production estimated much higher figures for 1943 than Russian figures show. The Germans estimated production of 12 million tons of pig iron and 16 million tons of steel; Russian figures are 5.6 million tons of pig iron and 14.2 tons of crude and rolled steel. According to German sources, the Russians used 7 of 16 million tons of steel for war production. In addition, the Soviets received 1.7 million tons from the United States and Britain, for a total of 8.7 millions tons. Germany in 1943 produced 29 million tons and used 9 million tons for military purposes. About 70% (6.3 million tons) went to the Russian front.[98] Although the Russians regained the industrial regions in the Donbas late in 1943, rebuilding the blast furnaces and steel mills was a slow process. An increase in steel production did not appear until 1944, when the total for all steel production reached 18.8 million tons. Pig iron remained well below the German estimate for 1943.

German intelligence was apparently faulty in this instance. The allocation of only 7 million tons of steel to the military is illogical in the face of other comments about the all-out Russian concentration on war production. In 1943 the Russians used 2.44 million tons of iron and steel in ammunition production alone." In the same year the Russians used 17.8% of their steel production in making tanks.[100] If one uses the Soviet figure of 8.5 million tons of crude steel produced in 1943, 17.8% is equal to 1.5 million tons. Total tank and SU production in 1943 was 24,000, and 1.5 million tons would have provided an average of 63 tons per unit, well over the average weight of armored vehicles produced in that year and an appropriate amount considering the steel lost in the production process. If ammunition and tanks used nearly 4 million tons, total military use (including artillery, aircraft, trucks, and automatic weapons) was probably more than the German estimate of 7 million tons. As the Germans used only 6.3 million tons of steel for the Russian front and the Russians were outproducing them, the more likely figures are the Soviet total of 14 million tons of steel with an estimated 9 or 10 million tons for military purposes.

After July 1943 the Russians began to regain their territory, but the Germans often destroyed or carried away any economic assets and sometimes also men of military age. The liberation of occupied territories added little to the Soviet economy because of the thoroughness of German destruction. In 1943 the Ukraine produced only 1.2% of the goods produced in 1940, though the Russians had retaken a large part of the republic.[101] And there was less food for more people. Agricultural production in 1943 was lower than in 1942, while the population requiring food increased from 130 million to 143 million. Food from the United States began to play an important part in feeding the army.[102] The reconquest of territory did bring some rewards, however. As early as February 1943 plans were under way for reconstruction of the Donbas. Heavy industry received priority along with agriculture. On January 23, 1943, a directive ordered that the regained farms be furnished with machines and mechanics to maintain them. On February 22, 1943, a directive ordered restoration of the Donbas coalfields. The latter was an extraordinary success, and during 1943 the Donbas provided one-fifth of the country's coal.[103] From 1943 through 1945, 7,500 factories were restored in reoccupied territory, compared to an average of 800 to 900 new plants opened annually during the five-year plans.[104]

The demand for weapons leveled off in 1943. Production exceeded losses and provided a surplus for the creation of new units. On March 18, 1943, some plants that had manufactured mortars converted to the manufacture of needed farm machinery.[105] After October 1943, arms production flattened out, with only minor variations until the end of the war.[106] The alteration of priorities for lend-lease revealed changing conditions; after September 1942 the priorities were food, chemicals, industrial equipment, oil piping, refining equipment, and hydroelectric equipment. Other than the food, all items were for the restoration of liberated territory. The Russians believed correctly that they had won the production war by late 1942, and their concern in 1943 was to restore their economy.[107]

The increased production of 1944 reflected the time necessary to rebuild factories in the recovered areas. The increases were substantial in all areas except oil. The slow recovery of oil production is difficult to explain. In 1942 the Germans held the Maikop oil fields, which produced 71.5% of the oil in 1940.[108] Russian demolition was so thorough that German technicians could not return the fields to production, and may have delayed the restoration of production by the Russians.

Soviet economic potential never equaled that of Germany except in the production of oil, as shown in the following table:[109]

BASIC MATERIALS PRODUCED DURING THE WAR 1941-45. (millions of tons)		
Product	**Soviet Union**	**Germany (1941-44)**
Coal	441.5	2,151.0
Iron	31.5	98.1
Steel	45.4	133.7
Oil	91.3	62.0
Electricity (billion kw)	147.3	334.0

The recovery of the western area of the Soviet Union in 1944 did not foster riches. Only 17% of industrial workers remained in the liberated Russian Republic areas. In the Ukraine, 17% of workers remained, and in White Russia only 6% remained. In the three republics, remaining inventories of livestock varied from 10% for hogs to 40% for cattle. In essence what the Red Army recovered was a devastated land with many hungry women and children, not an economic bonus.[110] Only after many months was the land again in production. By January 1944 the collective farms in the liberated area had been restored to prewar status.[111] In 1943 and 1944, 839,000 homes were restored or built for 5.4 million people.[112] In the critical area of railroad reconstruction in 1943 and 1944, the Soviets were able to restore the liberated regions to only 40% of prewar mileage[113]; they were unable to achieve prewar production by the end of the war.

The Russians won the economic war, not because of total capacity but by concentrating on war production in more modern, efficient factories. Production for the civilian sector continually shrank. By 1944 production of civilian goods sank to only 54% of 1940, while arms production increased by 251%.[114]

The Russian people, through their sacrifices, bought the victory over the Germans. Those sacrifices were partly responsible for over 15 million civilian deaths during the war. While the German people continued to enjoy a peacetime lifestyle until the closing months of the war, the Russians existed on short rations, lived in crowded and poorly heated dwellings, and worked long, hard hours in poor conditions.

In conclusion. Soviet economic conditions passed through three periods during the war. In the first period—from June 1941 to November 1942—arms production expanded, using evacuated factories and converting plants to war production. These plants received additional workers, machines, and raw materials. To increase production, the labor force worked longer hours. In the second period—from November 1942 to the end of 1943—there was little if any increase in arms production. The focus was on balancing civilian and military production, with increases in heavy industry. In the third period of the war—1944 and 1945—the economy grew from the liberation of territory. The labor shortage was over, and the primary concern was restoration of agricultural output.[115] The Germans were defeated by early 1943, and the major concern of the Soviet government from then until the end of the war was restoration of the civilian economy.

NOTES

1. Milward, p. 23.

2. Harrison, p. 46; Milward, p. 57.

3. Milward, pp. 28-29.

4. Milward, p. 57.

5. Milward, p. 26.

6. Milward, p. 269.

7. S. M. Shtemenko, *The Soviet General Staff at War 1941-1945* (Moscow: Progress Publishers. 1970), p. 27.

8. S. P. Ivanov, *The Initial Period of the War A Soviet View,* Soviet Military Thought Series, no. 20 (Washington, DC: U.S. Government Printing Office, 1986), p. 152.

9. U.S.S.R. *National Economy,* pp. 50-51; Grechko, *Liberation Mission,* P- 24; Harrison, p. 6.

10. Milward, p. 26; R. H. S. Stolfi, *Hitler's Panzers East: World War II Reinterpreted* (Norman: University of Oklahoma Press, 1992), *passim.*

11. Milward, pp. 56-57.

12. Martin Van Creveld, *Technology and War* (New York: Free Press, 1989), p. 164.

13. Milward, pp. 57-58.

14. Nove, pp. 249, 271; Stepan A. Tiushkevich, *The Soviet Armed Forces* (Washington, DC: Superintendent of Documents, GPO, 1985), p. 266; Harrison, p. 64.

15. Harrison, p. 61.

16. *Geschichte des Grossen Vaterlandischen Krieges der Sowjetunion,* 8 vols. (Berlin: Deutscher Militaruerlag, 1964), SB, p. 9; VI, p. 49; John Erickson, *The Road to Stalingrad: Stalin 's War with Germany* (New York: Harper & Row, 1975), p. 223; Nikola A. Voznesenskii, *Soviet Economy During the Second World War* (New York: International Publishers, 1949), p. 3S; FHO, CGR, H 3/468.1, May 7, 1942, Roll 564, Frame 844.

17. Tiushkevich, *Soviet Armed Forces,* p. 266; Harrison, p. 64.

18. Harrison, p. 63.

19. Harrison, pp. 53-54; Milward, p. 92; Susan J. Linz, *The Sinews of War* (Ames: Iowa State University Press), p. 83.

20. Tiushkevich, *Soviet Armed Forces,* p. 226.

21. Harrison, pp. 54-55.

22. Harrison, pp. 59-60, 63.

23. Harrison, p. 63.

24. Harrison, p. 101,

25. Harrison, pp. 78-79.

26. Harrison, pp. 65-67.

27. Bryan I. Fugate, *Operation Barbarossa* (Novato, CA: Presidio Press, 1984), p. 57.

28. Harrison, p. 67.

29. Harrison, p. 72.

30. Harrison, pp. 67-68.

31. Voznesenskii, p. 37.

32. Harrison, p. 68.

33. FHO, CGR. H 3/1521, Roll 587, Frame 368.

34. Erickson, *Stalingrad*, p. 235; J. N. Westwood, *A History of Russian Railways* (London: George Allen and Unwin Ltd., 1964), p. 238; Harrison, p. 75.

35. Harrison, p. 76.

36. Harrison, pp. 76-77.

37. Harrison, p. 75.

38. Erickson, *Stalingrad*, pp. 227, 233; Yeaton Manuscripts, Military History Institute, Carlisle Barracks.

39. Harrison, p. 78.

40. Harrison, p. 86.

41. Harrison, p. 90.

42. Tiushkevich, *Soviet Armed Forces*, p. 266.

43. Voznesenskii, p. 36.

44. *IVOVSS* (German), III, p. 12.

45. Erickson, *Stalingrad*, p. 236.

46. Harrison, pp. 87-88.

47. Harrison, p. 168.

48. Harrison, p. 133.

49. Harrison, pp. 122-23.

50. Harrison, p. 101.

51. Harrison, p. 98.

52. Harrison, p. 93.

53. Harrison, pp. 93, 135.

54. Harrison, p. 137.

55. Harrison, p. 135.

56. Harrison, pp. 208-08.

57. Harrison, p. 81; Nove, pp. 87, 273.

58. Tiushkevich, *Soviet Armed Forces*, 266.

59. Albert Seaton, *The Russo-German War, 1941-45* (New York: Praeger, 1970), p. 267.

60. Seaton, *Russo-German War,* p. 267.

61. Harrison, pp. 169-70, 172.

62. Tiushkevich, *Soviet Armed Forces,* pp 310, 341; *IVOVSS* (German), VII, 49; Harrison, pp. 124-25.

63. Harrison, p. 79.

64. Tiushkevich, *Soviet Armed Forces,* p. 266.

65. Harrison, p. 77.

66. Nove, p. 274.

67. Harrison, p. 130.

68. Harrison, p. 83.

69. The mathematics are complicated because of the lack of definite figures. If the civilian economy received 70% of the 1940 total and only 56% of the 1942 total that had been reduced by 33%, then the civilian economy received only 37.5% of an amount equal to the 1940 production (70:100 compared to 56:67). However, in 1942, 140 million people shared that 37.5% compared to 200 million who shared the 70% in 1940, increasing the 1942 individual share to 52.5% of the 1940 total instead of 70%, a decline of 25%.

70. Nove, p. 274.

71. Harrison,, p. 83.

72. Harrison, p. 100.

73. FHO, CGR, H 3/468.1, May 7, 1942, Roll 564, Frame 844.

74. FHO, CGR,, H 3/340, August 2, 1943, Roll 562, Frame 261.

75. Harrison, p. 128.

76. Harrison, pp. 69-72.

77. Werth, p.108; Harrison, pp. 31-33; Nove, pp. 235, 262-63.

78. Nove, p. 272.

79. Harrison, pp. 77, 137, 144.

80. Erickson, *Stalingrad,* p. 236.

81. Harrison, pp. 189-90; Tiushkevich, *Soviet Armed Forces,* p. 267.

82. Harrison, p. 189,

83. Harrison, p. 144.

84. Harrison, pp. 84, 138.

85. Harrison, p. 141.

86. Harrison, p. 141.

87. Hubert P. Van Tuyll, *Feeding the Bear: American Aid to the Soviet Union, 1941-1945* (New York: Greenwood Press, 1989), pp. 80-81.

88. Harrison, pp. 144-46.

89. Harrison, pp. 146-47, 191.

90. Harrison, p. 142. 91. Harrison, p. 81.

92. Nove. p. 278.

93. Nove, p. 277.

94. Milward, *War,* p. 92.

95. Tiushkevich, *Soviet Armed Forces,* p. 267; *IVOVSS* (German), HI, 9; Milward, *War,* p. 92.

96. Nove, p. 281.

97. Harrison, p. 146.

98. FHO, CGR, H 3/340, June 6, 1944, Roll 562, Frame 204.

99. Voznesenskii, p. 69.

100. Steven J. Zaloga and James Grandsen, *Soviet Tanks and Combat Vehicles of World War Two* (London: Arms and Armour Press, 1984), p. 128.

101. Nove, pp. 274-75.

102. Harrison, p. 130.

103. Harrison, pp. 193-94.

104. Harrison, p. 134.

105. Harrison, pp. 174, 196.

106. Harrison, p. 175.

107. Harrison, p. 182.

108. Seaton, *Russo-German War,* p. 267.

109. K. F. Skorobogatkin, et al., *50 Let Voorezhennykh sil SSSR* (Moscow: Voyenizdat, 1968), p. 457,

110. Voznesenskii, p. 49.

111. Voznesenskii, p. S3.

112. Voznesenskii, *p.* 54.

113. Voznesenskiii p. 52.

114. Harrison, 127.

115. Harrison, pp. 155-57.

3 Logistics

The Red Army supply system was less complex than other major combatants in World War II. The Russians were fighting on their own soil until 1944 and could use civilian facilities to transport much of the material. The Red Army could not live off the countryside, however. Although some food and fodder could be obtained locally, weapons, ammunition, and fuel came from the interior through a logistical system similar to those used by the other powers.[1]

At the beginning of the war the supply services, under the direction of the General Staff, calculated the needs of the various units. The staff then issued orders to factories and other suppliers for weapons, clothing, food, and supplies. The supply service prepared the items for shipment based on requisitions received from the front. The Military Transport Service was responsible for delivery of the materials.[2] The system faltered in the early months of the war, in part because the General Staff was too busy with operations to direct the supply services. Two major transportation crises occurred simultaneously: the evacuation of industry to the rear and the westward movement of reserve armies and supplies to the front. In addition, an average of 50 air attacks on the transportation system occurred each day.[3]

The government centralized the entire system for supplying the army on August 1, 1941, under the control of the Main Directorate of the Red Army Rear, directly responsible to the Stavka and the Economic Council. The new organization was charged with improving the supply situation. Sixteen different commissariats provided supplies. The chief of the Red Army Rear, A. V. Khrulev, provided all supplies except weapons, munitions, and special equipment. The latter were the responsibility of the chiefs of the various military branches—for example, the artillery. The Red Army Rear provided food and clothing; operated mobile workshops; recorded losses and replacement requirements; supervised battlefield salvage; and procured local transportation, food, and forage.[4] Each "front" had a chief of the front rear subordinate to Khrulev, chief of the Red Army Rear. All the front chiefs met with Stalin on July 31, 1941. Stalin personally informed them of the crucial nature of their responsibility, signifying the importance of the problem.[5]

The Main Artillery Commissariat (GAU) provided munitions for all infantry and artillery weapons, and trucks and tractors for transporting or towing the weapons. The GAU submitted requirements for ammunition each month for approval by the Defense Committee (GKO). The GAU then placed orders with the factories. There was also a commissariat for tank and mechanized troops that provided tracked vehicles. Additional commissariats were established for signal, chemical, and aviation supplies and equipment.[6]

After his appointment in August 1941, Khrulev reorganized the entire army supply system. Among his reforms was a reduction in the number of depots and the number of service units in the rifle division and other units. Khrulev eliminated or reduced service units and, when possible, substituted women for men. Efforts to reduced wastage by theft or spoilage included making the transport personnel responsible for safe delivery. Losses resulted in trials and punishment of drivers or others responsible.[7]

The supply process began with "acceptance commissions" at factories and at collecting points. The commissions checked the incoming supplies and arranged transport to the main depots, normally located near the collecting points or factories. For example, there was a tank depot located near each major tank factory. Each branch of the army had separate depots. The Germans identified more than 365 depots.[8]

The railroad played the major role in delivering supplies to the front. The depots were located near a railroad junction and a marshaling yard. A marshaling yard was a system of short parallel tracks connected by many crossovers that simplified sorting cars and assembling trains. Cars were loaded at sidings in depots or factories and sent to the marshaling yard. The yard master shunted loaded cars back and forth on the short tracks to assemble trains. The trains ran directly to a front or field army depot, without further sorting or reloading of the cars.[9] The front depots were distribution centers that forwarded supplies and equipment to field army supply depots. The field army supply service

collected supplies from the front distribution center and carried them to the various field army depots.

The principal level for supply administration was the field army. The front distribution centers did not physically handle most of the supplies; the supply trains usually went directly to the field army supply railway station. Field army depots, medical units, and repair shops were located nearby. Army service personnel unloaded the trains at the station and trucks moved the supplies to the depots for subsequent distribution to the divisions. The corps played little, if any, role in the supply system.[10]

The role of the field army rear was to provide a reliable stream of supplies to the troops. To ensure this flow, the field army created mobile reserve stocks of equipment and supplies. The field army rear organized repair and maintenance of equipment both in army workshops and in civilian shops. The rear also was responsible for moving replacements forward and evacuating the wounded and prisoners of war. The field army rear organized local sources of rations, fodder, repair facilities, and even production of needed items. The army rear also collected, evacuated, and reissued abandoned or damaged Soviet equipment and captured German equipment, trucks, weapons, combat vehicles and supplies.[11]

The field army rear organized rail, road, and water transport from the army depots to the division reloading point located 8 to 10 km from the front. The rear service built and maintained roads in its area to move supplies forward. The rifle division had very little organic transport for logistic use. The army delivered the supplies to the divisions in trucks or horse-drawn wagons (widely used throughout the war to move supplies). The division sent horse-drawn wagons to the army depots for urgently needed supplies, but this was not the usual practice. In 1944 and 1945, field army supply trucks carried shells directly to gun emplacements, bypassing the division reloading point.[12]

To carry out logistical duties, each front had a motor transport brigade of 300 trucks, one or two road construction and traffic-control regiments, and two bridge-building battalions. Each field army had two or three motor transport battalions with 100 to 150 trucks each, two road construction battalions, one traffic-control battalion, and one labor battalion. The army also had an NKVD regiment for rear security and to prevent any stragglers from deserting their units. The rifle division had a motor transport company of 60 to 80 trucks, a medical battalion, a motor vehicle repair shop, and some personnel in the divisional supply service.[13]

The German division usually sent its vehicles back to the army depots to pick up supplies instead of having them delivered, as did the Russians, therefore, the German division needed far more service units, employing many more service troops, horses, horse-drawn wagons, and trucks.[14] In October 1943, a German division had 4,047 men, 2,652 horses, 1,029 wagons, and 256 trucks performing service functions. A Red Army division had only 879 men, 556 horses, 253 wagons, and 91 trucks in its service element.[15]

The Germans analyzed the factors that allowed the Russians to operate with such a slender service element in the rifle division.

1. The Red Army man needed fewer supplies; Russian weapons were less complex and needed less attention; civilians performed duties in rear areas, in hospitals, on the railroads, and as veterinarians,

2. The smaller wagons were easier on the horses; tractors pulled heavy loads instead of large teams of draft horses,

3. The German division had more men to supply and more heavy weapons;

4. German service units had to protect themselves against partisans and required more men to do so,

5. The German philosophy was that a division supplied itself directly from the army depots using its own men to bring forward the munitions, fuel, rations, and fodder.

The Red Army division supplied itself only with rations; the rear area service units delivered all other supplies.[16] Late

in 1942 the Red Army established supply levels, ammunition "issues," fuel "fills," and daily rations. The High Command set standards for each offensive operation, the number of issues of ammunition, fills of fuel, and days of rations to be accumulated before the offensive began. For example, for the Stalingrad offensive, the artillery received three issues of 122mm howitzer shells for seven days of combat. The allotment was ample because only 1.2 issues were used.[17] The supply service usually met the established level of supply. However, only rarely did the rifle division receive the 1.5 issues of ammunition usually set or the tank brigades get the usual 2.5 fills of fuel. Sometimes, offensives were delayed if sufficient supplies were not available.[18]

The most difficult process for the Soviet logistical system was transporting supplies to the troops during an advance, the very time when the supplies were critical. Offensive operations created major problems for the Red Army supply system. Huge quantities of munitions, fuel, rations, and other supplies had to be brought forward and stockpiled without arousing German suspicions. An example of the operation of the system was the buildup for the Stalingrad offensive. Weapons and ammunition went from GAU depots to the front depots on three main railroad lines, via the Volga River on barges, and on roads east and west of the Volga. The rail yards at the small stations near the front could not cope with the huge volume, and trains were unloaded on the mainline tracks. Trains sat for two to seven days at stations; until all the cars were unloaded, the train could not leave. Daily air attacks added to the confusion.[19]

For the Stalingrad offensive, the GAU sent 500,000 rifles, 80,000 machine pistols, 17,000 machine guns, 16,000 antitank rifles, nearly 9,000 guns and mortars, and over 1,000 rocket launchers. Simultaneously, stocks of ammuni-tion accumulated. Small trains of six cars went directly to army depots. Each army had two main depots near the railroad. At night convoys of 10 or 12 trucks moved the ammunition from the army depots forward to the divisions, sometimes over 160 km.[20] The program was successful: the well-supplied attacking forces surprised the Germans.

A faltering supply system had a detrimental impact on operations. In September 1944, the 1st White Russian offensive bogged down because the fuel shortage inactivated the tanks. Supplies of artillery shells had to be transported hundreds of kilometers from depots far behind the front.[21]

The Soviets maintained reserves of supplies at the army level. The army field depots held mobile reserves equal to one unit of fire of ammunition, three or four days' supply of rations and fodder, and up to two refills of fuel. The army commander also accumulated maneuver reserves of up to one-fourth of a unit of fireof ammunition, up to two days' supply of rations and fodder, and up to one refill of fuel.[22]

A field army about to embark on an offensive received 8 to 10 days' supplies (18,000 to 22,500 tons). The daily average for an army was .3 to .5 issues of ammunition (1,500 tons), one-half fill of fuel (300 tons), and 200 tons of rations. Assuming an additional 250 tons of fodder, the total daily average was 2,250 tons.[23] In October 1943, the 5th Army and several attached mechanized corps had a daily requirement of 3,160 tons, as follows:[24]

Munitions	1,600 tons
Rations	773 tons
Fodder	238 tons
Fuel	549 tons
TOTAL	3,160 tons

In June 1944, the Red Army became more capable of stockpiling. As the army advanced westward the rail net grew more dense. For the offensive against the German Army Group Center in June 1944, the High Command ordered the

Soviet armies to stockpile two issues of munitions, 10 to 20 refills of fuel, and 30 days of rations. The four fronts exceeded the goal in munitions. They accumulated 2.2 issues in the 3rd White Russian Front, three in the 2nd White Russian Front, and four in the 1st White Russian and 1st Baltic. Munitions buildup required 13,500 rail cars. The total supply and buildup effort delivered 3 million tons. A total of 5,000 trains arrived at the rate of 100 per day for nearly two months. Two thousand trains carried additional troops and 3,000 tons of supplies. Twelve thousand trucks carried the supplies from the railhead. Each front had a brigade of 1,257 trucks and each army 350.[25]

The major categories of supply were munitions, rations, fodder, and fuel.

A table prepared by the FHO in 1943 provided figures for the first issue of all supplies carried by Soviet units. The munitions represented a full first issue for each weapon, and the fuel total represented a complete fill-up for every motor vehicle, as follows:[26]

FIRST ISSUE OF SUPPLIES (in tons)					
Unit	**Munitions**	**Food**	**Fodder**	**Fuel**	**Total**
Guards rifle division	351	21	17	15	404
Rifle division	311	19	15	13	358
Tank brigade	50	2	-	34	86
Tank regiment	27	1	-	27	55
Guard cavalry division	123	11	45	16	195
Cavalry corps	433	34	139	50	656
Tank corps	265	15	-	160	440
Mechanized corps	570	34	-	250	854

The Soviet soldier needed as much clothing and food as the German. The Russians could not withstand the cold without adequate clothing any easier than could the Germans. The difference ia December 1941 was that the Russians had better clothing and adequate supplies. The Germans had not made adequate provisions for winter warfare in 1941, expecting the war to end in a matter of months.[27] The Soviet winter uniform included felt boots *(valenki),* a lined winter overcoat (some supplied by Great Britain), and a winter cap lined with lamb's wool. During the summer the Red Army man wore a lightweight twill or denim uniform, boots (many supplied by Britain and the United States), and an overcoat that served as a blanket in the summer.[28]

There were 13 different ration scales depending on duty. The standard daily ration was 2 pounds of bread, 1/2 pound of meat of fish, and 3/4 pound of vegetables.[29] Another source lists the combat ration at 1.5 pounds of bread, 3.5 ounces of meat, 1 ounce of sugar, 1 ounce of fat, .5 ounce of tobacco, and 4 fluid ounces of alcohol for frontline troops.[30]

Meals consisted of porridge *(kascha)* for breakfast; soup *(borscht)* for lunch; and bread and a cucumber pickle for supper, plus whatever could be foraged. Later in the war the ration consisted of 800 grams (nearly 2 pounds) of bread in the morning, a half-liter of soup with two or three spoons of oatmeal at midday, and in the evening more soup with a herring.[32] Spam supplied by the United States became a major component of the ration after 1943. The total ration was nearly 2 kg—very similar to the German ration that was essentially the same with the substitution of sausage for the herring or Spam.[33]

Until 1943 the rations were not being delivered efficiently, and the troops were not being fed adequately. The State Defense Committee issued a directive on May 31, 1943, that placed responsibility for the failures on front headquarters. The directive further stated that preparation of the food was as important as delivery and that insufficient supervision led to poor meals. Some officers substituted poorer quality food—for example, dried eggs for meat and flour for vegetables—and sold the meat and vegetables on the black market. The directive stated that the welfare of the troops was paramount. Officers found guilty of infractions faced trial and assignment to penal battalions, whose duties included clearing enemy minefields under German fire.[34] Such Draconian measures were a clear indication that the offense was widespread.

Harsh directives indicated a serious problem. There was a severe food shortage in the Soviet Union from 1941 to 1943. The civilian ration was short on fat, protein, and calories, and the army rations were not much better. The Soviets turned to the United States for assistance. A major part of the aid delivered was food. Although lend-lease grain amounted to less than 3% of Soviet consumption, the aid equaled more than 50% of the sugar and vegetables, more than 20% of the meat, and nearly 100% of the fat consumed by the total Soviet people. Lend-lease increased the calorie intake of the Russians by more than 50%. The scale of assistance can be measured by the fact that the United States sent enough concentrated food (canned meat, dried eggs, dried vegetables, and other concentrates) to provide 1 pound per day for 6 million troops for the entire war.[35]

The prime item of supply, both in priority and in weight, was ammunition for the weapons. Without ammunition the troops could not fight, and there were no options such as making do with worn-out uniforms or foraging for food. The quantity of munitions is measured in two ways: the basic amount assigned to a unit and the amount needed to replace expenditures. A division was allocated a certain amount of each type of ammunition based on what would be required for two or three days of combat before additional supplies could be sent forward. This amount was termed the first issue of supply. Daily supply was that amount needed on a daily basis to replaced expenditures. Estimates of expenditure during different types of activity determined replacement quantities. Attacking a fortified line required more munitions than defending a quiet sector, for example. The basic allocation of munitions for a Soviet rifle division with 9,373 men in 1944 as shown below was not generous, and even these totals were maximums. The actual amounts on hand were probably less.[36]

Weapons	Number in the Division	Rounds per Weapon	Rounds in Division	Weight (tons)
Rifle	5,595	100	559,500	16.9
Light machine gun	490	800	392,000	11.9
Heavy machine gun	110	2,500	275,000	8.3
Pistol	1,456	21	30,576	0.3
Machine pistol	2,110	300	633,000	7.7
Antitank rifle	213	120	25,560	6.1
50mm mortar	54	120	6,480	11.0
82mm mortar	84	120	9,080	45.4
120mm mortar	18	60	1,080	27.0
45mm antitank gun	48	200	9,600	37.3
76mm gun M1927	12	140	1,680	18.0
76mm gun M02/30	20	140	2,800	30.1
122mm howitzer	12	80	960	32.6
Hand grenades (4 per man)	--	--	37,492	37.5

Explosives	--	--	--	15.0
TOTAL	--	--	--	305.1

In comparison to the Soviet division, a German division with half again as many men received 845 tons of ammunition —nearly three times as much. The Red Army did not tie up large amounts of ammunition in divisions in quiet sectors. The Soviets depended on the field army supply service to replace expenditures in active sectors.

In November 1944 the Germans published another study on Soviet first issue of munitions based on captured records. The numbers agree with the above table and additional data were provided listed in the table below, which included artillery pieces that had come into wider use in 1944. The number of rounds remained low compared to other armies.[37]

Weapon	First Issue
122mm gun	80 rounds
152mm gun	60 rounds
203mm howitzer	40 rounds

The total weight of munitions issued to a rifle division was 311 tons and to a guard rifle division, 351 tons.[38] The Soviets limited the quantities even late in the war when supplies were plentiful.

About two-thirds of the total tonnage allotted to a division was artillery and mortar ammunition. Trucks assigned to the divisional artillery regiment carried the ammunition for the guns and mortars. Each battery of 122mm howitzers had 5 trucks, 4 towing guns carrying 40 rounds of ammunition, and a gun crew. The fifth carried ammunition. The regimental supply column carried additional munitions. The howitzer regiment had a total of 114 trucks, mostly 2.5-ton Studebakers and 1.5-ton Dodges and Fords.[39]

The FHO estimated the daily requirements of Soviet units (representing average expenditure of these supplies) in October 1943 as follows:[40]

DAILY SUPPLY REQUIREMENTS (in tons per day)					
Unit	**Munitions**	**Food**	**Fodder**	**Fuel**	**Total**
Rifle division	76	20	15	7	118
Tank brigade	25	2	-	16	43
Cavalry division	25	10	5	8	48
Guard cavalry division	30	11	5	15	61

These tables indicated that the Soviet rifle division carried a basic load of about 310 tons of ammunition and nearly 50 tons of other supplies. An average division used 76 tons of ammunition (about one-fourth of the assigned amount) daily and consumed its entire supply of rations and fodder and half its fuel. These official allocations showed a heavy reliance on prompt daily deliveries from field army depots. Divisions probably accumulated stocks of rations and fodder from other sources for reserve.

Because of the impossibility of making complete use of rail cars and trucks owing to the problems of loading, there

was a difference between actual tons needed and the rail tonnage or "cargo tons" required to haul the supplies. An example of this difference is the cargo tonnage of munitions compared to the actual tons as shown above. Even though munitions were compact and heavy and took fewer cargo tons per actual ton than most classes of supplies, still the requirement for cargo tons was greater than the actual tonnage.

DAILY ALLOCATION OF MUNITIONS (in cargo tons)		
Unit	**In the Rear**	**Attacking**
Rifle division	120	180
Average for army troops per division	40	60
TOTAL PER DIVISION	160	240

A train carried 1,200 cargo tons, but the average train actually carried only 850 tons of supplies because of inefficiency in loading the cars. Some supplies were bulky and weighed comparatively little. Some supplies could not be stacked and therefore the upper portion of the railroad car would be empty. Because the supply routes were short compared to the U.S. routes, the Russians did not package their supplies as carefully. One train per day was sufficient to supply seven divisions in the rear or five divisions in active operations (7 times 160 = 1,120 and 5 times 240 = 1,200). Later in the war, trains had only 45 cars carrying only 900 cargo tons, and therefore theoretically, one train could support six and four divisions. On the other hand, the divisions were smaller and needed fewer supplies, and one train could have supplied more divisions.[41] A single-track railroad could carry 24 trains per day and supply the equivalent of 100 to 150 divisions.

In 1942, a Soviet officer estimated that one train could supply a Red Army division for six days with 350 tons of rations and fodder, 240 tons of munitions (two units of fire), and 85 tons of gasoline and oil, for a total of 675 tons. Dividing by 6 compares to the 1943 table prepared by FHO. The study estimated that in 1942 a division in a quiet sector required only 71 tons daily for 9,000 men, assuming the use of one-third of a fill of fuel and one-tenth of a fire unit of ammunition. In 1943, there were fewer men and more weapons in the rifle division, which reduced the need for rations and increased the need for ammunition. The rifle division of 1943 had an authorized strength of 9,354 men, 1,732 horses, 633 horse-drawn wagons, and 140 trucks, but few divisions had that many men.[42] By 1943 many rifle companies were below strength and the total number of men in the rifle division may have averaged as few as 7,000. However there were more automatic weapons in the division which required more ammunition.

COMPARISON OF DAILY REQUIREMENTS OF A RIFLE DIVISION (in tons per day)		
Type of Supply	**1942**	**1943**
Rations and fodder	58	35
Munitions	40	76
Gasoline and oil	14	7
TOTAL	112	118

The comparable figures for U.S. units are given in terms of a "division slice. " A division slice represented an infantry division and its share of the service and supporting units in the theater of operations. In the European Theater the U.S. division slice included 43,000 men, compared to a Soviet division slice of about 15,000. The larger number of men in the U.S. slice reflects the difference in service troops but there is some similarity in expenditures of munitions and rations. The table on daily munitions supply that follows shows that army support troops needed about 50% more per

division. Presumably a Soviet division slice had fewer than 15,000 men, one-third the size of the U. S. slice:

DAILY REQUIREMENTS OF AN AMERICAN DIVISION SLICE, 1944	
Rations	100 tons
Service material, replacements	117 tons
Fuel	144 tons
Munitions	180 tons
TOTAL	541 tons

A division slice was the total number of men in the European Theater divided by the number of divisions, producing a total of 43,000 men of which only 14,316 were in the infantry division. The figures are for a division in normal combat, which exceeded actual expenditure in 1944 and 1945.

The Soviet Guards division had about 10,000 men. Dividing these totals by available data produces a comparison: the Red Army still used many horses and fodder was a substantial item. The difference in fuel reflects the small number of trucks available to the Soviet division. The table below reflects a comparison of the daily consumption per man based on figures for a Soviet rifle division and the U.S. division slice in France.

DAILY CONSUMPTION PER MAN (in kilograms)		
Type of Supply	**Soviet**	**United States**
Rations	2.0	2.3
Munitions	7.6	4.2
Fuel	0.7	3.3
Fodder	1.5	-
Service materials	?	2.7
TOTAL	11.8	12.6

Another table can be prepared based on an estimated 275 tons per Soviet division slice for the June 1944 offensive (Operation *Bagration)* against Army Group Center. Dividing the 275 tons by the ratio used for the 5th Army in October 1943 listed above, the daily consumptions of a U.S. and Soviet division slice can be compared.

DAILY CONSUMPTION PER DIVISION SLICE (in tons per day)		
Type of Supply	**United States**	**Soviet**
Men	43,000	15,000
Rations	100	66
Munitions	180	140
Fuel	144	47
Fodder	-	22

Service	117	-
TOTAL	541	275

The Soviet division slice probably contained about 15,000 men. The total number of men in the four fronts included in the offensive was 1,670,000 in 166 rifle divisions, 2 cavalry corps, and 8 mechanized and tank corps, for a total of 176 divisional-size units. The size of the division slice was 9,488 not including air force and rear area troops.[45] The fronts consumed 50,000 tons of supplies per day or 284 tons per division slice, close to the 275-ton estimate above.[46] The U.S. troops probably ate better and used much more fuel than the Russians, but the Russians fired more munitions per man at the Germans.

There is further evidence of a division slice of more than 9,500 men. An examination of the total deployment of the Red Army in June 1944 reveals that 183 rifle divisions, 4 cavalry corps, and 16 mechanized and tank corps were assigned to the 1st Baltic, and 1st, 2nd, and 3rd White Russian Fronts out of 482 rifle divisions, 7 cavalry corps, and 44 mechanized corps assigned to the European Theater including the Caucasus. Therefore, 203 of the division-size units of 533 were assigned to the *Bagration* operation, or roughly 40%. The total manpower on the European front was about 6.5 million. Dividing 6.5 million by 533 results in a division slice of 12,195.[47] Given the offensive operation, the division slice for *Bagration* should have been well above the average, considering the concentration of artillery and armored forces.

A third table below is based on the requirements for supporting Soviet troops in the Manchurian operation in August 1945. These needs were broken down on a per man, per day basis.[48]

Rations	1.45 kg
Munitions	3.53
Fuel	4.41
Miscellaneous	4.31
TOTAL	13.70

The table in the source has flaws, however: the columns do not add up and there are duplicate lines. However, the total of individual lines is similar to the earlier tables. Munitions in the Manchurian operation were only half the German front totals, probably a reflection of a smaller requirement to deal with the comparatively weak Japanese defenses compared to German defense in depth. The fuel allotment is much higher, as thousands of U.S. trucks gave the Soviet armies far greater mobility than on the German front. The miscellaneous total is high, but corresponds to U.S. ratios in the first two tables. The ration total is one-fourth less than the first table. However, all of the figures are within the realm of possibility.

The three tables have many flaws, but together they produce a picture of Soviet logistical support. The Soviet division slice was smaller than that of the U.S. slice, but the use of munitions per man was higher. The June 1944 Russian division slice showed Soviet consumption of munitions nearly equal to an American division slice with far more men. The German estimate of October 1943 showed a Soviet rifle division using 118 tons of supplies including 76 tons of munitions, 20 tons of rations, and 32 tons of other supplies daily. Supporting troops would add no more than 50% to these figures. In comparison, the U.S. division expended 422 tons of supplies including 124 tons of munitions, 81 tons of rations, 124 tons of fuel, and 93 tons of other supplies.

The U.S. division used 124 tons of fuel; the Russians 15 tons of fodder and 13 tons of fuel, indicating the high price of U.S. mobility. Soviet fuel consumption was much less because the Soviets assigned few trucks to the rifle division, using horses to pull the 76mm field artillery. There was no need for fodder in the American slice.

Ration scale was higher for the U.S. slice probably because of the weight of packaging. The U.S. provided about 3 kg

(6 pounds) of food, including packaging, per man per day; the Germans and Russians provided almost 2 kg (4 pounds). The difference was in the heavy weight of U.S. packaging: wooden crates, metal cans, and other materials to preserve the food through an extremely long supply line.

Despite the flaws, the tables suggested a picture radically different from the usual interpretation of the Red Army. Although the U.S. troops were lavishly supplied with ammunition by Western standards—far more than the British or German armies—the Soviets exceeded the U.S. levels. Soviet usage of fuel, though less than U.S. usage, was substantial, showing a high rate of motorization above the rifle division level. Even if the computations are off by a considerable percentage, the conclusion remains the same: the Red Army was well supplied with combat-related goods from 1943 on. By 1943, the Red Army was using artillery, tanks, and heavy weapons amply supplied with ammunition to win battles, not the proverbial waves of poorly armed men.

NOTES

1. Louis B. Ely, *The Red Army Today* (Harrisburg: Military Services Publishing Co., 1953), p. 97.

2. A. V. Khrulev, "Stanovlenie Strategicheskogo Tyla v Velikoi Otechest-vennoi Voine," in *Stalin and His Generals: Soviet Military Memoirs of World War II*, Seweryn Bialer, ed. (New York: Pegasus, 1969), p. 369.

3. Khrulev, p. 369.

4. Erickson, *Stalingrad*, pp. 224-25; Hans Hinrichs, "The Supply System of the Soviet Army," in Basil H. Liddell-Hart, *The Red Army* (New York: Harcourt Brace, 1956), pp. 275-77; Khrulev, p. 372.

5. Khrulev, pp. 372-73.

6. Hinrichs, p. 279; Erickson, *Stalingrad*, p. 431.

7. Khrulev, pp. 373-74.

8. Hinrichs, p. 282.

9. Hinrichs, p. 282.

10. Hinrichs, pp. 275, 282.

11. Michael Parrish, ed., *Battle for Moscow: The 1942 Soviet General Staff Study* (Washington, DC: Pergamon-Brassey's, 1989), p. 185-88.

12. Hinrichs, pp. 276, 283; Ely, p. 97.

13. Hinrichs, p. 280.

14. FHO, CGR, Report, no date, H 3/104, Roll 551, Frame 238; For comparable German and American data, see Walter S. Dunn, Jr., *Second Front Now 1943* (University, AL: University of Alabama, 1980), pp. 164-185.

15. FHO, CGR, Kraefteberechnungen, H 3/118, October 1943, Roll 552, Frame 357.

16. FHO, CGR, Report, no date, H 3/104, Roll 551, Frames 239-40.

17. Hinrichs, p. 283; Van Tuyll, p. 96.

18. Hinrichs, p. 283.

19. Erickson, *Stalingrad*, p. 432; Van Tuyll, p. 97.

20. Erickson, *Stalingrad,* p. 432.

21. Grechko, *Liberation Mission,* p. 100.

22. Parrish, p. 188.

23. Hinrichs, p. 283.

24. FHO, CGR, H 3/468.2, October 24, 1943, Roll 564, Frame 940.

25. Gerd Niepold, *Battle for White Russia: The Destruction of Army Group Centre June 1944* (London: Brassey's Defence Publishers, 1987), p. 51.

26. FHO, CGR, H 3/118, 1943, Roll 552, Frame 359; H 3/380, November 16, 1944, Roll 562, Frame 1057; H 3/189, December 1943, Roll 556, Frame 360.

27. Seaton, *Russo-German War,* p. 241; Martin Van Creveld, *Supplying War* (Cambridge: Cambridge University Press, 1977), pp. 150-54.

28. James Lucas, *War on the Eastern Front 1941-1945: The German Soldier in Russia* (New York: Bonanza Books, 1979), p. 56.

29. Ely, pp. 97-98; Khrulev, p. 375.

30. Khrulev, p. 375.

31. Lucas, p. 56.

32. FHO, CGR, Reports, H 3/464, January 24, 1945 and September 1944, Roll 564, Frame 249.

33. Dunn, pp.. 173-75.

34. Khrulev, pp. 376-77.

35. Van Tuyll, p. 117.

36. FHO, CGR, H 3/340, Roll 562, Frame 136.

37. FHO, CGR, H 3/380, November 16, 1944, Roll 562, Frame 1057.

38. FHO, CGR, H 3/380, November 16, 1944, Roll 562, Frame 1057.

39. FHO, CGR, H 3/69, 1942, Roll 549, Frame 127.

40. FHO, CGR, Report, H 3/468.3, October 18, 1943, Roll 564, Frame 1000.

41. FHO, CGR, H 3/1521, Roll 587, Frame 369.

42. Ibid.

43. FHO, CGR, Report, H 3/468.2, July 6, 1942, Roll 564, Frame 898.

44. Dunn, p. 175.

45. John Erickson, *The Road to Berlin* (Boulder, CO: Westview Press, 1983), p. 214.

46. Van Tuyll, p. 98.

47. The totals in the analysis come from a database created by the author which includes the unit history of all Soviet combat units; Harrison, p. 111.

48. Van Tuyll, p. 177, quoting the *Records of the Joint Chiefs of Staff: Part 1, 1942-1945; The Soviet Union* (Frederick, MD: University Publications of America, n.d.), p. 30.

4 Lend-lease

Russia's dedication to the production of weapons was not enough to secure victory. Lend-lease aid from Britain and the United States was essential, especially transportation and communication equipment, clothing, and food. Lend-lease and the launching of the second front were interrelated. To the United States and Britain, supplying aid was an alternative to direct military support on a second front. The Russians received $10.8 billion in value, about one-fourth of all lend-lease materials exported by the United States. An additional $5.9 billion in aid came from the British.[1] The Russians considered both aid and the second-front treaty obligations of the West: providing aid was no excuse for not providing military support. The Soviets believed that the belated opening of the second front only hastened the defeat of Hitler, and that the West exaggerated the importance of lend-lease.[2]

Immediately after the German invasion on June 22, 1941, Stalin made a Personal appeal to the British for both a second front and supplies.[3] In July, Lord Beaverbrook from Britain and Averell Harriman representing the United States went to Moscow to learn what the Russians wanted and to make an agreement concerning what Britain and the U.S. could provide. Even before the conference concluded, the first convoy of supplies left Iceland on August 21, 1941. The conference met from September 29 to October 1, 1941. The result was the first protocol.[4] The long detailed list was to be delivered between October 1941 and June 1942. Some items promised by the British and Americans were as follows:[5]

SUPPLIES UNDER THE FIRST PROTOCOL		
Supplies and Weapons	**Request**	**Offered**
Aircraft	400	400
Tanks	1,100	500
Antiaircraft guns	300	152
Antitank guns	300	500
Antitank rifles	2,000	200
Scout cars	2,000	
Trucks	10,000	5,000
Aluminum and duraluminum (tons)	4,500	2,000
Boots, pairs	400,000	400,000
Uniform cloth (thousand sq m)	1,200	1,200
Wheat (thousand tons)	200	200

On October 6, 1941, Churchill informed Stalin that a convoy would be dispatched every 10 days. Supplies from Britain and the U.S. began to flow instantly. PQ 1 left Iceland for Archangel on September 28, 1941, before the first protocol. The cargo included 20 tanks and 193 fighter aircraft. The convoy arrived without interference from the

Germans.[6] The British gave high priority to shipments to Russia. In February 1942, aid to Russia took precedence over equipping the British Home Army and reduced shipments to the Far East by 50%. Hurricane fighter planes went to Russia instead of Burma.

In most categories the deliveries fell short of the promises in the first period because of shipping difficulties. In the first nine months the British delivered only 1,323 aircraft of the 1,800 promised, only 1,442 tanks of the 2,250 promised, 338 antitank guns of the 500 promised, and 3,685 trucks of the 4,800 promised. There were three routes: via the North Atlantic to Murmansk and Archangel, via the Persian Gulf and then overland through Iran to the Caucasus, and via the Pacific to Vladivostok. After Pearl Harbor in December 1941 the Japanese allowed the Russians to deliver only nonmilitary items in Russian flag ships to Vladivostok. From the beginning, the Pacific route carried the bulk of the tonnage. In the last six months of 1941, the British and Americans delivered over 360,000 tons to the Russians—54% via the Pacific, 43% via the North Atlantic, and only 3% via the Persian Gulf. The lack of port facilities and inefficient railroads in Iran limited delivery by way of the Persian Gulf. These railroads and roads needed improvement before large quantities could be moved north to Russia.[8]

Although the Pacific route was the safest, the limitation to nonmilitary supplies and the long rail trip via the Trans-Siberian Railway reduced the impact of the supplies. The most important route in the first period was the North Atlantic, however the dangers were great. During the entire war, of the 811 ships sent out, the Germans sank 58 and 33 turned back because of mechanical failure or other reasons.[9] German attacks in the summer of 1942 limited the convoys to the dark winter months of 1942-43 and 1943-44, when ice blocked the route to Archangel. Most ships unloaded at Murmansk, the only ice-free port remaining clear throughout the winter, but with few facilities for receiving cargo. The capacity of the heaviest crane was 11 tons, not enough to lift a tank from a ship. A crane mounted on a ship sent from England substituted for the port equipment. Coal and oil was not available to refuel the ships for the return journey, so the British sent tankers and colliers to refuel the ships for the return convoys.[10] During the warmer weather, ships could have traveled a farther 400 miles to Archangel, where better unloading facilities and rail connections to Moscow were available." The delay in unloading lengthened the turnaround time. If a ship did not unload by March, it had to remain in Murmansk until the following November.

Antiaircraft defense at Murmansk was at a minimum before July 1942. The aircraft carrier *Argus* escorted the first convoy. In August 1941, the 151st Royal Air Force Wing (24 Hurricane fighters) arrived with an additional 15 Hurricanes in crates.[12] The aircraft were based at Vaenga, 17 miles from Murmansk.[13]

The first five convoys on the northern route passed through without German intervention. By the end of 1941, 53 ships sailed to Russia with no loss. The cargo included 750 tanks, 800 fighters, 1,400 vehicles, and over 100,000 tons of other supplies.

In January 1942, the Germans moved the battleship *Tirpitz* to Trondheim as a threat to the convoys and increased the number of submarines by 20.[14] In January the Germans sank a British destroyer and damaged another ship. In February Hitler sent the pocket battleship *Scheer* and the heavy cruiser *Prince Eugen* to Trondheim and Narvik, along with more destroyers. In March the Germans attacked PQ 13 with aircraft, submarines, and destroyers, sinking five ships, the first major loss.[15]

In the spring, the North Polar ice began to melt and icebergs broke from the ice pack. The floating ice forced the convoys to travel farther south, where the icebergs had melted. However, this route brought the ships closer to the Norwegian coast and the German Navy. As the summer approached, the days grew longer. Near the Arctic Circle the summer days are very long—nearly 24 hours in June—providing the German forces with ideal conditions to attack, especially from the air. The Germans transferred many specially trained antishipping squadrons to the north. In May 1942, 264 aircraft including torpedo planes, dive bombers, and level bombers went to Norway.'[6]

In April and May 1942, convoys PQ 14 and 15 suffered heavy losses. Churchill wanted to reduce the frequency of convoys in view of the continuous attacks during the longer summer days; the Royal Navy wanted to cancel all of the convoys during the summer. However, in May 1942 Stalin was demanding more shipments, having suffered heavy

losses of guns and tanks in the debacle at Izyum. The next convoy, PQ 16, was increased to 35 ships and given a heavier escort. German submarines and aircraft attacked the convoy sinking seven ships, and one ship turned back.[18]

From April to June 1942, the Royal Navy, pressed by demands to escort transatlantic convoys, did not have enough cruisers and destroyers to provide escorts strong enough to drive off concerted attacks by the German submarines, aircraft, and surface ships.[19] In June 1942, the Royal Navy had to provide a large escort for a convoy delivering essential supplies to the island of Malta and delayed PQ 17 from June 11 to June 27. When PQ 17 finally sailed, the Germans concentrated their air and naval forces and sank 23 of the 36 ships in the convoy. The next convoy, PQ 18, lost 13 out of 40 ships sent. The losses were serious. The ships lost in PQ 17 carried 430 tanks, 210 aircraft, and 3,350 vehicles plus 99,000 tons of supplies.[20]

The next convoy, PQ 18, left on September 2, 1942. The British sent two torpedo bomber squadrons to Murmansk to protect the convoys. The Royal Navy increased the protective force, sending 51 warships including the escort carrier *Avenger*.[21] The Germans aircraft and submarines attacked in force and sank 16 of 45 ships, plus a destroyer, a minesweeper, and a fleet tanker. The Germans lost 41 aircraft and 3 submarines plus 5 damaged. The escort carrier was helpful, but the loss of merchant ships was still heavy.[22]

The total losses represented a sizable portion of the goods sent over the northern route, including 288 fighters, 470 tanks, and 220 Bren Gun carriers. Most of these losses occurred in June 1942 in PQ 17.[23] The Germans lost only 2,648 tanks in battle on the Eastern Front and in North Africa in all of 1942, compared to the 430 tanks lost in PQ 17.[24] In only a few days the Germans sank as many tanks as the combined Russian and British land forces were able to destroy in two months.

Despite pressure from Stalin to continue the convoys, after these disasters the British suspended the convoys. The convoys stopped until winter brought darkness and concealment from German aircraft, submarines, and surface ships. There were fewer icebergs floating south during cold weather, and the convoys could take a route farther from the Norwegian coast, reducing the German threat.[25]

While the convoys were meeting with disaster in the summer of 1942, negotiations were in progress for the next 12-month period. In May 1942, the second protocol was sent to Stalin and accepted on July 7, 1942. The second protocol covered deliveries between July 1942 and June 1943, see table below:

SUPPLIES UNDER THE 2ND PROTOCOL[26]

Equipment	Requested	Promised by U.S.
Aircraft	4,200	2,544
Tanks	5,250	7,500
Antiaircraft guns 90mm	204	204
Antiaircraft guns light	3,600	3,600
Machine pistols	247,878	240,000
Scout cars	24,000	6,000
Jeeps		18,000
Trucks	120,000	120,000
Prime movers	7,200	2,400
Boots (thousand pairs)	4,800	2,400
Uniform cloth (thousand		

sq m)	18,000	18,000
Webbing	36,000	36,000
Wheat (thousand tons)	2,400	2,400
Sugar (thousand tops)	840	840
Canned meat (thousand tons)	120	120
Meat (thousand tons)	180	180
Lard (thousand tons)	144	144
Vegetable oil (thousand tons)	120	120

Russian production had improved during the negotiations, and the need for aid had changed. Soviet factories were by then in large-scale production of weapons of all kinds. The only weapons requested in large numbers were tanks, fighter aircraft, and machine pistols. The emphasis then was on trucks and food. The German occupation had deprived the Russians of much of their best farmland.

MILITARY SUPPLIES FROM BRITAIN[27]			
Equipment	**Promised**	**Made Available**	**Shipped**
Hurricanes		943	943
Airacobras (P-39)		1,106	952
Kittyhawk (P-40)		300	300
TOTAL AIRCRAFT	**2,400**	**2,349**	**2,195**
Valentines		499	499
Matildas		332	332
Churchills		271	271
Valentines (Canadian)		824	617
TOTAL TANKS	**3,000**	**1,926**	**1,719**
Bren Gun carriers	2,400	2,385	146
Antitank guns two-pounder	600	174	174
Antitank guns six-pounders	600	100	100
Antitank rifles	3,600	1,150	1,150

The emphasis in 1941 and 1942 was on the supply of tanks and airplanes. But the Russians were critical of the Western tanks shipped, including the British Matildas and Valentines and the American Grants and Stuarts. The Matilda could not traverse poor ground because of narrow tracks and excessive weight per square inch of track on the ground. The two-pounder gun carried by the Matilda could not fire high-explosive shells, and the Soviets replaced some with a Russian 76mm gun. The engine on the Matilda was good, however, which made it suitable for training. The Russians preferred the Valentine, especially later models that carried a six-pounder gun that could fire a high-

explosive round.

In 1943, the Russians declined offers of British tanks armed with the two-pounder, especially the Matilda and the Crusader. The latter tank was vulnerable to antitank fire, mechanically unreliable, and had little armor.[29] The preferred tank was the Valentine, with a six-pounder gun. To satisfy the demand, the British kept the Valentine in production in Britain and in Canada exclusively for the Russians.[30] U.S. tanks were not wanted because of the spare parts problem. Each additional type required stocks of spare parts, and therefore the Russians preferred to receive a single type of tank from the West. The U.S. Grant and Stuart tanks used gasoline instead of diesel oil, as did the British and Russian tanks. When hit, the U.S. tanks often exploded and burned. The Grant earned the nickname "Coffin for Seven Comrades," referring to the unusually large crew of seven to operate the tank and its propensity to burn.[31] Although the lend-lease tanks may have been less than satisfactory in combat with German tanks, the Russians used great numbers in tank units supporting the infantry. In training units, the sturdy, long-lasting engines and the greater reliability of the foreign tanks were advantages. There was no fear of loss from enemy action, and engines and transmissions were run many hours by unskilled students learning to drive. A tank used in training operated for years. In combat, the average Soviet tank lasted about six months before loss from enemy action, and so there was little need for a quality engine.

With their increasing production of Soviet weapons, the Russians refused the offer of British six-pounders. Boys antitank rifles, and tanks armed with two-pounder guns.[32] The Russians canceled orders for the antitank guns in November 1942, and most of the Bren Gun carriers later, because they did not want the weapons. The Bren Gun carriers had no role in Soviet tactics. The Russians considered the two-pounder antitank guns unsatisfactory and they disliked the six-pounder because there was no high explosive round available, which limited its use.[33]

The new Canadian Valentines that should have been sent on the northern route did not arrive because the Germans had blocked the northern route throughout the period, except for four convoys that sailed in the winter of 1942-43. Most of the military supplies had to take the Persian Gulf route.

There is reason to believe that many tanks delivered by way of the Persian Gulf came from workshops in Cairo that rehabilitated obsolescent tanks after Allied units received Sherman tanks. In September 1942, the British had 2,848 tanks in the Middle East, mostly Grants, Stuarts, and Valentines. In May 1943, British units in the Middle East had 1,925 Shermans, Crusaders, Churchills, and other types ana an additional 1,311 tanks in repair and in transit. By July 1943, the British units no longer used the Grant or Valentine, so there was a large stock of repaired obsolescent tanks available close to the Persian Gulf.[34]

The British probably shipped the Russians obsolete U.S. aircraft that the British no longer wanted, probably from stocks in the Middle East. In the second protocol the British offered P-39s and P-40s to the Russians. Neither of these U.S. types were used in significant numbers in Great Britain; they had served in the Middle East in 1941 and 1942 and were surplus. The British squadrons in the Mediterranean received Spitfires, later versions of the Hurricane, and other British aircraft in 1943. The Russians considered the British Hurricanes and U.S. P-40s inferior. They accused Britain and the U.S. of sending obsolete and repaired equipment and keeping the most modern equipment for themselves.

Unimpressed with the quality of British and U.S. tanks and with ample Soviet tanks, Stalin demanded new fighters and trucks. The Russians also wanted shoes, leather, cloth, food, and aluminum for the manufacture of aircraft. The Germans had all but eliminated Soviet aluminum production, and Soviet fighters used many wooden components in place of aluminum. Looking forward to the winter offensive, Stalin asked for 20,000 to 25,000 trucks per month from the Western Allies. Russian production of trucks in 1942 was only about 3,000 per month. Most Soviet automotive factories had converted to the manufacture of light tanks.[35] The British responded with 6,000 tons of aluminum and 902 trucks between September and December 1942.[36]

Lend-lease trucks played a major role in making combat units more mobile and able to pursue more closely the retreating Germans in 1943. The trucks extended the distance that a unit could operate from the railhead imposed by the horse-drawn supply wagons. For example, Red Army rifle units supported by U.S. and British trucks were able to sustain a winter attack 350 km (200 miles) from their railhead.

Even before the final disaster of the summer convoys, Roosevelt told Molotov on June 1, 1942, that lend-lease shipments might be reduced from 4.1 million tons to 2.5 million tons in the next 12 months to make shipping available for the buildup preceding the second front. The disasters that befell the Russians in the summer of 1942 developed after the protocol was negotiated. Molotov, in Washington on a mission to accelerate the launching of the second front, responded negatively. He insisted on aid, even at the expense of the second front.[37] In June 1942, the Russians were confident that they could defeat the German Army, but they needed the lend-lease supplies. Had the problem been the number of ships instead of the effectiveness of German attacks on the convoys, it would have made more sense to cancel the longer Persian Gulf convoys. The actual reason for the reduction of shipments was the inability of the Royal Navy to protect the northern convoys and the lack of port and rail capacity on the Persian Gulf route.

In early July 1942, faced with Churchill's unrelenting opposition to a second front in 1943, Roosevelt agreed to the invasion of North Africa. By July 11, 1942, only four ships had arrived in Russia from PQ 17 {more arrived later).[38] No convoys were sent in July and August because of the German defenses and the need for shipping for the North African operation. Stalin was informed on July 17, 1942, of the cancellation of the convoys and postponement of a second front in France. The Allied decisions placed Stalin in an ugly mood in August 1942. With his armies retreating in front of Stalingrad, Stalin saw the invasion of North Africa as a weak substitute for a true second front. The invasion of North Africa would not draw any German divisions away from the offensive in the south. As a result, Stalin's Bequests for aid were insistent.[39]

Faced with the shipping demands of the North African invasion and the heavy losses, the British and the United States canceled the PQ convoys in October. With the battle in the south going badly, on October 3, 1942, Stalin again asked for more aid, including combat aircraft.[40] In October 1942» the Western Allies did send 13 individual ships without escorts, hoping to evade the Germans, but only 5 arrived in Murmansk.[41] Three turned back, four were sunk, and one was wrecked.

One positive result of allied activity in the Mediterranean for the Russians was the transfer of most of the specially trained torpedo bomber and dive bomber units from Norway to the Mediterranean in September 1942.[42] When activity increased in the Mediterranean, the antiship air groups moved from the north to the south, greatly reducing the air threat to the convoys.

The impact of the reduction in German aircraft and the lengthening hours of darkness made possible the four convoys sent in the winter months. On November 17, 1942, a convoy of empty ships left Murmansk on the return journey. Of 28 ships, only 2 sank. The bad weather kept the Nazi aircraft on the ground, and the long hours of darkness provided concealment.[43] In December two convoys departed from Iceland with heavy escorts. Not one ship was lost, nor were any ships lost on the following two convoys in January and February 1943.[44]

The Red Army stopped the German offensive in October and in November 1942, a massive Russian offensive began, surrounding the Germans at Stalingrad. Stalin had no outward negative reaction in January 1943 to the Casablanca Conference, but he was unaware of the decision to cancel convoys to Murmansk in the spring of 1943 because of the anticipated losses.[45] Stalin's acquiescence to the Allies' failure to deliver promised aid in 1942 must be viewed against the improving fortunes of the Red Army. November, December, and January were months of successive victories for the Soviets. The German 6th Army had been surrounded and crushed. The German Army Group A had retreated from the Caucasus, and the Red Army was chewing up satellite armies along the Don front. Stalin was confident of victory in early 1943.

German success against the northern convoy route is apparent when the deliveries in 1942 are reviewed. By December 1942 the United States had shipped only 55% of the promised materials. The British were short on their deliveries by 949 planes and 545 tanks by December 31, 1942. On the other hand, deliveries in 1942 had been far more than in 1941. During 1942, the Allies delivered 2.74 million tons, including 2,500 aircraft, 3,000 tanks, and 9,000 motor vehicles. More important in 1942 were food supplies mostly shipped by way of Vladivostok. Food made up 14% of lend-lease tonnage, sufficient to feed over a million men for a year.[46]

The Persian Gulf route began to make significant deliveries in 1942: over 700,000 tons, 29% of the total; compared to only 13,500 tons in 1941, less than 4% of the total. The North Atlantic route provided the largest amount—950,000 tons (39%)—most of it delivered before the German defenses became elective and in December when darkness brought safety. The Pacific route brought in 734,000 tons (32%) of nonmilitary supplies.[47] Had the northern route been open in the summer and fall of 1942, deliveries would have been closer to the 4 million tons originally promised.

In the spring of 1943, the return of the long days in the north would expose the convoys to Murmansk to increased risk.[48] The West claimed that it was heavy shipping losses in the Atlantic early in the year and preparation for the invasion of Sicily that led to cancellation of the convoys to Murmansk in March 1943, not the risk of German attack. The transfer of the German warships *Scharnhorst, Tirpitz,* and *Lutzow* to the Arctic area in March increased their ability to stop the convoys. Churchill delivered news of the cancellation of convoys to Stalin simultaneously with the German counteroffensive in the Ukraine, which ended hope of another major Soviet victory. Stalin's reply on April 2, 1943, referred to "a catastrophic diminution of supplies and arms."[49]

Stalin's attitude changed abruptly in April 1943 and he became less belligerent towards the West. The change was influenced by renewed confidence in the ability of the Red Army to defeat the Germans without Western military intervention. He realized the postwar political advantage of having the Red Army liberate as much of Europe as possible before the Western armies had landed in France. His major concern was lend-lease.

On April 1, 1943, the Russians had about 6 million men on the German front and 9,000 aircraft. On that date the Red Army on the German front and in the Stavka reserve included 384 rifle divisions, 139 rifle brigades, 30 tank and mechanized corps, 64 tank brigades, and 81 tank regiments. On January 1, 1943, there were 20,600 tanks on hand. The Germans in 1943 had 3 million troops on the Eastern Front, 2,500 aircraft, and 2,000 tanks. Ammunition consumption by the Russians doubled from 1.5 million tons in 1942 to 3 million tons in 1943. Fuel consumption increased 25% during the same period. The Russians were producing 2,000 tanks per month and large supplies of other weapons.[50] In 1942, much of lend-lease had been tanks, aircraft, and explosives; in 1943, tanks were only 10% of the shipments, while aircraft and trucks became more important. The Soviets tapered off production in 1943, as production exceeded losses. The continued need was for food, clothing, boots, and raw material.[51]

In view of the changing conditions, Stalin's demand for assistance from the West in 1943 was for trucks and supplies to rebuild the liberated regions. The third protocol covered deliveries from July 1943 to June 1944. During the negotiations, the Russians demanded a substantial increase in the number of aircraft and trucks, but did not ask the United States for any tanks, as follows:[52]

Equipment	Requested	Offered
Airacobras (P-39)	6,000	1,200
P-40	-	600
Light bomber	1,200	1,200
Medium bomber	600	222
Transport	360	240
TOTAL AIRCRAFT	**8,160**	**3,462**
Tanks	-	3,000
Trucks	144,000	132,000
Jeeps	24,000	24,000
Locomotives	3,000	500
Railroad cars	10,000	10,000

Boots (thousand pairs)	3,600	3,600
Wool cloth (thousand sq m)	18,000	18,000
Cotton (thousand sq m)	25,000	25,000
Food (thousand tons)		
Grain	1,680	1,180
Sugar	437	437
Canned meat	470	224
Meat	-	20
Fat	246	327
Vegetable oil	280	225
Concentrated food	178	252

Note that the British were still getting rid of P-40s that were no longer in production in the United States. Harriman objected to providing supplies that could be used to rebuild Russia after the war. The American ambassador, Admiral William Standley, wanted to bargain with the Russians over the supplies, but Roosevelt refused. Roosevelt's primary fear was a separate peace between the Soviet Union and Germany. In May 1943, the Russians believed that the United States wanted a weak Soviet Union after the war, according to Joseph E. Davies.[53] The Western Allies told Stalin in June 1943 that there would be no second front in 1943, nor any northern convoys till winter. Stalin angrily recalled his ambassadors from both Washington and London.[54] A period of tense relations among the three powers began.

The victory at Kursk and the invasion of Sicily did not mollify Stalin. On October 1, 1943, Churchill informed Stalin that the convoys would be resumed in November, with 35 ships departing each month for the next four months.[55] Those four winter months were periods of almost continual darkness in the north, and the proposal was to repeat the experience of the previous winter. But Churchill made no promise to continue the convoys during the spring and summer of 1944. The convoys would have to unload at Murmansk, as the route to Archangel was frozen in the winter.

In his reply to Churchill on October 13, 1943, Stalin stated that the delivery of supplies was an obligation by virtue of the treaty. Furthermore, the Soviet Union was bearing the brunt of the war. The northern route was the shortest and fastest; without it the requirements could not be made. The Russians had expected larger quantities than the Persian Gulf route could provide. Fewer supplies had arrived in 1943 than in 1942, and deliveries should not be subject to the arbitrary discretion of the British. Stalin did not mention the failure of the United States.[56]

Churchill refused the note. Despite difficult negotiations, the convoys did not resume until November, as Churchill had planned.[57] The unloading was slow as in the previous winter because of the lack of facilities in Murmansk. The Soviets took men from repair work on 18 ships to help in unloading, but the turnaround time was still long. Despite suspension of the convoys during the summer, over 70,000 tons of supplies were on the docks at Murmansk, and more supplies were in the holds of unloaded ships on November 30, 1943, when the convoy arrived. As stated, Murmansk lacked facilities to move the cargos. Another bottleneck was the lack of rail capacity to move the goods south. While on the docks, the supplies were subject to air attack from the Germans.[58]

The facilities at Murmansk were not sufficient to handle the promised supplies during the winter months. In February 1944, six U.S. ships moved south from Murmansk to Archangel, possibly with the aid of icebreakers, and unloaded there. The cargo included 50 Airacobras; 100 medium tanks; 50 Ford trucks; 40 tractors; spare parts for tanks, including engine blocks; and food, including sugar, canned meat, lard or bacon, rye meal, and white beans.[59]

Delivering the goods to Archangel during the summer months bypassed the Murmansk bottleneck.[60]

The meeting at Teheran in November and December 1943 resulted in a definite promise of a second front in 1944. The Russians in early 1944 began to praise the West publicly for its material support.[61] Although the Germans still blocked the northern route for most of 1944, the Persian Gulf route provided increasing military supplies and the Pacific Route even greater economic supplies. In January 1944, 46 ships averaging 8,000 to 10,000 tons each sailed from Seattle to Vladivostok. The McCormack Ship Building Company built most of the ships, which flew the Soviet flag and had Russian crews. The cargos provide an insight into the operation of lend-lease. Included were 22,000 tons of steel from U.S. Steel, 310 tons of ball bearings from the Fafnir Company, 500 half-tracks from the Minneapolis Moline Company, 400 electric motors from Wagner Electric Company of St. Louis, 1,550 batteries from the Price Battery Corporation, 3,000 differentials from the Thornton Tandem Company of Detroit, 3,000 truck chassis from the Ford Motor Company, 400 Bell aircraft from Los Angeles, 612 Douglas aircraft from Santa Monica, 200 U.S. Navy aircraft, 1,000 North American aircraft, 500 Allison aircraft motors, 200 Aeromarine aircraft motors, 70 Pratt & Whitney aircraft motors, 2,000 Allis Chalmers tractors for military or agricultural use, 600 Mack truck chassis, and 400 truck chassis and 100 tractor trailers from General Motors. Six of the ships carried munitions and weapons; four, food; two from the Chrysler Corporation, presumably Dodge trucks; and one from the Westinghouse Corporation at Boston, presumably communication equipment. The list provides a vivid picture of the breadth of the lend-lease aid going to Russia. Many supplies were weapons-related (half-tracks and aircraft), technically violating the agreement with the Japanese not to use the route for weapons.[62]

The British part of the Hard protocol was minor, but they delivered what they promised; see below. The British pawned off the obsolete P-39s from the Middle East. The Hurricanes and Valentines probably came from Britain and the Middle East.

BRITISH COMMITMENTS UNDER THE THIRD PROTOCOL[63]		
Equipment	**Promised**	**Delivered**
Valentine tanks	1,000	1,175
Hurricanes	651	441
Airacobras	1,800	1,579

By the end of 1943, the United States had sent 173,000 vehicles and 4,300 tanks. Machinery and parts made up one-third of the total tonnage. Food, ammunition, clothing, and boots were among the major items.[64] A German intelligence report analyzed the Allied deliveries in 1943 as follows:

Supplies	**% of total**	**Amount or Number**
Steel	6%	1 million tons
Tanks	14%	3,700
Aircraft	16%	6,500
Trucks	60%	up to 150,000 vehicles
Food	6%	
Meat	(20% of food)	400,000 tons
Fat	(50% of	600,000 tons

	food)	

The German report underestimated the quantities in part, but its relative accuracy suggested that it was based on a Soviet document summarizing deliveries.[65] The Germans had a fair estimate of total shipments: 2,880,000 tons in 1942 and 6 million tons in 1943, compared to actual totals of 2,453,000 tons in 1942 and 4,795,000 tons in 1943. They overestimated the deliveries via the northern route in both years and underestimated the other two routes.

DELIVERIES BY ROUTE[66] (in million tons)

Route	1942		1943	
	German Estimate	Actual	German Estimate	Actual
Northern	1.76	0.95	1.7	0.68
Pacific	0.51	0.73	1.9	2.38
Persian Gulf	0.61	0.70	2.5	1.61
TOTAL	2.88	2.45	6.0	4.80

The Germans did not realize how successful they had been in closing the northern route. Comparing deliveries in 1942 to 1943 reveals the impact of the canceled convoys. Deliveries via the northern route *declined* from 1942 to 1943, dropping from 950,000 tons in 1942 to only 681,000 tons in 1943, a decline of 28%. Shipments via the Pacific route increased from 734,000 tons to 2,388,000 tons, and those via the Persian Gulf from 705,000 tons to 1,607,000 tons. The percentage of shipments arriving at Murmansk dropped from 39% in 1942 to only 14% in 1943.[67]

Total deliveries increased in the latter half of 1943 and early 1944. For the eight months ending February 1944, the United States shipped 4 million tons of food, metal, vehicles, and other supplies to the Soviet Union. The Pacific route continued to be the major route through the end of the war. Large amounts of food, cloth, boots, trucks, and spare parts made up much of Pacific tonnage.[68]

The Persian Gulf route leveled off at 1.7 million tons in 1944. Oil came by pipeline from Abadan on the Persian Gulf.[69] The heavy tonnage items came via the Persian Gulf, including two entire truck plants, large cranes, railroad equipment, and a rubber tire factory. The factories were not operational by end of the war.[70]

Lend-lease shipments in 1944 were 30% greater than in 1943, despite some shipping problems. Deliveries were made ahead of schedule. Included were locomotives and rails to restore the liberated territory. The demand for food and aluminum declined in 1944 as Russian production improved, although food continued to be important. Trucks were in constant demand; there were never enough as the Red Army outran the railroad supply lines.[71]

Delivery in 1944 went almost without challenge. From November 1943 on, two northern convoys sailed each month because the number of ships had increased to the point that control became difficult. The British sank the German battleship *Scharnhorst* in December 1943 and the *Tirpitz* was damaged. The *Tirpitz* was repaired in March but damaged again by air attack. Convoys no longer needed a force of battleships for protection. Escort carriers were available to provide antisubmarine patrols. The submarines and bad weather sank only a few ships. In March 1944 a convoy escort sank four submarines and lost only one cargo ship and one destroyer.

By March 1944 all the loaded ships had been sent and in April 1944, 45 empty ships returned from Murmansk. The northern convoys were canceled from March until August 1944 because of danger from German attack in the almost continuous daylight and to make shipping available for the second front.[73] After the Allies landed in Normandy, the northern convoys resumed in August 1944 and continued through the end of the war. Though the Germans sent increasing numbers of submarines against the northern convoys, they sank few ships. The heavy escort, including

escort carriers, was able to fend off and sink many attackers.[74] Deliveries in 1944 exceeded those of 1943. During 1944, the Western Allies sent 243 ships to the Soviet Union via the northern route, compared to only 105 in 1943.[75]

The fourth protocol, which covered the period from July 1944 to the end of the war, included aircraft, tanks, and trucks plus quantities of raw materials, as below:[76]

Equipment	Requested	Promised
Spitfires	-	1,050
Airacobra (P39 or P63)	2,450	2,450
Medium bombers (B25)	600	300
Heavy bombers	540	-
Transports	360	240
Tank transporters	952	400
Tanks	3,173	3,173
Jeeps	9,683	9,300
3/4-ton trucks	28,144	16,000
1.5-ton trucks	41,821	41,436
2.5-ton trucks	79,790	73,560
Antiaircraft guns	240	240
Locomotives	1,714	1,649
Railroad cars	16,549	13,374
Food (thousand tons)		
Wheat flour	280	280
Grain	45	35
Peas and beans	75	75
Sugar	350	350
Canned meat	420	358
Fat	230	270
Butter	90	40
Vegetable oil	225	225
Dried foods	80	120

The total supplies delivered to the Russians from October 1, 1941, to March 31, 1946, made an impressive list. The table below lists only a few of the categories.[77]

Equipment	From Britain and	From the

	Canada	U.S.
Tanks	5,218	7,537
Trucks	4,020	375,883
Bren Gun carriers	2,560	
Motorcycles		35,170
Jeeps		51,503
Tractors		8,701
Aircraft	7,411	14,795
Antitank guns	4,932	
Antiaircraft guns		8,218
Machine pistols		131,633
Boots (millions of pairs)		15
Wool cloth (millions of sq yards)		62.5
Cotton cloth (millions of sq yards)		106.9
Leather (tons)		49,000
Food (thousands of tons)		4,478
Locomotives		1,981
Railroad cars		11,155

Four of the more vital items for operations in 1944 were trucks, tanks, rations, and telephone equipment. The trucks improved the organization of combat units, making them more mobile and effective in fighting the Germans and in supplementing the supply system. Scout cars, half-track tank destroyers, and late model Sherman M4A3 tanks were highly regarded by the Russians.

The huge quantities of Spam improved the diet of the Red Army by replacing dried fish as the major source of protein in their ration. The telephone equipment provided communication links between rifle units and forward observers and artillery batteries, making both more effective combat units.

Lend-lease trucks played a major role in making Soviet combat units more mobile and able to pursue more closely the retreating Germans In 1944. Russian production of trucks in 1942 had been only about 3,000 per month, as the automotive factories were converted to the manufacture of light tanks. American trucks made it possible to extend the distance that a unit could operate from the railhead beyond the limit imposed by the horse-drawn supply wagons. These Red Army rifle units supported by U.S. and British trucks were able to sustain a winter attack 350 km (200 miles) from their railhead.[78]

The major types of vehicles delivered in 1944 were the 2.5 six-wheel-drive truck (including GMC and Studebaker), the Jeep, and the 1.5-ton weapons carrier. The Jeep was not only essential as a command and reconnaissance vehicle in rifle units but also played a major role in the 120mm mortar regiments. The crew of five rode in the Jeep along with the mortar and ammunition. The Russians formed several hundred mortar regiments by 1944 that played a major role in providing close support for the advancing infantry»; The Jeeps allowed them to move forward very close to the infantry, a tactic not possible with horse-drawn vehicles or Russian two-wheel-drive light trucks.

Mortar regiments and tank destroyer regiments also used the 1.5-ton trucks. The crew and ammunition rode in the

truck that pulled the 76mm gun. The cross-country capability of the four-wheel-drive 1.5-ton truck enabled it to keep up with the attack. It provided the Russians with an immediate antitank gun line to withstand a German tank-supported counterattack. The arrival of thousands of trucks provided the cross-country motive power for most of the towed tank destroyer units, ending the previously effective German tank-supported counterattacks. Once the German defensive line was penetrated, the panzers could no longer force the Russians to retreat because U.S. trucks had been used to tow 76mm guns behind the advancing riflemen to repel the tanks. German commanders commented that the tank counterattacks were no longer possible in 1944.

The 2.5-ton trucks were used with the tank destroyers as well, but were most commonly used with the divisional and corps artillery. The large capacity of the 2.5-ton truck and its cross-country ability enabled the light and medium artillery to follow close behind the lines, an essential part of Russian tactics The artillery was the main offensive weapon as the number of riflemen declined. The Studebaker 2.5-ton truck was the standard vehicle for the Soviet rocket launcher units, an essential part of the Russian artillery barrage.

With the availability of large numbers of American 2.5-ton trucks, the Russians could use their two-wheel drive trucks for supply. When the Red Army crossed the old Polish border, converting the railroads from standard gauge to the wide Russian gauge became very difficult. When the Germans had invaded the Soviet Union, they moved one rail closer to the other without much trouble. When the Russians returned, they moved the rail back, although the German spike holes had weakened the tie. However, when the Russians crossed their own border, they tried to move the European standard-gauge rails farther apart to match the Russian gauge. Widening was not always possible because the ties were too short and the holes left by previous spikes had weakened the ties. Therefore, the Russians had to rely heavily on trucks for supplies in 1944.

Trucks made it possible to increase the distance from the railhead to the front line. Horse-drawn wagons carried a load 30 km per day. The most efficient system was one day out and one day back, because the horses needed stables every night. Two days each way or 60 km required a third set of stables. But the trucks could travel at least 100 km per day. Therefore, the practical distance from railhead to the front using trucks was over 100 km and could be extended to 300 km without much difficulty, as the trucks did not need cover at night.

The second major category was armored vehicles. Earlier, the Russians had declined offers of British tanks armed with the two-pounder, especially the Matilda and the Crusader. The latter tank was not only vulnerable to antitank fire but was mechanically unreliable and had little armor.[79] The preferred tank was the Valentine with a six-pounder gun. To satisfy that demand the British kept the Valentine in production in Britain and in Canada exclusively for the Russians.[80] There were also stocks in Egypt rendered surplus by the 8th British Army when it was reequipped with U.S. Shermans. The Russians did not want the older U.S. tanks because they used aviation gasoline and there would be a spare parts problem. Each different type of tank required stocks of spare parts, and therefore the Russians preferred to receive only a few types of tanks from the West.

The M4A3 Sherman with the high-velocity 76mm gun was considered the best of the imports. The gun had a longer effective range than the 75mm gun on the Panther tank and the German Mark IV tank. The Sherman could destroy Panthers and Mark IVs when the Russian tank was beyond the range of the Germans, making the Sherman an effective antitank weapon. The speed and reliability of the Sherman also made it effective. Guard tank brigades received Shermans in 1944, replacing the T34/85 mounting the heavier but less effective 85mm gun.

The heavy U.S. scout cars were highly prized by Russian reconnaissance units. The four-wheel drive provided better mobility than motorcycles and allowed reconnaissance units to carry heavier weapons. The T48 half-track tank destroyer with the 57mm antitank gun was a superior weapon when used properly. The U.S. Army had used poor tactics with the T48 and abandoned it, but the Russians used the T48 in mass, about 60 in a light tank destroyer brigade. Following up the advancing infantry, the T48s provided an instant antitank gun line when needed. The long effective range of the 57mm gun allowed the brigade commander to place his half-tracks in suitable locations.

The best position was on a reverse slope with only a few inches of the gun shields visible to the counterattacking German tanks.

Rations formed the third significant category of supplies. The United States sent large shipments of Spam that became a regular part of the Red Army ration. Food was in very short supply in the Soviet Union, especially in the early years of the war. Rations were very short on fat, protein, and calories. Although lend-lease grain was less than 3% of the grain consumed, aid provided 50% of the sugar and vegetables, 20% of the meat, most of the fat, and over 50% of the calories. American food was sufficient to feed 6 million troops one pound of quality food each day for the entire war.[81]

Before large quantities of American preserved food arrived, the Russian soldier lived on two pounds of bread, some dried fish, and whatever vegetables could be obtained by the company cooks. The main meal was soup and bread. On occasion the soup contained some meat. The dried fish did little to satisfy hunger and made the soldier very thirsty. Drinking too much water forced him to urinate frequently, which was a serious problem for a frontline rifleman in his foxhole within range of German snipers.

In 1944, the daily ration included a can of Spam that could be used in the soup, heated, or eaten cold. Because of its high calorie content, Spam satisfied hunger far better than dried fish. The Russians thrived on Spam and bread. The Spam could be stockpiled because the canned meat did not spoil and was impervious to rats. It was packed in boxes that were easy to transport, though heavier in bulk than the dried fish.

The fourth category was communications equipment. In the early years of the war, communication was a serious problem in the Red Army. Radios were in very short supply and there were not enough field telephones to provide an effective command structure below the regiment. Orders were delivered to company commanders by riders on horseback. Without telephones the artillery had no forward observers to call back to the batteries to correct fire. U.S. radios and telephone equipment were sent in enormous quantities, resulting in a marked improvement in Soviet communications in 1944 and 1945. Over 40,000 radios, 380,135 field telephones, and 1.25 million miles of telephone cable were provided.[82] With the availability of U.S. field telephones and wire, the Russians were able to make enormous improvements. Forward observers for the artillery became standard and led to more accurate fire. Companies were linked by telephone in defensive positions and often had American radios during offensive operations. The more advanced communications system was a major element in the improved performance of the Red Army in 1944.

Lend-lease made a major contribution to the successful offensives launched by the Red Army in 1944. The Red Army became a far more modern army than the German Army, which still relied on horses for supply and for towing; artillery. The only motorized unit in a German infantry regiment was the antitank company. The motorized Russian divisions moved faster and farther than the Germans. The U.S. rations allowed the Red Army to be fed better than the Germans and gave the Russians combat flexibility because they were no longer tied to the company soup kitchen. U.S. combat vehicles provided an extra 10% that could have been the margin of victory in many battles. All these advantages were multiplied by American radios and telephones that improved the command structure and the effectiveness of the artillery. Thus, the supplies provided by lend-lease were essential to the Soviet war effort, perhaps even more than a second front. During the crucial period from June 1941 to early 1943, the West tried several times to break through the German's defense in the Arctic to deliver the goods. The first convoys went to Archangel, the primary port for the import of Western goods even before the time of Peter the Great. The Archangel route had been a major link for delivery of Allied supplies to the Russians in World War I. The route already had been established in 1941 and supplies flowed immediately. The Persian Gulf route needed extensive development and the Transiberian Railroad was overloaded with military resources moving from Siberia for use in Europe. Unfortunately, the Germans were successful in blocking the route for 14 of the months between June 1942 and November 1943. German efforts had much to do with the cancellation of convoys between April and August 1944.

Despite the success of the Germans in blocking the northern route, by 1943 the Persian Gulf was fully functional and Siberia had been stripped of its resources, leaving the railroad free to move supplies from Vladivostok. Most lend-lease deliveries came by way of the Pacific Ocean (50%); the Persian Gulf was second (26%) and the northern route was third (24%).

A careful examination of the statistics presents a plausible alternative to the accepted interpretation of German failure to stop the convoys. Moderate losses were inflicted on four convoys between March 1942 and May 1942. Heavy losses

were suffered by a convoy in June 1942 and the convoys were canceled. In September 1942 another attempt was made and heavy losses were inflicted. No further attempt was made until the depth of winter and nearly 24 hours of darkness enabled four convoys to get through between December 1942 and February 1943. No further convoys were attempted until the dark months beginning in November 1943, when the Germans had withdrawn their air units. The convoys were canceled again in the warm months of 1944 and then resumed in September 1944 until the end of the war. In 1944 the northern route was no longer essential and the Germans were wise to restrict further risk to their warships. The vital significance of the northern route was in 1941 and 1942, when the Red Army needed supplies desperately. During those years the northern route provided 40% of the deliveries and would have provided much more had the Germans not intervened. The Germans did succeed in Hopping all but eight convoys to Russia from June 1942 until September 1944. That could be considered a victory. The real issue in the German success was not cargo losses but undelivered cargo—in other words, the convoys that were not sent between June 1942 and November 1943 and in the summer of 1944 because of feared German attack. The extent of the German victory should be measured in tonnage not delivered, not tonnage sunk.

Including all losses on the northern route during the war, only 7.2% of the ships dispatched were lost. Including only the period from August 1941 to March 1943, the losses were 14.7%. Including losses both on outbound and inbound voyages, only 12% of the total number of ships dispatched were lost. The gross tonnage of merchant ships lost to enemy action on the northern route was 604,000 tons compared to a total of 3,964,000 tons delivered, or 15 %. The average monthly delivery in the first five months of 1942 was 166,500 tons. Had this tonnage been delivered during the 14 months when convoys were not sent, the total would have been 3,263,000 tons (almost doubling the amount delivered during the war), and the supplies would have been delivered at a time when they were sorely needed—from May 1942 until November 1942. Delivery to Archangel with its port facilities and rail connections would have eased delivery immeasurably and made a major difference to the Red Army. However, the four convoys that did pass through in the winter of 1942-43 and improvement of the Persian Gulf and far eastern routes assured that the Soviets would receive the needed aid in 1943.

The impact of lend-lease on the Soviet war effort was difficult to measure. The food was often dehydrated or processed and therefore could not be compared by weight to other food products. Communications equipment was extremely important yet small in volume. The Germans believed that lend-lease was equal to 15% of Soviet production, and many postwar authorities place the number at 10%. Even a small percentage may have a determinant effect in war, deciding victory or defeat. Given approximate equality in other factors (manpower, skill, quality of weapons), a small margin in the number of weapons or men at a particular moment could be decisive. Ten percent was not a small margin when applied to an army of over 6 million men.

Although the Soviet leaders demanded lend-lease during the war, expressing appreciation when aid arrived and indignation when it did not, after the war the official line was that the shipments had little impact. One author stated that lend-lease provided only 2% of the antiaircraft guns, 7% of tanks and SUs, and 13% of the aircraft used by the Soviet Union during the war.[83] There was little point to the antiaircraft gun figure, as the Russians asked for few and received them. The tank percentage is incorrect. The Soviets made 102,800 tanks and SUs and received 12,755, a total of 114,555. The lend-lease share was 11%. And lend-lease had an impact beyond the actual number of tons delivered. Because of the easily recognizable origin of the supplies, most Russians were well aware that the aid was arriving in considerable quantities. Knowledge that the Western Allies were supporting him encouraged the common soldier. Though the English overcoats were derided as "Churchill's second front," the knowledge that the West was providing material, if not soldiers, to assist the Soviet Union was understood and appreciated.

Lend-lease provided few weapons. Instead food, raw materials» clothing, boots, railroad locomotives, aluminum, and other supplies were sent that replaced Russian productive capacity lost to the Germans. The aid reduced the need to provide workers, factories, farms, and mines to produce these goods. How many workers were freed for the army because of the large percentage of soldiers clothed and fed by lend-lease? Trucks provided by lend-lease made it possible for the Soviet truck factories to manufacture self-propelled 76mm guns.[84]

A problem was that most of the lend-lease arrived after November 1942, when the crisis was over. Still, the fact that lend-lease shipments were arriving in ever-increasing quantities after December 1942 was another indicator that the Russians had less and less need for the second front. In truth, lend-lease was the second front in 1943 and played an

important role in shifting the balance. The thousands of trucks that provided the cross-country motive power for most of the towed tank destroyer units spelled the end in 1943 to the previously effective German tank-supported counterattacks.

By 1943 the flow of lend-lease was increasing and making a major contribution to the Red Army. Stalin had mixed feelings on the issue of a second front versus a preponderance of lend-lease supplies, depending on circumstances at a particular moment. Roosevelt was stalwart in fulfilling his promises to Stalin to provide aid, whereas the British were reluctant to risk their ships on the northern route and sent outdated, rehabilitated aircraft and tanks from depots in Egypt via the Persian Gulf. However, the ever-increasing flow of trucks, food, and raw materials from 1943 on ensured the continued dominance of Soviet forces and the final defeat of Hitler.

NOTES

1. Van Tuyll, pp. 22-24.

2. Grechko, *Soviet Studies,* pp. 38, 50.

3. Joan Beaumont, *Comrades in Arms British Aid to Russia 1941-1945* (London: Davis-Poynter, 1980), p. 30.

4. Brian B. Schofield, *The Arctic Convoys* (London: MacDonald and James, 1977), pp. 12, 141.

5. Beaumont, pp. 59-60, 112; United States Department of State, *Soviet Supply Protocols* (Washington, DC: Government Printing Office, 1948), pp. 3-8.

6. Schofield, *Arctic Convoys,* p. 12.

7. Beaumont, p. 94.

8. Wolfgang Schlauch, *Rustungshilfe der USA 1939-1945* (Koblenz: Bernard & Graefe Verlag, 1985), p. 153.

9. Van Tuyll, pp. 26-27; Schofield, *Arctic Convoys,* p. 145.

10. Brian B. Schofield, *The Russian Convoys* (London: B. T. Batsford, 1964), *p.* 29.

11. Schofield, *Russian Convoys,* p. 30.

12. Schofield, *Arctic Convoys,* pp. 6-9.

13. Schofield, *Russian Convoys,* p. 28.

14. Schofield, *Russian Convoys,* p. 40.

15. Schofield, *Russian Convoys,* p. SS.

16. Schofield, *Arctic Convoys,* pp. 20-35.

17. Schofield, *Russian Convoys,* p. 65.

18. Schofield, *Russian Convoys,* pp. 67-74.

19. Schofield. *Arctic Convoys,* pp. 13-14; Van Tuyll, p. 52.

20. Schofield, *Arctic Convoys,* p. 62.

21. Schofield, *Russian Convoys,* pp. 106-11.

22. Schofield, *Russian Convoys,* pp. 117-125.

23. Beaumont, p. 112.

24. Mueller-Hillebrand, III, p. 274.

25. Schofield, *Russian Convoys,* pp. 66, 74-76, 104.

26. United States, *Supply Protocol* pp. 19-31.

27. Beaumont, p. 141.

28. FHO, CGR, H 3/828, Roll 578, Frame 1140. 29. Seaumont, pp. 138, 140.

30. Beaumont, p. 152.

31. FHO, CGR, H 3/828, Roll 578, Frame 1140; Van Tuyll, p. 50.

32. Beaumont, p. 133.

33. Arthur G. Volz, "Soviet Artillery Weapons: HI, 1941-1945," *Soviet Armed Forces Review Annual* XII (1988-1989), p. 222.

34. Dunn, p. 107; Public Record Office, Tank Return, Middle East, September 9,1942, WO 193/540; Tank Return, Middle East, May 9, 1943, PREM 3/284/9, Public Record Office.

35. Beaumont, p. 123.

36. Beaumont, p. 122.

37. Van Tuyll, p. 32.

38. Schofield, *Russian Convoys,* p. 105.

39. Beaumont, p. 121; Schofield, *Russian Convoys,* p. 104.

40. Beaumont, p. 123.

41. Schofield, *Russian Convoys,* p. 127.

42. Schofield, *Russian Convoys,* p. 128.

43. Beaumont, pp. 130-31; Schofield, *Russian Convoys,* p. 128.

44. Schofield, *Russian Convoys,* pp. 131-32, 154.

45. Beaumont, pp. 131-132.

46. Van Tuyll, pp. 54-56.

47. Schlauch, p. 153; Beaumont, p. 127.

48. Beaumont, p. 127.

49. Beaumont, pp. 137-38; Schofield, *Arctic Convoys,* p. 101; Schofield, *Russian Convoys,* p. 154,

50. Van Tuyll, pp. 61-62; G. F. Krivosheev, *Poteri Vooruzhenikh sil SSSR v Voinakh Voevikh Deistviiakh i Voenno*

Konflitakh Grif Sekretnosti Synat (Moscow: Izdatelistvo, 1993), p. 357; Voenno Nauchnoe Upravlenie Generaln-ogo Staba, *Voevoi Sostav Sovetskoi Armii Chast III (laniar-Dekabr 1943 r)* (Moscow: Izdatelistvo, 1972), pp. 91, 97, and 102.

51. Harrison, pp. 117-18.

52. Beaumont, p. 154; *Supply Protocols,* pp. 56-61, 74-75.

53. Beaumont, pp. 145-46.

54. Beaumont, p. 146.

55. Schofield, *Arctic Convoys,* pp. 101-03; Schofield, *Russian Convoys,* p. 163.

56. Arseni Golikov, *With the Red Fleet* (London: Putnam&Co., 1965), pp. 174-75.

57. Schofield, *Arctic Convoys,* pp. 101-03; Schofield, *Russian Convoys,* p. 163.

58. Golikov, pp. 188-89.

59. FHO, CGR, H3/811, April 22, 1944, Roll 578, Frame 346.

60. Golikov, pp. 188-89.

61. Beaumont, p. 169.

62. FHO, CGR, H3/811, May 9, 1944, Roll 578, Frame 345.

63. Beaumont, p. 169.

64. Van Tuyll, p. 56.

65. FHO, CGR, H 3/828, Roll 578, Frame 1118.

66. FHO, CGR, H 3/330, Roll 562, Frame 55.

67. Schlauch, p. 153.

68. Van Tuyll, p. 25.

69. Van Tuyll, p. 63; Schlauch, p. 153

70. Van Tuyll, p. 25.

71. Van Tuyll, pp. 63-65.

72. Schofield, *Russian Convoys,* pp. 181-88; Schofield, *Arctic Convoys,* PP. 104-24.

73. Schofield, *Russian Convoys,* p. 188; Schofield, *Arctic Convoys,* p. 12SL

74. Schofield, *Russian Convoys,* p. 193; Schofield, *Arctic Convoys,* p. 127. 75. Schofield, *Russian Convoys,* p. 199.

76. Beaumont, pp. 190-91; *Supply Protocols,* pp. 96-98, pp. 103-10.

77. Beaumont, pp. 204-08; Schofield, *Russian Convoys,* p. 213-14; Schlauch, p. 155.

78. Beaumont, p. 123.

79. Beaumont, pp. 138, 140.

80. Beaumont, p. 152.

81. Van Tuyll, p. 117.

82. Van Tuyll, p. 103.

83. Grechko, *Soviet Studies,* p. 51

84. Van Tuyll, p. 79.

5 Weapons Production

In short decisive campaigns such as their victories over Poland and France, the Germans fought with existing inventories tanks, artillery, and other weapons on hand at the start of the campaign. Their plan for victory over the Soviet Union, *Barbarossa,* anticipated a series of quick victories, defeating the Russians before winter set in. With this plan in mind, the Germans believed that they could defeat the Soviet Union with weapons available in mid-1941.[1] The Germans had increased arms production sharply in the first three quarters of 1941 in anticipation of the invasion of Russia. The new weapons were improved models plus additional stocks to equip the many new formations created for the campaign.

At first, in the summer of 1941, all went according to plan. The Germans were so confident in the fall of 1941 that they then reduced arms and ammunition production.[2] However events in the winter of 1941-42 changed everything. The Soviet counteroffensive was unexpected and caused a major setback to the Germans. The Germans were forced to abandon thousands of weapons in their retreat from Moscow. By early 1942, the Germans realized that they had a serious war on their hands and that more of their industry would have to be turned to war production. Tank production can be used as an example of the reaction to the realization that defeating the Russians would take an all out effort. In the table that follows, the comparison of tank output shows the dramatic increase in German production from 1941 to 1944.

GERMAN TANK AND SP PRODUCTION[3]			
Year	**Tanks**	**SP Guns**	**Total**
1941	3,256	540	3,796
1942	4,278	1,911	6,189
1943	5,966	4,781	10,747
1944	9,161	9,123	18,284

The Soviets managed to hold on in 1941, trading space for time and profiting from Hitler's interference in operations. In the war of attrition that followed, the battle of production became decisive. Soviet production of aircraft increased steadily throughout the war, while other weapons peaked as early as 1942 to meet the demands of new units and replacement of battlefield losses. In the final years of the war the Soviets reduced artillery and small arms production, as follows:

SOVIET ARMS PRODUCTION 1940-45[4] (in thousands)						
Weapons	**1940**	**1941**	**1942**	**1943**	**1944**	**1945**
Aircraft	10.6	15.7	25.4	34.8	40.2	20.1

Tanks and SUs	2.8	6.6	24.4	24.1	29.0	15.4
Guns, mortars	53.8	67.8	356.9	199.5	129.5	64.6
Rifles and carbines (millions)	1.46	2.66	4.05	3.44	2.45	0.57

One reason the Russians were able to win the production contest was the underlying strength of their economy, but even that was not equal to the total European economy under German control. Steel production of the four major powers in 1940 was as follows in millions of tons:[5]

Germany and Occupied Europe	31.8
Soviet Union	18.3
Great Britain	13.2
United States	62.5

The Soviets concentrated on war production at the expense of the civilian sector, but not more than Britain or the U.S. One estimate placed the percentage of Russians and British in war work at the same level, as this table shows:[6]

% in War Work	1939	1940	1941	1942	1943	1944
Great Britain	18%		38%		43%	43%
Soviet Union	--	11%		43%	45%	

Another estimate stated that in 1944, 66% of British manufacturing and 59% of American manufacturing was devoted to the war effort.[7] The unique Soviet advantage was the quality of its heavy industry and its armaments productive capacity. For more than a decade in the 1920s and 1930s, U.S. engineers had taught the Russians the techniques of low-cost mass production. U.S. manufacturers in the 1930s, in cut-throat competition to lower the cost of their products in a depressed American economy, had developed a philosophy of planned obsolescence. The idea limited the quality of a product to function efficiently for a predetermined life span. This philosophy reduced the cost of the original item and created a market for replacements. Cost-effective, functional design simplified each part of a product. The raw materials, the method of fabrication (stamping steel parts for machine pistols versus machining the parts from a forging, for example), the quality of the finish, and appearance were determined by a pragmatic point of view.[8]

Wearing out (planned obsolescence) was the part of the design offering cost savings. Increasing the tolerances in machined parts cut the labor cost in exchange for a shorter use life. Products were designed to last not for a lifetime but for an acceptable time, at which point the user would discard the product and buy a new one. Automobiles in the 1930s ran well for about five years. After that time the body would rust, the bearings in the engine would be worn, the springs would break, the drive shaft would be fatigued, and the steel in the axles would be crystallized and prone to break. The idea was epitomized in a poem concerning a carriage that never needed repair, but in a single day, everything broke. In contrast, German and British manufacturers tended to make longer-lasting products, though at higher cost. Rolls-Royce built aircraft engines for Britain during World War II. They licensed the Packard Motor Car Company in Detroit to build the engines, but Rolls-Royce engineers were shocked by the labor-saving modifications made by the Packard engineers. American tanks were designed to last for 40 hours of combat and a year or more of service. The interior provided for crew comfort for long periods. In contrast, Soviet tanks were designed with an expectancy of 14 hours of combat and six months of service. Little effort was made for crew comfort.[9]

The Soviets adopted the two ideas—cost-effective approach and planned obsolescence—and applied them more rigorously than did the U.S. originators.

Weapons were produced with the minimum number of man-hours and the least amount of material. Cost-effectiveness dictated a very rough finish on the T34 tank. Aesthetic appearance received no credits on the battlefield. The turret of the T-34 had no floor, greatly simplifying production at the cost of crew comfort. The tank crew had to perch on seats hung from the turret ring. The loader had to scramble around the floor of the tank for shells while the turret moved around him. Throughout the war, efforts continued to reduce the cost of weapons. Between 1941 and 1943, the labor cost of producing the 76mm regimental gun was reduced by 31%; the 152mm howitzer, 41%; the T-34 tank, 51%; and divisional 76mm guns, 73%.'° In 1942, 1,030 hours of machining produced a 76mm divisional gun. In 1944 the same gun required only 475 hours of machining.[11]

The second idea, planned obsolescence, was also part of the Russian system. Soviet tank engines seldom lasted longer than a few hundred hours or about six months, the average life span of a tank on the Russian front. Cutting the tolerances reduced the number of hours and the degree of skill to complete a weapon. Even the best engine could not overcome the law of averages that led to destruction by German antitank guns. English tank engines lasted much longer and therefore made ideal training machines, as new tank drivers needed many hours of experience.[12]

The Soviets adopted two other techniques of American production, mass production and long runs. Mass production broke down a complex task, such as building an automobile, into many semiskilled or unskilled tasks. An individual could be trained in a few minutes to perform a single task very quickly. The worker would then do the task repeatedly —for example, placing pins to join the links of a tank track. Some activities required more training—for example, welding two pieces of armor plate together. The Soviets went further than the Americans and abandoned any attempt at appearance. Thei welds on Soviet tanks were often crude. For the operation of complex machine tools by unskilled workers, skilled or semiskilled workers set up the work and supervised the unskilled. Women and boys performed many tasks not requiring physical strength. Indeed, women filled many jobs that would have required a man in a German factory.

Long runs multiplied the savings in skilled labor. The Germans continually tinkered with the design of their tanks and other weapons, improving them but only at the cost of numbers produced. The Russians were loath to make changes and did so only when absolutely necessary. Designers could not modify weapons and interfere with production schedules unless the weapon would be substantially improved. The Russians began and ended the war with the same machine pistols, rifle, pistol, light machine gun, heavy machine gun, and mortars. In contrast, the Germans introduced one or more new models of each weapon during the war. The improvements in Russian artillery were usually minor and made use of previous components. The new self-propelled guns used the chassis of earlier tanks and existing artillery pieces. The new Stalin tanks were improvements on the prewar KV, not an entirely new product such as the Tiger or the Panther, both of which incorporated many technological innova-tions. Most workers in the Russian armament industry probably made the same part during the entire war.

Cost-effective design, planned obsolescence, mass production, and long runs enabled the Russians to produce weapons at far less cost in factory space, machinery, raw materials, and labor than the Germans. An essential factor was that the plants were planned for a smooth flow of production. During the 1930s, American engineers designed and built all of the Soviet tank factories and many other factories for mass production. Many were improved copies of the most efficient American plants. The Germans could not adopt the American philosophy because their factories were not designed for mass production. The bombing offensive tied up their construction industry; repairing damage allowed little time for new construction. Also, plant layout was an essential component of efficient production technique. Large plants were necessary to build complex weapons efficiently. Many Russian plants employed from 10,000 to 40,000 workers. This economy of scale often made a major difference in the cost of the final product.[13]

An analysis of Soviet weapons shows how they applied the production principles. The Russian small arms situation was chaotic at the beginning of the war. In the 1920s, the Red Army had a wide miscellany of weapons: some inherited from the czarist array, some from foreign purchases during World War I, and others captured from the White armies during the Revolution. In 1929 the Red Army was heavily dependent on foreign-made and foreign-designed

weapons. The most common machine guns were the British Maxim and Lewis, the American Colt and Browning, and the French Chauchat.[14]

As part of the First Five-Year Plan during the late 1920s and early 1930s, the Soviets embarked on an intensive research and development program to improve their weapons. The result was an entire spectrum of arms, many based on copies or adaptions of the best weapons available in the West. The SG43 machine gun designed by Goryunov was based on a design patented by the American, John M. Browning. The machine gun used a Mauser (German) extractor and ejector. The Degtyarev machine gun used Mauser locking and Vickers (British) feed. In the late 1930s, production began on a massive scale. In 1928, the Soviets produced 8,811 light machine guns and 24,230 heavy machine guns; in 1937, they produced 95,000 light and 60,000 heavy machine guns.[15]

The small arms were manufactured in many factories. One of the largest was plant no. 173 at Tula. The plant was modernized in 1937 with new machinery. During the war the plant had 10,000 to 12,000 workers in three 8-hour shifts, making 600 M1938 Tokarev semiautomatic rifles per day and other arms.[16] Other factories probably received new machinery in the 1930s to make small arms.

The most common hand gun was the Nagant revolver adopted in 1895 by the Russian Army based on a Belgian design. In 1930 the Red Army adopted the TT30 7.62mm automatic pistol designed by Tokarev, based on the Colt-Browning design and similar to the Browning .32 caliber pistol. F. V. Tokarev improved the design, making the gun easier to manufacture. The pistol was made at the Tula arsenal. The tolerances were lower and the finish rougher than similar pistols made in the West, but the guns were sturdy and functional. Some types of German pistol ammunition would fit into the TT30. Improvements were made in 1933 (the TT33) and the pistol remained in use throughout the war.[17]

The primary weapons of the infantry were the bolt action rifle and the carbine. As the following table shows, production of the Mosin 1891/30 began slowly but increased sharply in the late 1930s. The basic weapons in World War II were the Carbine M1938 and the 1891/30 rifle.

PRODUCTION OF THE MOSIN 1891/30[18] (in thousands)

Year	Rifles	Carbines	Total
1930	102		128
1931	154		174
1932	283		224
1933	239		241
1934	300		303
1935	137		222
1936			403
1937	560		578
1938	1,125		1,175
1939	1,395		1,503
1940			1,461
1941	873	419	1,570
1942	3,027	687	4,040
1943			3,850
1944	1,376		2,060

The Russians had large stocks of foreign weapons. During World War I, Winchester made large numbers of Model 1895 bolt action rifles chambered for the Russian 7.62 Mosin cartridge for sale to Russia. The Russians also had stocks of Canadian Ross .303 rifles, British Pattern 14 .303 rifles taken in Latvia, Czech 7.92mm Mauser M1924s, and Polish Kar98s taken in September 1939. to 1941 the troops in Leningrad received French M1886/93 Lebels."

The standard rifle was the Mosin-Nagant 7.62mm rifle, adopted by the Russians in 1891. In 1930 the Soviets shortened the rifle and simplified the sights (the M1891/30), but the rifle remained the same as that used in World War I. In 1938 the sight of the carbine was improved along with minor changes. In 1937 a sniper version of the rifle had a telescopic sight.[20]

The Soviets had large reserve stocks of rifles by 1944, and curtailed production. In February 1944 a new carbine, the M1944 designed by N. S. Semin, with an attached folding bayonet, was approved for the airborne troops.[21]

The Red Army developed a completely new automatic rifle in 1936, the 7.62mm Siminov M1936 rifle (AVS36). The rifle was gas-operated and could be fired as a semiautomatic or continuously as a light machine gun. The piece had no bipod or other support and the recoil from the high-powered rifle ammunition made it difficult to control on automatic fire. The weapon was difficult to disassemble for cleaning. The gas-operated piston and the lock jammed from accumulated fouling. In 1938, Tokarev designed a replacement, the SVT38, that fired only semiautomatically. Although this rifle easily disassembled for cleaning, it was fragile. In April 1940, the SVT40, a sturdier version, replaced the 1938 model. Only a few were produced with the full automatic option. NCOs used the SVT40 as a sniper rifle. The Germans and Russians preferred semiautomatic rifles for sniping because the sniper would not have to move to operate the bolt and reveal his position.[22] The Americans and British, more concerned with accuracy, issued bolt action rifles to snipers; the Americans issued semiautomatic rifles to the other riflemen.

The Russians did not materially alter either their bolt action or semiautomatic rifle during the war. However, they reduced the proportion of rifles to machine pistols when it became apparent that they needed a low-cost weapon that produced a high rate of fire. The difference between a machine pistol and an automatic rifle is that the former fires pistol-type ammunition and is less accurate. The automatic rifle fires more powerful rifle ammunition (requiring a substantial chamber and bolt) with much longer range. Automatic rifles were very difficult to control without a bipod and hinged butt plate because of the tendency of the barrel to rise.[23] The machine pistol was much cheaper to manufacture because the low-powered ammunition did not apply as much stress on the weapon and stampings instead of machined parts could be used.

The Russians rejected the Finnish Suomi machine pistol in the early 1930s on the basis that it was a police weapon unsuitable for military use. Red Army commanders feared that wide use of a machine pistol would lead to wasting large amounts of ammunition, an attitude that persisted in the U.S. army throughout World War II. The conservative Soviet military leaders believed that the bolt action rifle was ideal.[24]

F. V. Tokarev designed a machine pistol in 1927 and Degtyarev designed another based on the German Bergman MP18 in 1929. Both were improved in the 1930s. In 1934 the Degtyarev model was designated the PPD M1934. The PPD originally used a 25 round banana magazine, but was modernized in 1938 and given a 73 round drum. The latter model was designated the PPD 1934/38. The PPD 34 was not highly regarded by the army and used primarily by the NKVD as a police weapon.[25] The PPD 40 was an improved Finnish Suomi, using a drum magazine and designed with ease of manufacturing in mind. In 1940 mass production began, as can be seen below:[26]

PRODUCTION OF PPD MACHINE PISTOLS	
1937	1,291
1938	1,115
1939	1,700

1940	81,118

In 1940 there were four models of the PPD in use, the M1934, the 1934/38 with 25 round magazines, the M1934/38 with a 73-round drum, and the M1940 with a 73-round drum.[27] The Finnish War and the beginning of the Great Patriotic War created the need for an effective, easily manufactured, sturdy machine pistol. In 1940 Georgii S. Shpagin and B. G. Shpitalnogo both designed machine pistols. The army selected the Shpagin, designated the PPSh 1941, and mass production began, replacing the PPD 40. Stampings replaced machined parts, making the gun simple to manufacture. Also, the PPSh was easy to disassemble for cleaning and delivered a high rate of fire from a 71-round drum.[28] The use of the machine pistols expanded dramatically during the war, as shown below:[29]

Year	Machine Pistols of All Types
1941	99,000
1942	1,506,000
1943	2,024,000
1944	1,971,000

Over 5 million were made by the end of the war, but demand exceeded supply as late as 1944.[30] In 1942, the PPSh-2 had a curved 30-round magazine instead of the drum. A completely new weapon, the PPS 1942, later modified as the PPS 1943, was designed by A. I. Sudaeva. The weapon was made in Leningrad during the blockade, when the supply of machine pistols was running low and there was a shortage of metal and workers. The new machine pistol required only 6.2 kg of metal and 2.7 hours to manufacture, compared to 13.9 kg of metal and 7.3 hours to manufacture the PPSh. The weapon was very crude and not widely adopted. In 1943, Leningrad factories made 46,572 PPS machine pistols.[31]

The machine pistols provided the Soviet infantry with heavy firepower to replace the dwindling numbers in the rifle companies. While production of rifles decreased from over 3 million in 1942 to 1.3 million in 1944, production of machine pistols increased from 1.5 million to nearly 2 million. Given the high attrition rate of small arms in combat, probably two-thirds of the men on the front lines carried machine pistols. The carbine continued as a personal weapon for the artillery and rear-echelon troops.

For sustained heavy fire, the Russians continued to use the Maxim machine gun copied from the British Maxim in 1905. Tokararev made some improvements in the water jacket in 1925 and the MT (Maxim-Tokarev) became the standard heavy machine until 1943. The Tula armory began production in November 1926, and made 2,450 in the first year. The gun was mounted on a two-wheel carriage, or on a sled for winter warfare.[32] In 1931 a new carriage readily converted into an antiaircraft tripod, while reducing the weight from 90 pounds to 77.[33] As the table shows, production of the MT was comparatively high through the 1930s.[34]

PRODUCTION OF MT HEAVY MACHINE GUNS	
1931	16,305
1933	8,637
1934	4,899
1935	4,409
1937	8,052
1938	16,094

1942	55,258

In September 1939, the defense committee approved the DS-39, an air-cooled 7.62mm heavy machine gun—a scaled-down version of the DShK heavy-caliber machine gun designed by Degtyarev and Shpagin in 1938. Production began with 6,628 in 1940 and 3,717 in 1941. Because the gun was not successful, production of the MT continued.[35] In 1942 work began on a replacement for the obsolete MT. The gun was too heavy, had a slow rate of fire, and, worst of all, was difficult to manufacture. Gorunova designed an air-cooled heavy machine gun on a two-wheeled carriage, designated the SG43. The SG43 heavy machine gun was one of the few completely new weapons adopted during the war. The gun, using the standard 7 62 rimmed cartridge, was reliable, easy to make, and simple to use. The major improvement over the Maxim was the reduction in the number of parts and weight. However, only a few of the guns were made before 1945, and they did not replace the Maxim.* As shown below, production of heavy and light machine guns reached a high level in the 1930s and increased sharply during the war.[37]

Year	Machine Guns Produced
1930	9,700
1931	41,000
1932	45,000
1933	32,700
1934	29,200
1935	29,600
1936	32,000
1937	42,000
1938	77,000
1939	114,000
1940	not available
1941	53,700
1942	356,100
1943	458,500
1944	439,100
1945	268,000

The Soviets met the need for a light machine gun M1928 when the Red Army accepted the DP-27 light machine gun designed by V. P. Degtyarev. In the early models the main spring, located under the barrel, heated up under continuous fire. When the spring became hot, it lost elasticity and the gun jammed. Later models moved the main spring to the rear, clear of the barrel. The modified gun was very simple, reliable, and robust. It seldom jammed because of dirt. Its only problem was that the standard rimmed cartridge was more prone to jam automatic weapons than the rimless cartridges used by the Germans and Americans. The gun used a 47-round drum that in some situations—for example, firing from the hip on the move—was more desirable than the belt-fed machine guns of the Germans. Large numbers of the gun were made throughout the war with few variations. In 1929 a tank version was accepted as the "DT."[38] In 1944 the DP-27 was modified as the RPD to use belts instead of drums, but again the DP remained in use. In 1944 and 1945 the Russians manufactured 2.8 million machine guns and machine pistols.[39]

In 1927 the Red Army studied various types of ammunition to be used in a heavy-caliber machine gun for antiaircraft and antitank use. In May 1927 the decision was made to adopt the British Vickers 12.7mm (50 cal) round. In 1930 Degtyarev designed a machine gun to fire the round, the DK. In 1938 Degtyarev and Shpagin together developed the DShk 1938 which became the standard antiaircraft machine gun of the war. Production was never very high. The number of DKs available in the army increased from 720 on January 1, 1942, to 1,947 on July 1, 1942; 5,218 on January 1, 1943; and 8,442 on January 1, 1944.[40] It used 50-round belts. The gun was a sturdy weapon, but difficult to manufacture and was in short supply throughout the war.[41] Imports of large numbers of the American .50 caliber machine gun filled the gap. The Soviets produced 45,300 heavy-caliber machine guns during the war besides the 2,200 on hand in June 1941. Of these only 10,000 were lost.[42]

The Russians, like the Germans and British, adopted an antitank rifle firing a round slightly more than 0.50 caliber. The Rukovishnikov design was accepted in 1939, but only 15,000 were made in 1940. The PTRD41, designed by Degtyarev, was adopted in 1941, The weapon was heavy (17.4 kg), long (over 2 m), and required a two-man crew. The muzzle velocity was 1,010 m/s, enough to penetrate the armor on 1941 and 1942 tanks at moderate range, 25mm at 500 meters. Another gun, the PTRS-41, designed by Simonov, used the same 14.5mm ammunition but was semiautomatic, used a five-round clip, and was 3.5 kg heavier. The Red Army used both rifles, though ineffective against the later German tanks, throughout the war. However, they reduced the proportion of antitank rifles in favor of heavier guns.[43] In 1943 the antitank rifle company in the rifle battalion was reduced to a platoon.[44] The Russians produced 471,500 antitank rifles during the war, losing 214,000, mostly from 1942 to 1944.[45]

Soviet small arms production increased rapidly in the 1930s and during the early years of the war. Weapons output leveled off or declined in 1944. Rifle production declined beginning in 1943. The sharp drop came in the third quarter of 1943, and in the first quarter of 1945 production had dropped to an annual rate of only 1.2 million. Although the increase in machine pistol production compensated for the lower rate in 1943, the combined total in 1944 was a million less than 1943. The quarterly rate in the first quarter of 1945 was about half that of 1944 and a third of 1943.[46] Tiushkevich indicated that there were large reserves of rifles in 1944.

Losses in small arms were heavy in 1941, with 5,550,000 rifles and carbines and 189,000 machine guns lost as the Germans overran the Red Army. In 1942 losses were still high: 2,180,000 rifles and carbines and 101,000 machine guns, an indication of the defeat in the south. In 1943, losses of rifles and machine guns remained at over 1 million rifles and 100,000 machine guns. These losses were offset by the end of 1942 with the enormous production. The stock of rifles in June 1941 was 7,740,000 plus 100,000 machine pistols. By January 1, 1943, the stock was up to 5,620,000 rifles and 1,110,000 machine pistols. Compared to 246,000 machine guns in June 1941, the Red Army had 240,000 in January 1943. Production late in 1941 and in 1942 had practically restored the huge losses of small arms.[47]

Several effects can be interpreted from these changes. First, despite the commonly accepted idea that the Germans through their early start had a much larger stock of weapons in 1941, the Soviets were already exceeding German production in 1940. The Russians and their allies had won the personal weapons production war by 1943. As the following table shows, comparable statistics for production of rifles and machine pistols by Germany, Britain, and the United States placed the Russian production in perspective.[48]

ANNUAL PRODUCTION OF RIFLES AND MACHINE PISTOLS

(in thousands)

Year	Germany	United States	Great Britain	Soviet Union
1940	1,272	48	84	1,542
1941	1,224	288	84	1,670

1942	1,644	1,416	2,028	5,600
1943	2,508	5,328	2,472	5,910
1944	3,144	3,840	1,212	3,840
TOTAL	9,792	10,920	5,880	18,562

German production was little more than half of Soviet production alone-American production approached that of the Soviet Union only in 1943 and 1944. British production was less than half the Russian output. The American and British products were superior in finish and tolerances, but not significantly superior in battlefield performance. Given the comparative size of the four economies, the Russians were able to provide as many weapons as needed by the end of 1942.

The Soviet Union, the United States, and Britain cut production of personal weapons in 1944, indicating sufficient reserves for battlefield attrition. The Germans continued to increase production until the end to replace heavy battlefield attrition. Owing to Germany's early start, their production for the five years was only 1 million less than the U.S. and 4 million more than Britain. However, German production was about half the Soviet production. The Germans continued to produce multiple types of machine pistols, and even introduced an entirely new weapon—the M1944 automatic rifle—near the end of the war. The technologically advanced German weapons may have been necessary because of the superior numbers of the Russians, but the German policy was faulty. They lacked German weapons to arm some of their troops during the last three years of the war, so the Germans used captured rifles and machine pistols needing different kinds of ammunition. The nightmare of providing many types of rifle and machine pistol cartridges made an already overburdened supply system even more desperate.

Production of machine guns showed the same pattern. The comparable figures are as follows:[49]

PRODUCTION OF MACHINE GUNS (in thousands)				
Year	**Germany**	**United States**	**Great Britain**	**Soviet Union**
1940	52.8	0.6	30.0	unknown
1941	92.4	18.6	39.6	53.7
1942	85.2	264.0	64.4	221.0.
1943	169.2	297.6	80.4	340.0
1944	290.4	254.4	52.8	268.0
TOTAL	690.0	834.6	267.2	882.7

Again, the Germans were in production earlier than Britain and France and nearly equaled the combined production of the Western Allies in 1944. However, the numbers were far smaller than Soviet production in 1942 and 1943, and exceeded Soviet production only in 1944, when the Russians cut back, The development of the MG42 by Germany was a major improvement reducing the cost of the weapon with stampings instead of machined parts while also improving performance. Production almost doubled in 1943 and nearly doubled again in 1944. However, the question arises: why was the costly MG34 with its machined parts still in production in 1942, when the Russians had developed a simple light machine gun as early as 1928 made primarily of stamped parts? The design could have been adapted to belt feed, as the Russians did in 1944. Machine gun production was another example of Russian adoption of American cost-effective design and mass production, while the Germans continued their tradition of European craftsmanship until 1942.

When the Germans attacked in June 1941, Russian arms production, though substantial, had not been sufficient to

equip all of the new units formed in 1940 and 1941 and the additional reserve units mobilized in the second half of the year. In June 1941, the Red Army had less than 30% of the automatic weapons called for in the tables of organization. Western Front troops had only 60% of the authorized number of rifles.[50] The 34th Cavalry Division had no weapons at all in July, and later did not have enough rifles to equip all of the men.[51]

In the south in June 1941, the rifle divisions of the 5th, 6th, 26th, and 12th Armies had sufficient weapons for the available men. The 17 divisions had from 8,400 to 10,200 men with one exception—the 173rd Rifle Division had only 7,177 men. Only two divisions had more than 10,000 men. The table of organization called for 14,483 men, so all of the divisions were under strength. The divisions had from 7,300 to 11,000 rifles and most had more that 3,200 automatic rifles. Machine pistols were short—only 300 to 400 in most divisions compared to the authorized 1,200. Machine guns were in good supply with 450 to 700 per division compared to the authorized 558.[52] The most serious problem was the many obsolete types of small arms left over from the 1920s, still in the hands of the troops.[53] An example was the machine gun inventory that included the Degtyarev, the Maxim-Tokarev, the Lewis, the 1910 Maxim, and the Colt. The last three dated to World War I.[54]

The defeats of the summer of 1941 led to reduction of the table of organization of the rifle divisions, especially in automatic weapons. The number of machine pistols in the rifle division went from 1,200 to 171, machine guns from 558 to 270. The number of men declined to 10,859. The rifle company had only 6 machine pistols and 6 light machine guns.[35] The howitzer regiment was taken from the rifle division to provide army artillery.

The losses suffered in the first months of the war and the evacuation of the arms industry to the east placed a severe strain on the Red Army. Weapons and munitions production in 1941 declined by 50%; aircraft production declined to 30%; and tank production was only 10 to 20% of prewar figures.[56] In the first five months of the war, aircraft were lost at the rate of 45% per month of existing frontline strength, while new production equaled only 16%. Tanks were lost at the rate of 41 % per month, while production equaled only 18%. The artillery position was better with losses running at 57 %, while production was at 47%. Much of the lost equipment was obsolete or obsolescent, so the remaining stock in December 1941 was of better quality—for example, T34 and KV tanks instead of BT light tanks.[57]

Aircraft production dropped sharply. July production was 1,807, September 2,329, but only 627 were produced in November. Tank production in the second half of 1941 was only 50% of the target—only 6,542 tanks. The supply conference held in September 1941 established a requirement of 1,100 tanks per month. Of the total, the Russians expected to receive 500 per month from the British and Americans, and expected to produce only 600 per month themselves. Steel production dropped from 11.4 million tons in the first half of 1941 to 3.9 million tons in the second half.[58]

The most critical short-term loss that the eastward movement and German advances entailed was ammunition production. By November 1941, Russia lost over 300 munitions plants that had produced 8.5 million artillery shell cases, 3 million mines, and 2 million bombs per month. Chemical plants that had produced explosives were overrun by the Germans. By August 1941 artillery ammunition production began to decline, as shown below:

August	5 million rounds
September	4 million rounds
October	4 million rounds
November	3 million rounds
December	3 million rounds

The total production from July to December was only 26 million rounds, while over 50 million were expended as prewar stocks were exhausted.[59]

By the winter of 1941-42 the logistical support of the army had broken down. Ammunition was severely rationed. The new armies being formed did not have sufficient equipment. Strategic reserves of metal were nearly exhausted and the supply of raw material to the arms industry was unstable. Desperate tank producers were breaking into warehouses and rail cars to steal material. Movement of freight was slowing and total production was dropping.[60] In December 1941, production began to turn around, but had not reached the point where all losses could be replaced.[61]

There was a move to redress the problem of automatic weapons» Small arms production in the second half of 1941 included 90,000 machine pistols and nearly 106,000 machine guns.[62] The two antitank rifles were placed in mass production, but were still scarce though 17,765 had been made by the end of 1941.[63] By January 1942 the manpower situation and hand weapons crisis had turned the corner. The rifle division was increased to 11,626, with 582 machine Pistols and 359 machine guns.[64]

In the first half of 1942 the Russians created 10 reserve armies, but finding the necessary equipment was a severe strain. From December 1941 to May 1942, the Russians manufactured 129,683 guns and mortars, and despite serious setbacks, lost only 108,043. The result was an increase from 22,000 in December 1941 to 43,640 guns and mortars in May 1942. The new guns included a modernized version of the 45mm antitank guns and the improved ZIS-3 76mm gun. The number of guns 76mm or greater doubled from 1941 to 1942, from 15,856 to 33,111. Production of 82mm and 120mm mortars increased more than five times.[63]

From May to November 1942, production made enormous strides—182,433 guns and mortars. The heavy losses of the summer reduced the stock by 153,753, but because of increased production, the inventory increased from 43,640 to 72,500, the greatest increase for any period in the war achieved during the period of the greatest losses.[66] In the second half of 1942, rifle and carbine production increased to 1,943,000, machine pistols to 524,000, antitank rifles to 114,370, and machine guns to 150,000. These were greater numbers than had been produced in the six months before the war.[67]

Most of the gains came at the end of 1942, however. Sending weapons to the troops in the south to replace losses was hampered because of the limited rail capacity. When the Nazis drove into the Caucasus, sweeping aside the Russian defenders, the Soviets had to employ the reserve armies before they were ready and armed with whatever weapons were at hand. On August 27, 1942, the Stavka sent the 1st Guard, 24th, and 66th Armies to defend Stalingrad. The armies were poorly equipped, manned by old reservists and short of fuel and ammunition.[68] In the 9th Army in August 1942 defending the Caucasus, the recently formed 417th Rifle Division had only 500 rifles. The 151st Rifle Division of the same army equipped half of its men with foreign rifles. Only 30% of the men of one infantry brigade were armed with foreign rifles, and there were no machine guns or artillery.[69]

By the end of 1942, the supply of weapons for the Red Army had improved. As the following table shows, the inventory of heavy weapons on hand had increased dramatically compared to the year before.[70]

Weapons	December 1941	November 1942
Guns and mortars	22,000	77,851
Tanks	1,954	7,350
Combat aircraft	2,238	4,544

These totals exceeded the number of weapons in the hands of the Germans and their satellite forces on the Russian front in November 1942. The Soviet rifle division in December 1942 had a table of organization of 9,435 men, 727 machine pistols, 605 machine guns, and 212 antitank rifles. With about two-thirds of the number of men, the division had more machine guns than the prewar division. The rifle company had 12 machine pistols and 12 light machine guns, double the number in December 1941. The supply of antitank rifles was ample. The Russians were winning the production battle by the end of 1942.[71]

In the next six months Russian production came into full swing. Between November 1942 and July 1943, the Russians produced 175,067 guns and mortars but lost 148,177 in the costly defeats in the Ukraine. Still, the total on hand grew from 72,500 in November 1942 to 98,790 in July 1943, the greatest number of guns and mortars on hand during the war. Subsequent reductions in production leveled the supply at 90,000. Tank production in the same period reached 15,708 and imports were 2,413 for a total of 18,121, increasing the number in the field armies on the front to 9,580 in July 1943, with more in the supply line and depots.[72] Small arms production also increased sharply. By June 1943 the allotment of machine pistols to the rifle division increased to 1,500 and machine guns to 666. The rifle company then had 35 machine pistols, 18 light machine guns, and one heavy machine gun. Some divisions had more than the authorized number. The 112th Guard Rifle Regiment in July 1943 had 745 machine pistols, compared to the authorized 450. The 5th Company of the 574th Rifle Regiment had 70 machine pistols instead of the authorized 35. These were only two of the many examples of supplies of automatic weapons exceeding the established number.[73]

During 1943 the Russians produced 3.4 million rifles and carbines, 2.4 machine pistols and machine guns, 130,000 guns, mortars, and rocket launchers, and 82 million shells. The production battle had been won, and there were to be no shortages of weapons in the future.[74]

In 1944 the supply of small arms to the Red Army was ample and production was reduced. In the armies of the Southern Front in 1944, the average of the five armies was about 45,000 combat troops, 25,000 rifles, 10,000 machine pistols, 2,400 machine guns, and 800 antitank rifles. The machine pistols and the machine guns were concentrated in the rifle companies, where most men were using automatic weapons.[75] The plentiful supply of machine pistols was extended to the support troops. In March 1944 the 615th Howitzer Regiment had 412 rifles and carbines, 62 pistols, 153 machine pistols, 1 light machine gun, and 1 antiaircraft machine gun in addition to 28 122mm howitzers.[76]

Production of tanks and SUs leveled at about 24,000 per year in 1944, roughly equal to battlefield losses. The production of guns and mortars was about equal to battlefield losses as well, about 126,000. The inventory of guns and mortars increased from 88,900 in January 1944 to 91,400 in January 1945.[77] During 1944 the Russians upgraded the quality of weapons in the rifle division. The supply of 57mm guns improved and, although the shortage did not end, the 45mm antitank guns in the divisional antitank battalion were being replaced by 57mm guns. The 50mm mortar was replaced by the 82mm mortars in the rifle divisions.[78] The new M1944 100mm antitank gun replaced the 57mm gun in the tank destroyer brigades and the 76mm gun in other units.[79]

Small arms production was greater than losses, though production had been reduced. In 1945 the number of machine pistols in the rifle division increased from 727 in 1942 to 3,557 in 1945. The number of machine guns was reduced from 605 to 561 and antitank rifles from 212 to 11,[80] By 1945 the supply of weapons exceeded need. Whenever a unit was short a weapon, the unit was probably short the men to carry it or a better weapon had been substituted. In January 1945 the 3rd Guard Tank Army had 21,000 rifles versus an authorized 25,600, probably indicating a shortage of riflemen. The 9th Mechanized Corps was short 1,500 rifles, while there were nearly 2,000 rifles stored in the army depots. The army had 16,900 machine pistols, greater than the authorized 15,600. The 9th Mechanized Corps had an extra 830 men armed with machine pistols. The commander of the 9th Mechanized Corps was probably short about 700 men and had elected to arm 800 riflemen with machine pistols. The 3rd Guard Tank Army had more than the authorized quantity of light machine guns, heavy machine guns, and antiaircraft machine guns. The army was short of antitank rifles, but this weapon had outlived its usefulness. The army was short 35 57mm antitank guns, but had a surplus of 61 76mm antitank guns. The army was also short 13 SU57s, but these American imports were no longer in production. The army was short one SU in each of the three SU regiments. In all of the other categories the army was either at strength or had surplus weapons.[81] As the following table shows, the Soviets had won the battle of

production.

TOTAL WEAPONS PRODUCED FROM 1941 TO 1945 (in thousands)		
Weapons	**Soviet Union**	**Germany**
Mortars	347.9	68.0
Guns	188.1	102.1
Tanks and SUs	95.1	53.8
Military aircraft	108.0	78.9
Motor vehicles and tractors	205.0	375.0

At the end of the war, the Soviet Union had 11 million men in the armed forces, including 6 million in the army. There were about 6.5 million men on the German front. The Red Army had 91,400 guns and mortars, 2,933 rocket launchers, 11,000 tanks and SUs, and 14,500 military aircraft. The Poles, Czechs, and other allies had 326,500 men, 5,200 guns, and 200 tanks on the Eastern Front. In comparison, the Germans on the Eastern Front had only 3.1 million men, 28,500 guns and mortars, 4,000 tanks and self-propelled guns, and 2,000 aircraft.[82] Only in production of motor vehicles did the Germans exceed Soviet levels. The import of American vehicles substituted for Russian production.

In summary, at the beginning of the war, the Red Army had a vast arsenal of weapons, although some were obsolete. In the first three or four months of the war, the Soviets lost or consumed most of their prewar stocks of weapons and munitions. Simultaneously, production was severely disrupted by occupation of the western territory, where much of the military productive capacity had been located. Weapons production became the first priority in late 1941 and continued so through 1943. Losses continued at a heavy rate, but by early 1942 production exceeded losses in all categories, and quantities available increased steadily with the exception of six months of heavy losses in armored vehicles to the second half of 1943. By early 1943 the Red Army had a clear superiority in weapons that increased as the war progressed.[83] The Soviet Union, with an economy severely disrupted by occupation of its most productive land —analogous to occupation of the United States east of the Mississippi—was able to outproduce Germany. This productive capacity was a major cause of Germany's defeat.

NOTES

1. Stolfi, pp. 169-70.

2. Harrison, p. 109.

3. Mueller-Hillebrand, II, p. 274.

4. Harrison, p. 118.

5. Fugate, p. 32.

6. Harrison, p. 148.

7. Milward, *War*, p. 59.

8. Sutton, II, p. 244.

9. Milward, *War,* p. 182.

10. Harrison, p. 161; Milward, *War,* p. 186.

11. Vladimir Kotelnikov, "The Role of Soviet Science in the Great Patriotic War," in Grechko, *Soviet Studies,* p. 156.

12. Milward, *War,* p. 186.

13. Milward, *War,* pp. 184-85.

14. Sutton, I, p. 266, quoting a report to U.S. military intelligence in 1929. 15. Tiushkevich, pp. 186-87; Sutton, II, pp. 244-45.

16. FHO, CGR, H3/1711, Roll 588, Frames 285-86.

17. Ian Hogg and John Weeks, *Military Small Arms of the Twentieth Century* (Northfield, IL: Digest Books, 1973), pp. 1.32-34; Garret Underhill, "The Red Army's Small Arms," *The Infantry Journal,* 56 (May 1945), p. 48; Frank C. Barnes, *Cartridges of the World* (Northfield, IL: Digest Books, Inc., 1972),p. 151.

18. Bolotin, pp. 47-48; Krivosheev, pp. 351-52; sources vary, the total column has the latest figures in Krivosheev.

19. Underhill, p. 45; Barnes, p. 188.

20. D. N. Bolotin, *Sovetskoe Strelkovoe Oruzie* (Moscow: Voennoe Izdatelistvo, 1990), p. 45; Hogg and Weeks, pp. 3.34-36; Tiushkevich, p. 341; Underhill, p. 44.

21. Hogg and Weeks, pp. 3.34-36; Tiushkevich, p. 341; Bolotin, pp. 52-55.

22. Hogg and Weeks, pp. 4.31-33; Tiushkevich, p. 227; Underhill, pp. 45-46.

23. Bolotin, p. 27.

24. N. N. Voronov, *Na Sluzhbe Voyennoy* (Moscow: Izdatelistvo, 1963), excerpt in Bialer, p. 132.

25. Bolotin, pp. 132-38; Underhill, p. 47.

26. Bolotin, pp. 13.2-38; Underhill, p. 47.

27. Bolotin, pp 141-143; Underhill, p.47.

28. Bolotin, pp. 144-50.

29. Harrison, p. 250.

30. Bolotin, pp. 144-51; Hogg and Weeks, pp. 2.39-40; Tiushkevich, p. 227; Liddell-Hart, pp. 286-88; Underhill, p. 47.

31. Bolotin, pp. 153-64; Hogg and Weeks, p. 2.42.

32. Bolotin, pp. 181-82; Hogg and Weeks, p. 5.47; Sutton, II, p. 244.

33. Underhill, p. 49.

34. Bolotin, p. 217.

35. Bolotin, pp. 214-17; Underhill, p. 49.

36. Hogg and Weeks, p. 5.47; Sutton, II, p. 244; Bolotin, pp. 220-25; Underhill, p. 49.

37. Harrison, p. 250; Krivosheev, pp. 351-52, gives 221,000 for 1942 and 340,000 for 1943.

38. Tiushkevich, p. 341; Hogg and Weeks, p. 5.46; Bolotin, pp. 183-84; Underhill, p. 48.

39. Tiushkevich, p. 341; Hogg and Weeks, p. 5.46| Bolotin, pp. 183-84; Underhill, p. 48.

40. Bolotin, pp. 235-42; Hogg and Weeks, p. 5.48.

41. Hogg and Weeks, pp. 5.46-47; Tiushkevich, p. 227; Underhill, p. 49.

42. Krivosheev, pp. 350-51.

43. Hogg and Weeks, pp. 6.04-05; Tiushkevich, p. 227; Underhill, p. 48.,

44. FHO, CGR, H 3/65, February 12, 1945, Roll 460, Frame 6438526.

45. Krivosheev, pp. 350-51.

46. Harrison, p. 250.

47. Krivosheev, pp. 351-52.

48. Dunn, p. 255; Krivosheev, pp 351-52.

49. Dunn, p. 255; Krivosheev, pp. 351-52.

50. Harrison E. Salisbury, *The 900 Days The Siege of Leningrad* (New York: Avon Books, 1970), pp. 75, 101.

51. Salisbury, p. 76.

52. A. A. Gurov, "Boyeviye Deystviya Sovetskikh Voysk no Yugo-Zapadnom Napravlenii v Nachaliom Periode Voyny," *VlZh* 8 (August 1988), p. 33; I. G. Pavlovskii, *Sukhoputniye Voyska SSSR* (Moscow: Voyenizdat, 1985), p. 109.

53. Tiushkevich, p. 268.

54. FHO, CGR, H 3/82, December 1, 1941, Roll 550, Frame 387.

55. Pavlovskii, p. 109; FHO, CGR, H 3/104, September 20, 1943, Roll 551, Frame 251.

56. FHO, CGR, H 3/468.1, May 7, 1942, Roll 564, Frame 844.

57. Harrison, pp. 91-92.

58. Erickson, *Stalingrad,* pp. 232-33; Zaloga and Grandsen» p. 128.

59. Erickson, *Stalingrad,* p. 233.

60. Harrison, p. 92.

61. Harrison, p. 91.

62. Tiushkevich, p. 268.

63. Tiushkevich, pp. 268-69.

64. Pavlovskii, p. 109.

65. Tiushkevich, p. 269.

66. Harrison, p. 264.

67. Konstantin K. Rokossovsky, *Velikaia Pobdea Na Volga* (Moscow: Voennoe Izdatelistvo, 1965), pp. 11, 212.

68. Erickson, *Stalingrad*, p. 384.

69. Shtemenko, *General Staff*, p. 59.

70. Tiushkevich, p. 272.

71. FHO, CGR, H 3/104, September 20, 1943, Roll 551, Frame 251; Pavlovskii, p. 109.

72. Harrison, p. 264. 73. FHO, CGR, H 3/104, September 20, 1943, Roll 551, Frames 251-52.

74. Skorobogatkin, p. 322.

75. Gurov, p. 35.

76. FHO, CGR, H 3/69, March 11, 1944, Roll 549, Frame 84.

77. Harrison, p. 264.

78. FHO, CGR, H 3/65, February 12, 1945, Roll 460, Frames 6438526-27.

79. Tiushkevich, p. 342.

80. Pavlovskii, p. 109.

81. FHO, CGR, H 3/73, January 28, 1945, Roll 549, Frames 594. 82.. *VOVE*, pp. 460-61; Skorobogatkin, p. 457. 83. Harrison, pp. 113-15.

6 Tanks and Mechanized Artillery

Russia's top priority in 1941 was to replace the thousands of tanks lost in the first months of the war. Given the disruption of Soviet tank production in 1941 and the need for great numbers of tanks, the Russians concentrated on building four types: the T34, the KV, the T60, and the T70. To increase production, using unskilled labor, the Soviets simplified the design of tanks and prohibited any unnecessary variations or improvements. The Soviets made changes only to reduce the cost of manufacture, either in man-hours or in material, or to make major essential improvements in the gun, armor, or engine. Soviet tanks appeared rough and poorly made, but important parts were finished to a high standard. The ideal design was one that was just good enough; anything better was wasted effort. The outstanding characteristic of Soviet tanks was simplicity, making them easy to manufacture, operate, and maintain.[1]

Russia entered the war with a large stock of obsolescent tanks. One Published breakdown in types was 500 heavy tanks (KVs), 900 medium tanks (T34s), and 21,200 light tanks, which included 11,000 BTs and 6,000 T26s.[2] Another Soviet source gave the total of modern heavy and medium tanks as 1,861, including T34s and KVs, both of which were better than any German tank. The 11,000 BTs and T26s were better than the German MK II, but the remaining 5,000 were of little value.[3] The Germans destroyed or captured more than 20,000 Russian tanks in 1941.

Production after early 1941 had concentrated on the T34 and the KV to the exclusion of other mediums and heavies. New production concentrated on the T60, the T70, the T34, and the KV. Production of the T60 light tank began in July 1941. The disruption caused by the German advance reduced the monthly output from 2,000 in June 1941 to 1,400 in September 1941. However, the new tanks were T-34s from Stalingrad and T-60s from Gorki and Kirov. Tank production from June 22 to December 31, 1941, was only 5,600, half of which were light tanks.[4]

The two light tanks manufactured in 1941 and 1942 were the T60 and T70. The T60 weighed 6.4 tons, had a crew of two, carried a 20mm gun and 15 to 35mm of armor, and had a speed of 45 km per hour.[5] The T70 was an improved T60 with a 45mm gun and armor of 15 to 45mm, and weighed 9.8 tons. The Soviets stopped production of light tanks in 1943 and turned the manufacturing facilities to the production of SU76s.

The Russians used the T34 medium tank with improvements throughout the war. It weighed 30.9 tons, carried a 76mm gun, and had a crew of four, a speed of 55 km per hour, and armor from 45 to 52mm. The M1939 76mm gun was a high-velocity piece, with a 30.5-caliber barrel, compared to the short 24-caliber 75mm gun on the German Panzer IV in 1941.[6] The bad points of the early T34 were the two-man turret requiring the tank commander to be the gunner, poor vision for the commander, discomfort for the crew, problems with the transmission, and a short track life.[7]

Later models of the T34 had the M1940 76mm gun with a 41.5-caliber barrel, giving it higher velocity, and a larger turret. In 1943 the Russians modified the T34 by replacing the 76mm gun with the M1939 85mm antiaircraft gun, producing the T34/85. The weight increased to 32 tons, the crew to five, and the armor to 90mm, but the speed remained at 55 km per hour.[8] The Russians stressed the heavy projectile approach instead of high velocity. The 85mm gun had a heavier projectile than the 75mm gun used on the German Panther, but the latter was able to penetrate thicker armor at longer ranges.[9]

The heavy tank in July 1941 was the KV 1 weighing 47.5 tons, with a crew of five, an M1940 41.5-caliber 76mm gun, 75 to 100mm of armor, and a speed of 35 km per hour. The KV 2 had a 152mm howitzer for use in destroying bunkers. The Russians made only a few of the KV 2s because the tank was difficult to manufacture and there was a limited need for the heavy projectile.[10] Needed was a lighter version of the KV to attain a better balance between engine power and weight that would give greater speed. The KV 1S entered production in August 1942, and by April 1943 the Soviets had built 1,370 for the heavy tank regiments .[11]

In October 1943 a further development of the KV was the KV 85, equipped with the 85mm antiaircraft gun. Production of the JS-1 heavy tank armed with a 122mm gun to replace the KVs began in December 1943. The JS-2 weighed 46 tons and had a crew of four, a 122mm gun, 90 to 120mm of armor, and a speed of 37 km per hour. In 1945 the JS-3 appeared, weighing 47 tons with a speed of 40 km per hour. The Guard heavy tank units received JS tanks in early 1944. The purpose of the heavy tank was to destroy German tanks and antitank guns at long range from positions behind the T34s. At Korsun, the 11th Guard Heavy Tank Brigade successfully engaged the German 503rd Heavy Panzer Battalion equipped with Tigers. The 122mm guns on the JS tanks outranged the German 88mm guns.[12]

SOVIET TANK PRODUCTION BY TYPE (in thousands)[13]

Year	Tanks	Heavy	Medium	Light	Total
2/2 1941	On hand	0.5	0.9	21.2	22.6
	Produced	1.0	2.2	2.4	5.6
	Lost	0.9	2.3	17.3	20.5
1942	On hand	0.6	0.8	6.3	7.7
	Produced	2.6	13.4	11.9	27.9
	Lost	1.2	6.6	7.2	15.0
	On hand	2.0	7.6	11.0	20.6

1943	Produced	0.9	16.3	5.7	22.9
	Lost	1.3	14.7	6.4	22.4
1944	On hand	1.6	9.2	10.3	21.1
	Produced	4.0	17.0	0.2	21.2
	Lost	0.9	13.8	2.3	16.9
1945	On hand	4.7	12.4	8.2	25.4
	Produced	1.5	6.1	0.9	8.5
	Lost	0.9	7.5	0.3	8.7
TOTAL WAR	Produced	10.0	55.0	21.0	86.1
	Lost	5.2	44.9	33.4	83.5
	On Hand	5.3	11.0	8.8	25.2

The Soviets produced 28,000 tanks and SUs in 1942 and 34,700 tanks and SUs in 1944, over 2,000 per month in 1942 and nearly 3,000 per month in 1944. A comparison of Soviet totals and German estimates is contained in the following table:[14]

SOVIET TANK AND SU PRODUCTION AND LOSSES				
Year	**German Estimates**		**Soviet Figures**	
	Production	**Losses**	**Production**	**Losses**
2/2 1941	4,900	21,000	5,600	20,500
1942	14,400	16,197	28,000	15,100
1943	20,250	17,333	27,300	23,500
1944	25,500	19,050	34,700	23,700
1945	23,450	N/A	13,500	13,700
TOTAL	N/A	N/A	109.100	96,500

The Germans based their estimates of Soviet tank production on captured documents and prisoner of war statements. Prisoner statements were not as reliable in production estimates as in more specific areas, such as the identification of their unit. A production worker would not know annual production, although he might have known the daily rate. In developing their estimates, the Germans considerably reduced the numbers given by prisoners, placing the Sverdlovsk production at 200 monthly instead of 1,200, Chelyabinsk at 100 to 200 instead of 540, and Omsk at 200 instead of 600. The Soviet totals on hand were higher than the German estimates. The German estimate of a stock of 6,835 was well below the Soviet number of 20,600 available to the Soviets on January 1, 1943. In June 1943, the Germans estimated a possible 12,500 including 7,050 in known units, 4,000 in unlocated units, and about 1,500 not in units--far below the actual number of over 22,000.[15] The Germans estimated the Soviet stock at 13,581 versus the Soviet number of 25,400 in January 1945. Thus the Germans seriously underestimated the Soviet production and losses in the last two years of the war.

Although the total number of tanks on hand at the beginning of the war and at the end were similar (25,200 in 1941 and 25,200 at the end), the relative proportion of light, medium, and heavy had shifted towards the heavier tanks. In June 1941 there were 21,200 light tanks and only 1,400 medium and heavy tanks. In May 1945 there were 16,300 medium and heavy tanks and only 8,800 light tanks. The totals produced by type according to Soviet figures were as

follows:[16]

Light Tanks	14,508
T34	35,119
T34/85	29,430
KV and KV85	4,581
JS	3,854
TOTAL TANKS	87,492
SU76	12,671
SU85	2,050
SU100	1,675
SU122	1,148
SU152	4,779
TOTAL SUs	22,323
TOTAL SUs AND TANKS	109,815

Various Soviet sources do not agree in detail, but the totals are close. The Germans had few sources of information beyond the Eastern Front. The German estimate of the distribution of Soviet tanks on October 31, 1944, was as follows:[17]

At the front	3,160
In reserve	2,060
In the rear area	2,880
Unlocated units	4,370
Far East, Iran, Caucasus	930
Replacement units, repair, and in transit	4,800
TOTAL	18,200

The Soviet figures for total tanks on hand on January 1, 1945, was 25,400.[18] The FHO made similar estimates for other months, usually placing about 1,000 in the Far East, Iran, and the Caucasus; 2,800 in transit to the front; 1,000 in training units; and from 8,000 to 12,000 in units at the front, in, reserve, or not located.[19] The Germans underestimated the extent of Soviet losses and the Soviet ability to repair damaged or worn tanks. The Soviets deliberately underestimated the totals for tank production and losses before 1993 for political reasons.

The SU—the self-propelled gun or mechanized artillery—served as an infantry support weapon like the tank, or as an antitank weapon. Although the towed antitank gun was a powerful asset to the defense and useful in offense, it was clumsy to handle. Hooking the gun to its towing vehicle, moving it forward over rough terrain, unhooking, and bringing the gun into position made it less than ideal during offensive operations. The most effective form of tank destroyer was the self-propelled gun. The Russians formed nearly equal numbers of regiments of towed and self-propelled guns. Both types of regiments had multiple roles, fighting tanks and supporting the infantry either with direct: or indirect fire. The Soviets referred to the self-propelled guns as SUs. The term "mechanized artillery" is a

closer translation of the Russian than most terms used to describe artillery pieces mounted on vehicles. The terms "mechanized artillery," "SU," and "self-propelled artillery" are used interchangeably.

The United States halted creation of self-propelled tank destroyer battalions in 1944 and subsequently disbanded existing units, presumably because of lack of need. There were few attacks by masses of German tanks, thanks to the ever-present P-47s of the tactical air force. The difference between the Western and Eastern Fronts was Allied air superiority. The fighter bombers made exposing German armor in large numbers by day too costly, except during periods of bad weather that grounded the fighters. The Russians did not have complete air superiority. German tank commanders from the Eastern Front commented on the adjustment in tactics when moving to the west. In the east, German tank-supported counterattacks were a constant menace, requiring heavy investment by the Soviets in both towed and self-propelled tank destroyers. The; Red Army formed more self-propelled artillery units than any other army in World War II.

The Germans had two types of mechanized artillery, neither with turrets. The *Sturmgeschütz,* or assault gun, was well armored, including the top, but had no turret. The assault gun was used like a tank, including infantry support and antitank defense. The *selbsfahr-lafette,* like the American self-propelled artillery, had an open top, no turret, and light armor.[20] These vehicles delivered indirect fire in support of panzer divisions. None of the Russian SUs had turrets. The Russian SU76 was opened topped, lightly armored, and based on a light tank chassis. Other Russian types had heavy armor and closed tops. All functioned as assault guns, mobile antitank guns, and substitute tanks.

The need for a mobile, lightweight, low-velocity, large-caliber gun emerged from the German assault tactics developed at the end of World War I. The gun was needed to knock out bunkers and machine gun nests to ease the advance of the infantry. The original solution was the regimental infantry gun incorporated into the cannon company of the infantry regiment of the German Army in the 1930s. The U.S. and Russia copied the idea, the latter adopting a low-velocity 76mm regimental gun.

The Red Army recognized the need for mechanized artillery in the 1930s, and a variety of low-velocity guns were mounted on light tank chassis. The SU5-1, developed in 1935 using a T26 tank chassis, carried a 76mm M1902/30 divisional gun. The SU5-2 carried a 122mm M1910/30 howitzer, and the SU5-3 carried a 152mm M1931 Howitzer.[21] None of these weapons went into large-scale production. To supplement antitank defense, the Russians developed the SU ZIS-30 with a 57mm antitank gun. The few used at Moscow in August 1941 were not very successful.[22]

The Russians realized the need for a mobile 76mm gun, both as an infantry support gun and as a tank destroyer. The answer was the SU76, a 76mm gun on a light tank chassis. The 76mm gun outranged the German 50mm antitank gun and was equal to the 75mm antitank gun. The idea of the SU76 was that it would engage targets (antitank guns, machine guns, and tanks) at distances beyond the effective range of its targets. The SU76 was best at providing escort artillery fire. It was not successful in the tank role: the open top invited grenades and machine-gun fire; the armor was thin, and the SU had no machine gun. Therefore, it could not drive infantry from trenches without riflemen for protection. However, the gun could destroy bunkers and machine gun nests, making the job of the infantry easier. In the escort role, the SU was especially useful in breaking through the German antitank gun line.

In July 1942, the Russians had developed three prototypes: the SU76 (a 76mm gun on a T60 or T70 chassis), the SU122 (a 122mm howitzer on the chassis of a captured German Mk III), and the AA SU37 (a 37mm antiaircraft gun on a T60 chassis).[23] The Germans unveiled the Tiger in November 1942, identified in January 1943 by the 86th Tank Brigade at Leningrad.[24] The Soviets needed a heavy self-propelled tank destroyer to cope with the Tiger. The Russians had already decided on December 9, 1942, to produce the SU76, the AA SU37, and the SU 122 (using a T34 chassis instead of the Mk III). But the mixture of the SU76 and the SU122 in the same regiment was a failure.[25] The two chassis moved over rough terrain at different speeds, and the guns were not appropriate for the same targets.

Most of the SU regiments were attached to tank and mechanized corps, but some were attached to the infantry. The Russians used SUs in four ways: to Provide direct support for tank attacks; to establish an antitank gun line behind tanks; to attack strong points, machine gun nests, antitank guns, and tanks; and to provide indirect fire for the infantry in defense.[26]

Based on the Kursk experience, production of SUs increased in the second half of 1943. The Russians concentrated on a few types of SUs, making thousands of SU76s by the end of the war with slight modifications. Of the 21,000 SUs manufactured, 59% were light SUs armed with the 76mm gun; 21.5% were mediums with 85mm guns, 100mm guns, and 122mm howitzers; and 19.5% were heavy with 122mm and 152mm guns.[27]

The Germans underestimated the number of Russian SUs. Based on Soviet sources, the following table presents the production and losses during the war.[28]

Year	Number at Beginning	Production	Total	Losses
1942	0	100	100	100
1943	0	4,400	4,400	1,100
1944	3,300	13,600	16,900	6,800
1945	10,100	5,000	15,100	5,000
TOTAL	0	23,100	23,100	13,000

The number of crews trained compared closely to production figures (see below) compiled from a variety of sources that confirm the official figures listed above. The excess crews in 1945 were probably trained for the Manchurian operation.[29]

Year	Annual Production	SU Crews Trained
1942	100	
1943	4,000	4,355
1944	11,958	13,032
1945	6,267	10,115
TOTAL	22,275	27,503

SU76 production began in December 1942 in the factories at Gorki and Kirov that had previously produced the T70 light tank. The SU76 used the T70 chassis and was easy to manufacture. Production of the T70 continued for a time, then halted to devote all the capacity to the SU76.[30] The SU76 mounted the comparatively high-velocity gun used as the divisional artillery piece, making it satisfactory for all three roles: infantry support, antitank defense, and indirect fire. An improved model, the SU76M, was produced in May 1943.[3I]

The Soviets developed the SU122 with the 122mm M1938 M30 howitzer in late 1942 using the T34 chassis. The howitzer had a muzzle velocity of 500 m/s, but the heavy weight of the 21.7 kg shell quickly reduced the velocity and its ability to penetrate armor. The gun was a poor antitank weapon except at short ranges.[32] Unless a projectile had a high velocity at the point of impact, it could not penetrate the armor. However, a heavy projectile had the total energy to blow a turret off a tank.

In 1943, the SU85 and an SU 152 were developed to counter the German Tiger tanks. Production of the SU 152 began in March 1943 using an ML-20 (Model 1937) 152mm gun-howitzer on a KV 1S chassis.[33] The ML-20 fired a 43.6 kg shell with a muzzle velocity of 655 m/s. At short range the projectile delivered a powerful blow to even the heaviest tank.[34] However, the JS chassis replaced the KV in 1943, and few of the SU152s were made.[35]

The SU85 tank destroyer developed late in 1943 mounting a D-5S antiaircraft gun on a T34 chassis. The gun had a

muzzle velocity of 880 m/s and the high velocity held for a greater distance because of the lighter weight of the shell. The 85mm gun performed much better in penetrating armor at long range than did the 122mm howitzer.[36] Beginning in August 1943, the SU85 regiments had four batteries, each with four SU85s.[37] The 1438th Mechanized Artillery Regiment equipped with SU 122s suffered heavy losses at Kharkov and was sent to Pravda, near Moscow, in late 1943. There the regiment reequipped with 16 SU85s plus a T34 command tank.[38]

The Russians formed seven light mechanized artillery brigades in late 1943 equipped with the SU57, an American T48 half-track mounting an American M2 57mm antitank gun. In 1942 the U.S. Army mounted the American version of the British 6-pounder antitank gun (the M1 57mm gun) on the basic M3 halftrack. The M1 gun had a muzzle velocity of 2,720 fps (900 m/s). The lightweight shell, (6.25 pounds, 2.8 kg) would retain this velocity for a considerable distance.[39] The German analysis rated the M2 57mm gun with a muzzle velocity of 830 m/s, effective at 800 m and able to penetrate 70mm of armor at 300 m.[40] The front armor on the Mk IV was 85mm and the side armor on the Panther was only 50mm and the Tiger 80mm, so the 57mm gun was still useful at close range. Mounting the gun on a half-track gave it the mobility to find a desirable hull-down position.[41]

The U.S. Army abandoned the half-track as a tank destroyer after the tragic experience in Tunisia, resulting from inexperienced tank destroyer commanders charging German tanks over open ground. The United States believed that the 57mm gun was too small to deal with German tanks, except at close range as a towed battalion antitank gun. The United States had ample supplies of M10 fully tracked, turreted tank destroyers with 90mm guns. They offered the T48s to the Russians under lend-lease. Based on a study of the battery numbers and the serial numbers, the Germans estimated that the Russians received 600 by September 1944. The U.S. sent 650, the total remaining stock in the United States.[42]

Captured German tanks were converted into light SUs. The Russians converted captured German Mk III and T38 chassis into SU 76Is at Zavod no. 38. Over 1,200 of the chassis were rebuilt as fully armored self-propelled 76mm guns and used both as tanks and as SUs.[43] The 1202th Mechanized Artillery Regiment was formed at Jeno near Moscow on January 13, 1945, and equipped with 21 SU76is. After enduring losses, the regiment received seven replacements, showing the continued availability of the type.[44] The 438th Mechanized Artillery Regiment formed in 1944 at Tarjan and received rebuilt German assault guns. Later it received SU85s made at Sverdlovsk.[45] Use of the SU76is in 1944 and early 1945 may have reflected a temporary shortage of SUs as the number of regiments rapidly expanded.

The Russians halted production of the original SU 122 with the howitzer in November 1943.[46] Production of the SU85 stopped in June 1944 because the same gun was then available on the fully armored T34/85.[47] The increasing number of Panthers and Tigers in 1944 led to the development of more powerful guns. The new SUs were designed primarily as antitank weapons, the other roles being left to the SU76s that continued to come off the assembly lines in increasing numbers.

In 1944 a 100mm antitank gun was mounted on a T34 chassis to make the SU100.[48] The SU100 used a D-10S (antiaircraft designation) or BS-3 (antitank gun) 100mm gun on a T34 chassis. The BS-3 had a muzzle velocity of 900 m/s, greater than the 85mm, and fired a 15.6 kg shell, much heavier than the 85mm that it replaced in the medium self-propelled tank destroyer battalions. The 100mm gun pierced 150 armor at 1,000 meters, sufficient to destroy any German tank at a range beyond the reach of the German tank gun.[49] The production of the SU 100 was under way at Sverdlovsk in September 1944. Guard mechanized artillery brigades were formed in December 1944 equipped with 65 SU 100s.[50]

A new JSU122 using an A-19 Model 31/37 122mm gun on a JS chassis was also developed in 1944. Production began in 1944 at Chelyabinsk. The A-19 gun was far more powerful than the howitzer used on the SU 122 in 1942 and 1943. The A-19 gun had a muzzle velocity of 800 m/s compared to only 515 m/s for the howitzer. The shell was also heavier (25 kg compared to 21.8 kg). The range of 122mm gun was 20.4 km versus 11.8 km for the howitzer.[51] Later models designated as the SU249 used an even more powerful gun, the D-25C, the same gun used on the JS tank. Production

began at Chelyabinsk with eight made in August and seven in September 1944.[52]

The JSU 152 was developed with the M1937 ML-20 gun-howitzer similar , to the SU 152 but mounted on a JS chassis. The same gun was merely transferred to an improved chassis; the characteristics of the gun remained the same. The change was made necessary by the termination of KV chassis production at Chelyabinsk.[53] The JSU 152 and JSU 122 were used by the heavy mechanized artillery regiments until the end of the war and in a heavy SU brigade formed in December 1944. The heavy brigade had 65 JSU152s, 3 SU76s, and 1,804 men.[54]

The Germans estimated monthly production of SUs in 1944 at 100 SU76s at the Kirov plant, 100 SU76s at Gorki, 200 SU85s or SU 100s at Sverdlovsk, and 100 SU152s at Chelyabinsk for a total of 500 per month.[55] The Germans estimated that 4,100 SUs were made by April 1944; the Soviets stated that 4,050 were made by January 1944.[56] Total production in 1944 was 16,900 and monthly production was 1,400. By January 1945, the Red Army had 10,100 SUs.

The Germans determined the approximate level of SU76 production at Gorki and Kirov by a study of the serial numbers of destroyed vehicles. Because of the small number destroyed at the front, the Germans believed correctly that the large number produced were used to form additional regiments to make the antitank gun line behind advancing Red Army units even more deadly.[57] The production of SUs exceeded losses and made possible the expansion of the number of mechanized or self-propelled artillery units.[58] A German study in July 1944 revealed that of 360 tanks and SUs destroyed in that month, 73% were T34s and KV 1s, and only 6% were SUs. Of the remaining, 15% were obsolete tanks and 6% were miscellaneous types. The destruction ratio was at least 12 tanks to 1 SU, whereas production in 1944 was only 4 tanks to 3 SUs.[59]

The supply of SUs was so plentiful that battalions were assigned to some rifle divisions. The 252nd Rifle Division received the 110th SU Battalion, and the 62nd Guard Rifle Division received the 69th SU Battalion, apparently new formations added to the divisions.[60] By the end of the war, 70 mechanized artillery battalions had been formed.[61] The Germans attributed the replacement of antitank guns with SUs to increased production of the SU76, then estimated at 500 per month. The SU probably fired more rounds than a tank because of its multiplicity of roles. The lack of a turret meant there was ample room for a large supply of shells and space for the gunners and loaders to work quickly (see table below). The number of rounds carried with the mechanized artillery guns was nearly identical for the same gun in a towed battalion.[62]

SU76	60 Rounds
SU85	48 Rounds
SU 100	34 Rounds
JSU122	30 Rounds
JSU152	20 Rounds

There was a steady increase in non-tank armored strength in 1944 and 1945. In the White Russian operation, there were 1,548 SUsj in East Prussia, 1,654; in the Vistula Oder operation, 2,479; and in Berlin, 2,701.[63] By March 28, 1945, the Germans had identified 243 mechanized artillery regiments, including 49 with SU76s, 36 with SU85s, and 48 with heavy SUs.[64] The SU regiments were acquiring better equipment. In January 1945 the 382nd Guard Heavy regiment had JSU122s with a model 249 gun, more powerful than the previous gun. Of eight vehicles from the regiment destroyed by the Germans, all were made at the Kirov plant in Chelyabinsk in August and September 1944 and had a vehicle life of only five or six months. The JSU122 had replaced the JSU152 on the production lines at Chelyabinsk. The 1443rd regiment also had SU 122s with the type 249 gun produced at Sverdlovsk in November 1944.[65]

To build its array of tanks and SUs the Russians had embarked on a massive program of industrial expansion in the late 1920s. The plants were the largest of their type in the world. They would provide the tanks and SUs to carry out

the Soviet tank doctrine. Most of the plants were built or reconstructed from 1929 to 1933 as automobile and tractor factories, under technical assistance contracts with American companies.[66] In 1928 the Soviets hired a Detroit architect, Albert Kahn, to design a tractor plant and other buildings. Kahn had designed the Ford River Rouge plant, the largest automotive factory complex in the world, and factories for Chevrolet, Packard, Hudson, Oldsmobile, Cadillac, Chrysler, and DeSoto automobiles. His designs remain as landmarks scattered across Detroit. By 1938 Kahn had designed 19% of the architect-designed industrial buildings in the United States.[67] The Russians obviously wanted the best.

Kahn accepted the project. He designed 12 of the Russian buildings in Detroit and the remainder in the Soviet Union using Russian engineers alongside Americans. Kahn designed standardized buildings, saving cost and time. He was responsible for the design, for providing construction equipment to build the plant, and for selecting and ordering machinery to equip the finished plant. To equip these factories, from 1929 to 1932 the Russians purchased massive amounts of American, British, and other foreign machine tools. American engineers designed and constructed or enlarged all of the tank plants using American or German imported machinery. In 1932, 64% of all American metal-working machinery exports went to the Soviet Union.[69]

Americans were initially in charge of the factories and were responsible for training Russians in operation. Over 1,000 Russians went to the United States to learn industrial techniques.[70] Many more trained on the job in America.. By imitating American techniques, the Russians achieved 30 years of technical development in 3 years. It took an additional 10 to 15 years to absorb all the knowledge and skill.[71]

The automobile plants were converted to light tank and self-propelled artillery production during the war, but they had already started some tank production before the war. The tractor plants made some medium and heavy tanks before the war and were converted to full-time production of tanks once the war began. The Soviet replicas of American factories were often larger than their models. The Chelyabinsk plant had three times the capacity of its model, the Caterpillar plant at Peoria, Illinois. The Stalingrad and Kharkov tractor plants had twice the capacity of their model, the Milwaukee plant of the International Harvester Corporation.[72]

In 1941 Soviet tanks were produced in a few plants located in European Russia, the Ukraine, and the Urals. In the face of the advancing Germans, the Russians moved the machinery from tank factories in Kharkov and other threatened locations to the east to expand existing factories. Thus, factories in the east built from 1930 to 1932 produced the tanks that defeated the Germans. "A prudent, far-sighted policy accounts for Soviet ability to turn back the Nazi invasion before Lend-Lease goods flowed in any great quantity."[73] The Germans estimated the breakdown of Soviet production by factory in 1943 and 1944, as shown in the table below. Although these numbers do not coincide exactly with Soviet totals, they do give an approximation of the relative importance of the plants.[74]

Factory	Type	10/43	12/43	4/44	7/44	10/44
Gorki Molotov GAZ	T-70	260	550	260	250	250
	SU-76	0	0	0	0	380
Gorki Sormovo	T-34	0	0	0	0	300
Kuibyshev, Kirov	T-70	100	150	100	250	0
	SU-76	0	0	0	0	450
Nishnjj Tagil	T-34	610	550	610	700	700
Chelyabinsk	T-34	100	100	0	0	0
	KV	100	100	0	0	0
	JS	0	0	200	200	200
Omsk	T-34	150	100	150	200	200

Sverdlovsk	T-34	200	100	200	200	200
Tashkent		0	100	0	0	0

In Gorki, the Molotov GAZ no. 1 plant made light tanks and self-propelled guns during the war. This huge factory—designed, built, and initially operated by the Ford Motor Company under an agreement made in 1927—originally produced copies of the Ford Model A automobile. The plant was modeled on the Ford River Rouge plant near Detroit. The Rouge plant concentrated in one complex all of the facilities to build an automobile, beginning with raw materials. The Gorki plant, operating on January 1, 1931, entirely with American machinery, still had problems. Designed to build 140,000 autos per year, the plant was enlarged in 1936 and 1937. In 1938, the plant produced 84,288 GAZ AA light trucks, 23,256 GAZ M autos, 6,314 GAS AAA 2-ton trucks, and 1,796 buses.[75] Before the war ft had 45,000 workers and had produced some BT tanks.[76]

After the war began, the Molotov plant continued making 1.5-ton GAZ trucks, but also made T60 light tanks. Later the factory made the T70, until October 1943 when production switched to the SU76 using the same chassis.[77] By 1944 the plant had 60,000 workers, 45% women, 10% boys ages 16 and 17, 5% invalid soldiers, and 40% older men. There were two 12-hour shifts for some workers and three 8-hour shifts for others, with a 1-hour break at mid-shift.[78] In 1944 the Molotov plant reduced truck production because of the large number of American imports, and production concentrated on the SU76. By September 1944, production of the SU76 reached 380 per month.[79]

The Krasnoye Sormovo no. 112 plant, also in Gorki, had a long history of tank manufacture, having produced the first Soviet-made tank in 1920.[80] Before the war, the plant had 27,000 workers and made the T32 medium tank. In July 1941 production of T34s began. In September 1941, when the evacuation of industry began, the only plants making the T34 were the Stalingrad tractor plant and the Krasnoye Sormovo.[81] The Sormovo plant had the facilities to manufacture a cast turret for the T34 that was superior to the welded turrets made in Stalingrad. The first T34/85s with a new enlarged cast turret were produced in December 1943 at Krasnoye Sormovo.[82] In September 1944 that plant's production was 300 T34s per month.[83]

The tractor factory at Stalingrad was the first tractor plant to be designed and equipped by Americans. The Soviets selected the site in 1926 and started work, but little was accomplished until 1929, when American technical assistance arrived. The plant was designed by Albert Kahn and built under the supervision of a Detroit architect, John Calder, who became a troubleshooter at other plants. American companies provided the equipment, including Rockwell. Niagara, Bliss, Seper, Westinghouse, and Chain Belt. The plant made copies of the International Harvester 15/30 tractor. Construction of the plant began in June 1929, and by June 1930 the buildings were up and most of the machinery from the United States and Germany was in place. The plant was the largest in Europe, designed to build 50,000 tractors per year.[84]

Before the war, the Stalingrad tractor factory employed 20,000 workers making agricultural tractors and light tanks. During 1941 and 1942, Stalingrad was the major producer of T34s while the other plants were being evacuated. Production continued until the Germans stormed the factory itself, in late 1942. After the city was retaken in 1943, the factory was rebuilt and by 1944 it employed 40,000 workers. The restored factory became the primary tank-repair center, refurbishing up to 600 per month and building 150 new T-34s monthly.[85]

The Putilov factory (Kirov) in Leningrad made the KV heavy tank before the war. The oldest engineering plant in Russia, the Putilov factory was rebuilt and expanded in 1929 with the help of the Ford Motor Company. The plant was in production in 1931, making copies of the Fordson tractor. By 1934 the Fordson had failed to meet Russian agricultural conditions, and production switched to the International Harvester Farmall, which had large steel wheels instead of Ford's smaller rubber tires.[86] Part of the plant was evacuated to Chelyabinsk in September 1941 along with the Izhorskiy steel factory which made armor place at Kolpino, just south of Leningrad. Only 525 machine tools and 2,500 workers from the Kirov plant were able to leave Leningrad before the blockade halted the evacuation. A few skilled workmen were sent later out of the city by air.[87] Also in Leningrad, the Bolshevik factory, modernized with

German assistance in the 1930s, made the light T26 tank before the war.

The Kharkov tractor factory was a copy of the Stalingrad tractor factory built by the Russians using the American blueprints. An American, Leon A. Swajian—an engineer who had worked on the River Rouge plant for seven years—was a consulting engineer during the construction. The plant used structural steel purchased in Czechoslovakia and American and German machinery. Both the Stalingrad and Kharkov factories were complete complexes, manufacturing all of the tractor components in the plant. Parts were not readily available as in the United States, where large plants purchased parts elsewhere unless it was more economical to manufacture them in the complex. Kharkov was in operation in 1933, building copies of the International Harvester 15/30, the same as Stalingrad. American engineers were still helping in the operation in 1933.[88]

Other factories manufactured tanks. Before the war, the Stalin plant at Saratov made light tanks and combines with technical assistance from the American Holt Combine Company. The Novosibirsk plant also made Holt combines before the war and had received technical assistance from the company.[89] At Kherson in the Ukraine, the Krasnaya Svesda plant made T37s. In Kiev the Bolshevik plant manufactured light BT tanks. At Kramatorskaya in the Don Basin, the Stalin plant made medium T32s and heavy tanks. At Rostov the Rosselmasch factory made light BTs and agricultural machinery; the plant had been built and equipped with American and German technical assistance. In Voroshilovgrad, the October Revolution plant made BTs and heavy tanks. During the war, the Mitishchi factory no. 40 in Moscow, with 16,000 workers in September 1944, was producing 10 SU76s per day.[90]

The four largest tank producers during the war were the Ordzhonikidze factory at Sverdlovsk, the Chelyabinsk tractor factory, the Ural tanks works (Stalin) no. 183 at Nishnij-Tagil, and the Lenin plant no. 174 at Omsk.

Construction of the Chelyabinsk tractor factory, the third tractor plant, began without foreign assistance in 1930 as part of the Second Five-Year Plan. Chelyabinsk was to be another duplicate of the Stalingrad plant. By March 1931 construction was in chaos, and John Calder and other Americans arrived to correct the problems. The plant received some help from the Caterpillar Company of Peoria, Illinois, and the plant made copies of the Caterpillar 1925-31 tractor. Caterpillar Company engineers helped to begin production. The plant had German and American machinery. In 1937 the plant had 25,000 workers and made 6,460 Stalinets, copies of the Caterpillar tractor.[91]

The extent of the Chelyabinsk tank production facility can be gauged by comparison with two major industrial plants in Detroit. The assembly and mechanical building alone in Chelyabinsk was 820 meters (nearly a half-mile) long and 150 meters (one-tenth of a mile) wide. The Chrysler Tank Arsenal in Detroit, including many buildings, was a little more than a half-mile by a quarter-mile. The entire Ford River Rouge complex was only one-mile by one-mile and a third.[92]

During the war, part of the Kirov factory in Leningrad was evacuated and added to the Chelyabinsk factory, but the Germans blockaded Leningrad before the evacuation plan had been completed. Factory no. 75 that made tank engines in Kharkov was also added to the Chelyabinsk tractor works. Part of the Stalin heavy machine factory from Kramatorsk, part of the pump and compressor factory from Melitopol, machine tools from the metal works in Mariupol, and the Red Proletariat machine works from Moscow were all added to the Chelyabinsk plant. The new combined factory, which included almost all of the facilities to manufacture a tank, was named Kirovskiy Works no. 100, better known as Tankograd.[93]

The Chelyabinsk factory employed 60,000 workers in 1944. The workers were 50% women, 15% boys of 16 and 17, 5% invalid soldiers, and only 30% men. The factory worked seven days per week, two shifts, each 12 hours with one hour off at mid-shift. Workers had only two free days each month.[94]

The first KV tank was completed at Chelyabinsk in October 1941. In 1943 the KV85 replaced the KV and in November 1943 the JS (Joseph Stalin) replaced the KV85. Chelyabinsk also produced heavy SUs based on the KV ana! JS chassis. In April 1942 production of T34s began with up to 15 per day. By January 1944, the SU85 and the T34/85 replaced the T34. Average daily production in 1943 was 17 or 18 T34s, 5 or 6 KV85s, and 6 KV14 SUs.[95] In May 1944 production was 6 KV14s and 12 JS 13s daily.[96] According to Soviet sources, the level of production at

Chelyabinsk was about 180 heavy tanks and SUs monthly in 1943 and 540 heavy tanks plus 100 T34s per month in 1944.

Chelyabinsk was an excellent example of the strengths and weaknesses of the Soviet production system. Production of heavy tanks required powerful cranes to move the components (turrets and hulls) to assemble the tanks.

Chelyabinsk was one of the few factories with this equipment. The design of the factory followed Henry Ford's idea of assembly-line production and the vertical concentration of production. In contrast, the horizontal technique concentrated the production of a common component—for example, engines—in a few plants and transported the components to various plants for assembly in a variety of finished products. For example, the Germans built the Mann tank engine in one plant and sent the engines to various plants for use in a variety of tanks. The vertical method concentrated production of all components for a single finished product in one location, limiting the incoming shipments to raw materials. Chelyabinsk was planned to make tractors with the latter idea and converted to heavy tank production by the addition of evacuated factories in 1941. Because of the increased complexity of producing tanks compared to tractors, fewer units were made at far greater labor cost. The workforce at Chelyabinsk increased from 25,000, when it made tractors, to 60,000 in 1944, when it made tanks.

The advantage of the vertical system was no added burden to the limited rail network to move heavy components from distant locations. The advantage of the horizontal system was that the various plants profited from large-scale production and could be located near the source of raw materials. Producing 20 engines per day fell short of the economy of large-scale production. Concentrating the production of heavy tanks in Chelyabinsk was possible because its remote location protected it against air attack and the threat of sabotage was minor. The Germans could not risk such a concentration because any interruption would halt the production of all heavy tanks.

The Chelyabinsk factory worked on a cycle. From the drawing of the assembly plant included in one report, the tanks were assembled on a line nearly a half-mile long. From various photographs one can guess at the building method. The road wheels were attached to the hull on an auxiliary line. The 20-ton chassis was then picked up by two cranes and hoisted to the beginning of two parallel assembly lines in the center of the building. The motor was dropped in, and then the turret, complete with gun, was added, both major components coming from auxiliary lines probably located in separate buildings. The tanks could be pulled forward on the road wheels as work progressed. One of the final steps was the addition of the tracks. The complete tank could then be driven off the end of the line.[98]

Another possible technique would not require the tanks to move. Batches of tanks could have been assembled at various points in the building, starting with the chassis and adding the hull, the engine, and finally the turret. When a batch was finished, all of the tanks were rolled out of the building at once and a new batch started." The difficulty of moving the heavy chassis once assembly had begun, and the probable scarcity of assembly space equipped with overhead cranes, precluded large, open aisles to facilitate moving the finished tanks. Soviet photographs show very crowded work space in the tank factories.

The second largest tank factory was the Ural tank works (Stalin) no. 183 at Nishnij-Tagil. Construction of a railroad-car manufacturing plant was begun in 1931 as part of the Second Five-Year Plan and was completed in 1935. In 1936 the factory made 39,000 modern four-axle railroad cars. In September 1941, the locomotive and tank factory no. 183 at Kharkov was moved to Nishnij-Tagil, added to the existing factory, and renamed the Ural tank works. The Kharkov plant that employed 14,000 workers before the war sent hydraulic presses and heavy machine tools. Other machines came from Mariupol, Leningrad, and Moscow.[100]

The first 11 Nishnij-Tagil T34s were completed on December 25, 1941. Daily production increased from 5 tanks to 15 by December 1942, to 22 in January 1943, and to 30 in July 1943. The monthly production of T34s in 1943 was 850. In March 1944, production began on the T34/85. The factory also made 250 to 300 long-barreled 76mm antitank guns monthly. [101] The factory employed 40,000 workers, including women (50%), 10% boys of 16 and 17, and 5% invalid soldiers. The workers had either 8-hour or 12-hour shifts. The work was hard and bread was rationed according to the work assignment, from 400 grams (1-pound loaf) to 800 grams per day.[102]

Another T34 plant was located at Omsk—Lenin plant no. 174. Before the war, the Lenin plant in Omsk had employed

5,000 workers making tractors. In 1941 additional machines and men came from plant no. 174 in Leningrad. Work conditions were similar to those in Nishnij-Tagil. The plant first made T60 light tanks but soon switched to producing T34s. By 1944, there were 15,000 workers producing up to 20 T34s per day and 200 per month.[103]

The Ural heavy machine tool factory (Uralmash) at Sverdlovsk also made T34s and other military equipment. The factory began production of mining and metal industry equipment along with military equipment on July 15, 1933. The large complex began with raw materials, made its own steel, and produced finished heavy equipment. In 1936 the plant made a prefabricated submarine. The Germans supplied most of the machinery for the Soviet plant. Construction was supervised by 150 foreign engineers and employed 12,000 men. One building was one-fourth of a mile long. The machinery was the best American, British, and German designs. The complex included foundries, hammer and press shops, forge shops, heat treating, mechanical departments, machine fabrication, and assembly.[104]

Before the war, the plant at Sverdlovsk had employed 27,000 workers making tractors and some medium and heavy tanks. The factory began making parts for the T34 in 1942 and by the end of the year was assembling complete tanks. By May 1944 the factory was turning out 200 T34s per month. In September 1943 the plant began production of SU85s using the T34 chassis, and in May 1944 was producing 15 SU 122s per day.[105]

The Kuibyshev factory no. 38, located in Kirov, northeast of Moscow, was the second major light tank factory. No information concerning the prewar plantt located at Kirov has been found. In the fall of 1941, the Kolomensky locomotive works no. 38 from Kolomna, south of Moscow, and some men and machines from plant no. 37 combined to form the new Kuibyshev factory no. 38.[106] Plant no. 37 had developed light tanks before the war and continued to make T60s until September 1941, when it was evacuated. The Kolomensky factory, also involved in developing the light tank, began making T60s in July 1941 and continued until it was evacuated. When no. 38 resumed production of the T60, it became one of the two major sources of the T60 along with the Gorki GAZ factory.

Research and development on light tanks continued at factory no. 38, resulting in an improved T60 in 1942 and the T70 that went into production in September 1942. In October 1943, light tank production ceased and the facilities were used to make SU76s that were developed at no. 38. Production of the SU76s began in December 1942, but the faulty design limited output. In the spring of 1943, full-scale production of the SU76 began at both the GAZ plant and no. 38. Over 1,200 German Mk III panzers and *Sturmgeschütz* IIIs were converted into SU76Is at no. 38 in the fall of 1943. Production of light tanks increased to 30 per day in 1942. By June 1944 monthly production at Kirov included 550 SU76s, 2,700 GAZ trucks, 350 armored cars, and the assembly of American trucks shipped in crates. In September 1944 the plant had 8,000 to 10,000 workers and was producing 450 SU76s per month.[107]

Tank production took place in other factories in the east. The Kaganovitch factory in Charabarovsk employed 4,000 workers before the war. During the war the plant repaired tanks for the Far East and assembled some T70s and T34s.[108] The Germans also believed that there was a tank factory at Tashkent producing 100 tanks per month.

The Germans based their estimates of Soviet tank production on studies of the serial numbers of captured and destroyed tanks and on interrogation of prisoners. Prisoner-of-war statements were not always reliable, but often were close to the facts. One prisoner reported that in May 1944, daily production at Sverdlovsk was 15 SU122s and 25 T34/85s; at Chelyabinsk, 6 KV14s and 12 JS85s; and at Omsk, 20 T34s.[109] Multiplying these numbers by 30 resulted in monthly and annual totals that were close to the Soviet figures. The production of 78 tanks per day by these three factories equaled 28,470 per year, compared to the total Soviet tank production in 1944 of 34,700 in all six plants then in production. Chelyabinsk had a production rate equal to that of the prisoners report—540 per month—as the plant worked seven days a week.

In summary, before the war many Russian factories made components and assembled tanks. With the advance of the Germans, the High Command decided to maintain the plants at Stalingrad and Gorki and to create five major centers at Kirov, Nishnij-Tagil, Chelyabinsk, Omsk, and Sverdlovsk, enlarging ousting factories with men and machines from factories in Leningrad, Kharkov, Moscow, and other cities. Although production fell to 500 per month in October 1941, by March 1942 it reached 1,000 and by the end of 1942 over 1,500, as the new plants came into full-scale

production. Heavy tanks came from Chelyabinsk; mediums from Nishnij-Tagil, Gorki, Sverdlovsk, Omsk, and Chelyabinsk; and light tanks from Gorki and Kirov, providing the Red Army with enough to replace losses and create new units."[0]

At the end of 1942, the number of Soviet tanks on hand exceeded 20,000 and continued to increase until the end of the war, when 35,000 were on hand. Soviet figures published before 1993 are very questionable and probably do not refer to total numbers but rather some undefined subtotal. For example, before 1993 the Russians claimed to have 6,900 on hand in November 1942 and to have produced 24,000 in 1943, but state that only 5,400 were on hand in January 1944. The Soviet figures published in 1993 gave the number on hand as 24,400 in January 1944. From as early as mid-1942 the Russians had an ample supply of tanks to maintain the strength of their units.[111]

Including the units in the SU and tank destroyer brigades and the battalions in the rifle divisions, the Red Army probably had the equivalent of about 400 mechanized artillery regiments at the end of the war, with 7,000 to 8,000 SUs. In January 1945 the German Army had about 12,000 tanks and assault guns on all three fronts and in noncombat formations. Probably fewer than 10,000 were on the Eastern Front. Facing these vehicles were over 7,000 SUs and at least as many antitank guns. Little wonder that German losses in January 1945 were 1,375 tanks and assault guns, over 10% of the total. With its overwhelming numbers of tank and SUs, Soviet forces were able to break through the strongest defenses. The Red Army no longer feared the German tank-supported counterattacks that had turned victory into defeat in 1942 and early 1943. The results were far-reaching advances and rapid conquest of enemy-held territory by the Red Army.

NOTES

1. Liddell-Hart, pp. 286, 306; Zaloga and Grandsen, pp. 17, 129.

2. Krivosheev, p. 357.

3. Zaloga and Grandsen, p. 125.

4. *IVOVSS* (German), VI, p. 279; Krivosheev, p. 357.

5. O. A. Losik, *Stroitelistvo i Boyevoye Primeneniye Sovetskikh Tankovykh Voysk* v *Gody Velikoy Otechestvennoy Voyne* (Moscow: Voyenizdat, 1979), p.. 24; Krivosheev, p. 347.

6. Liddell-Hart, pp. 300-01.

7. Liddell-Hart, p. 302; Krivosheev, p. 342.

8. Liddell-Hart, p. 304; Losik, p. 24; *VOVE*, p. 704.

9. Liddell-Hart, p. 304; Krivosheev, p. 347.

10. Zaloga and Grandsen, p. 19; *VOVE*, p. 704; Krivosheev, p. 342.

11. Zaloga and Grandsen, p. 25; *VOVE*, p. 704.

12. Losik, p. 24; Liddell-Hart, pp. 301, 304; Zaloga and Grandsen, PP-27-30; *VOVE*, p. 704; Krivosheev, p. 347.

13. *VOVE*, pp. 705-06; Revised figures in Krivosheev, pp. 357-58.

14. The first four columns are based on a wide variety of German sources. The last column includes Soviet figures. Sources: FHO, CGR, H 3/468.2, June 5, 1943, Roll 564, Frame 1069; H 3/123.2, 1944, Roll 552, Frame 771; H 3/123.2, 1944, Roll 552, Frame 676; H 3/123.2, 1944, Roll 552, Frame 689; H 3/123.2, 1944, Roll 552, Frame 724; H 3/123.2, 1944, Roll 552, Frames 761-62; H 3/123.2, January 26, 1944, Roll 552, Frame 725; H 3/105, February 1944, Roll 551, Frame 424; H 3/123.2, March 1944, Roll 552, Frame 719; H 3/123.1, April 1944, Roll 552, Frame 519; H

3/68, June 14, 1944, Roll 562, Frame 160; H 3/1034, May 31, 1944, Roll 581, Frame 88; H 3/1521, October 10 1944, Roll 587, Frames 349, 350, 352; H 3/123.2, November 30, 1944, Roll 552, Frames 718-19; H 3/123.2, February 6, 1945, Roll 552, Frame 676; H 3/1508, February 10, 1945, Roll 587, Frame 19; H 3/1522, March 1945, Roll 587, Frame 407; *IVOVSS* (German), IV, 123 and VI, 230; Seaton, pp. 399-402; Erickson, *Berlin*, p. 83; Erickson, *Stalingrad*, p. 370; Zaloga and Grandsen, p. 225; *VOVE*, pp. 705-06; Krivosheev, pp. 357-58.

15. FHO, CGR, H 3/468.2, June 5, 1943, Roll 564, Frame 1069; Krivosheev, pp. 357-58.

16. Krivosheev, p. 357-58; Totals on tables disagree because of inclusion or exclusion of production after April 1945.

17. FHO, CGR, H 3/123.2, December 17, 1944, Roll 552, Frame 702.

18. Krivosheev, pp. 357-58.

19. FHO, CGR, H 3/1522, March 1945, Roll 587, Frame 390.

20. FHO, CGR, H 3/104, October 8, 1943, Roll 551, Frame 234. 21, Losik, p. 25.

22. Losik, p. 26.

23. N. Popov, "Razvitie Samokhodnoi Artillefii," *VIZh* 1 (January 1977), p. 27.

24. Popov "Razvitie," p. 28.

25. Popov, "Razvitie," p. 28.

26. FHO, CGR, H 3/104, October 8, 1943, Roll 551, Frames 234-37.

27. *VOVE*, p. 64.

28. Krivosheev, pp. 357-59.

29. *VOVE*, p. 64 states 21,000; FHO, CGR, H 3/123.2, 1944, Roll 552, frames 761-62; H 3/1521, 1944, Roll 587, Frame 364; H 3/340, 1944, Roll 562, Frame 144; H 3/123.2, March 1944, Roll 552, Frame 719; H 3/123.1, May 27, 1944, Roll 552, Frame 576; H 3/123.2, November 1944, Roll 552, Frame 718; Zaloga and Grandsen, pp. 224-25; V. Zelenskii, "Podgotovka Mladshik Tankovik Spetsialistvo v Godi Velikoi Otechestvennoi Voini," *VIZh* 9 (September 1981), p. 72.

30. FHO, CGR, H 3/340, September 5, 1944, Roll 562, Frame 145.

31. Popov, "Razvitie," p. 28.

32. *VOVE*, p. 516; *The Illustrated Encyclopedia of 20th Century Weapons and Warfare*, 24 vols. (New York: Columbia House, 1969), XII, p. 1336.

33. Zaloga and Grandsen, p. 26; Popov, "Razvtie," p. 28. 34, *VOVE*, p. 516.

35. Zaloga and Grandsen, p. 26.

36. *VOVE*, p. 64.

37. Zaloga and Grandsen, p. 181; Popov, "Razvitie," p. 29.

38. FHO, CGR, H 3/123.1, November 5, 1943, Roll 552, Frame 508.

39. E. J. Hoffschmidt and W. H. Tantum, IV, ed., *Tank Data 2* (Old Greenwich, Conn.: WE, Inc., 1969), p. 37; Losik,

p. 62; German intelligence confirmed that the T48 continued to use the U. S. 57mm antitank gun M2; FHO, CGR, H 3/340, Roll 562, Frame 146.

40. FHO, CGR, H 3/123.2, September 5, 1944, Roll 552, Frames 706, 710; The gun itself weighed 1,060 kg and fired a 2.85 kg projectile; FHO, CGR, H S/340, Roll 562, Frame 146.

41. Hoffschmidt, p. 183.

42. FHO, CGR, H 3/123.2, September 5, 1944, Roll 552, Frame 708; Zaloga and Grandsen, p. 219.

43. Zaloga and Grandsen, p. 180; Popov, "Razvitie," p. 29.

44. FHO, CGR, H 3/320, February 20, 1945, Roll 561, Frame 968.

45. FHO, CGR, H 3/320, January 12, 1945, Roll 561, Frame 968.

46. FHO, CGR, H 3/123.1, November 5, 1943, Roll 553, Frame 508.

47. Zaloga and Grandsen, p. 181.

48. *VOVE*, p. 631; Popov, "Razvitie," p. 29.

49. *VOVE*, pp. 64, 516.

50. Zaloga and Grandsen, p. 183; FHO, CGR, H 3/340, February 4, 1945, Roll 562, Frame 138.

51. *VOVE*, pp. 64, 516; Popov, "Razvitie," p. 29.

52. FHO, CGR, H 3/340, February 4, 1945, Roll 562, Frame 135; Malanin, p. 38.

53. *VOVE*, pp. 64, 516.

54. Malanin, p. 38; Zaloga and Grandsen, p. 178; Losik, p. 63.

55. FHO, CGR, H 3/123.1, May 27, 1944, Roll 552, Frame 577; H 3/123.2, September 2, 1944, Roll 552, Frame 706.

56. *VOVE*, pp. 64, 630.

57. FHO, CGR, H 3/123.2, September 4, 1944, Roll 552, Frame 706.

58. Zaloga estimated the growth of tanks and self-propelled artillery vehicles from 13,600 in June 1944 to 17,000 in December, 1944 and a drop to 14,000 to April, 1945, Zaloga and Grandsen, p. 223; David M. Glantz, *From Don to the Dnepr: Soviet Offensive Operations, December 1942-August 1941* (London: F. Cass, 1991), pp. 361-65.

59. FHO, CGR, Report from 18th Army, August 8, 1944, Roll 552, Frame 763.

60. FHO, CGR, H 3/123.1, December 24, 1944, Roll 552, Frame 464. 61. *VOVE*, p. 630; Popov, "Razvitie," p. 30. 62. *VOVE*, p. 64.

63. Popov, "Razvitie," p. 30.

64. FHO, CGR, H 3/123.2, March 3, 1945, Roll 552, Frame 616; *VOVE*, p. 631.

65. FHO, CGR, H 3/1508, February 10, 1945, Roll 587, Frame 19; H 3/320, February 20, 1945, Roll 561, Frame 971.

66. Sutton, II, p. 177.

67. Sutton, II, pp. 249-50.

68. Sutton, II, pp. 249-50.

69. Zaloga and Grandsen, p. 43.

70. Sutton, II, p. 251.

71. Sutton, II, p. 316.

72. Sutton, II, p. 297.

73. Sutton, II, p. 248.

74. FHO, CGR, H 3/1521, December 1943, Roll 587, Frame 366; H 3/123.1, April 1944, Roll 552, Frame 510; H 3/807, June 1944, Roll 578, Frame 272; H 3/1521, July 1944, Roll 587, Frame 351; H 3/340, September 7, 1944, Roll 562, Frame 154; H 3/1521, October 1944, Roll 587, Frame 351; H 3/320, February 20, 1945, Roll 561, Frame 971.

75. Zaloga and Grandsen, p. 43; Sutton, II, pp. 181-82.

76. FHO, CGR, H 3/1689, September 1940, Roll 587, Frame 810.

77. Zaloga and Grandsen, p. 128, 140.

78. FHO, CGR, H 3/807, 1944, Roll 578, Frame 276.

79. FHO, CGR, H 3/123.1, April 14, 1944, Roll 552, Frame 508; H 3/818, 1944, Roll 578, Frame 562; H 3/340, September 7, 1944, Roll 562, Frame 154.

80. Zaloga and Grandsen, p. 35; The tank was called the Light Tank KS and was a copy of the French Renault.

81. FHO, CGR, H 3/1689, September 1940, Roll 587, Frame 810; Zaloga and Grandsen, p. 127.

82. Zaloga and Grandsen, pp. 130, 169.

83. FHO, CGR, H 3/340, September 7, 1944, Roll 562, Frame 154.

84. Sutton, II, pp. 185-86.

85. FHO, CGR, H 3/818, 1944, Roll 578, Frame 562.

86. Zaloga and Grandsen, pp. 43-44; Sutton, II, p. 191.

87. Werth, pp. 328-30.

88. Sutton, II, pp. 187-88.

89. Zaloga and Grandsen, pp. 43-44; Sutton, II, p. 192.

90. FHO, CGR, H 3/818, 1944, Roll 578, Frame 676; H 3/340, September 7, 1944, Roll 562, Frame 154; Sutton, II, p. 192.

91. Sutton, II, pp. 188-90.

92. FHO, CGR, H 3/1711, January 28, l945, Roll 588, Frames 263-65; The area of the two Detroit plants was measured from a city map and includes all of the land, including parking lots, railroad spur lines, and roads. The actual

area of the buildings was less.

93. Zaloga and Grandsen, p. 127; FHO, CGR, H 3/1521, October 10, 1944, Roll 587, Frame 348; H 3/123.1, May 27, 1955, Roll 552, Frame 572.

94. FHO, CGR, H 3/1337, May 20, 1944, Roll 585, Frame 196; H 3/818, POW report, 1944, Roll 578, Frame 539.

95. FHO, CGR, H 3/123.1, April 14, 1944, Roll 552, Frame 508.

96. FHO, CGR, H 3/1337, May 20, 1944, Roll 585, Frame 196 and May 7, 1944, Roll 585, Frame 207

97. FHO, CGR, H 3/818, 1944, Roll 578, Frame 539; H 3/1337, May 20, 1944, Roll 585, Frame 196; H 3/123.1, April 14, 1944, Roll 552, Frame 508-Krivosheev, p. 357.

98. Photographs on Eric Grove, *Russian Armor 1941-1943* (London: Almark Publishing Co., Ltd., 1977), p. 52; K. M. Slobodin, et al, *T34: Puti K Pobede* (Kharkov: Prapor, 1985), pp. 80, 179.

99. *VOVE*, p. 705.

100. FHO, CGR, H 3/1337, 1944, Roll 585, Frame 153; H 3/818, 1944, Roll 578, Frame 562; Zaloga and Grandsen, p. 127.

101. FHO, CGR, H 3/818, 1944, Roll 578, Frame 562.

102. FHO, CGR, H 3/1337, 1944, Roll 585, Frame 153; H 3/818, 1944, Roll 578, Frame 562.

103. Zaloga and Grandsen, pp. 127, 130; FHO, CGR, H 3/1521, October 1944, Roll 587, Frame 351; H 3/1337, 1944, Roll 585, Frame 153; H 3/1337, May 20, 1944, Roll 585, Frame 196; More details on the Omsk plant on H 3/818, Roll 578, Frame 648.

104. Sutton, II, pp. 135-36.

105. FHO, CGR, H 3/123.1, October 25, 1943, Roll 552, Frame 508; H 3/1337, May 20, 1944, Roll 585, Roll 196; Zaloga and Grandsen, p. 135; More details on the Sverdlovsk plant on H 3/818, Roll 578, Frame 562.

106. Zaloga and Grandsen, pp. 128, 138.

107. FHO, CGR, H 3/807, 1944, Roll 578, Frame 276; H 3/807, 1944, Roll 578, Frame 562; *VOVE*, p. 348; Zaloga and Grandsen, pp. 140, 156, 180.

108. FHO, CGR, H 3/818, 1944, Roll 578, Frame 678; H 3/1689, September 1940, Roll 587, Frame 810.

109. FHO, CGR, H 3/1337, May 20, 1944, Roll 585, Frame 196; Krivosheev, pp. 357-58.

110. RIO, CGR, H 3/1521, October 10, 1944, Roll 587, Frames 347-48.

111. Krivosheev, pp. 357-58.

7 Artillery

The Red Army entered World War II with an excellent arsenal of artillery pieces that had been designed or improved in the 1930s. During this period, the Russians had increased the range, the rate of fire, the accuracy, and the destructive force of all of their artillery. During the war, the Red Army placed more reliance on artillery than did any of the other major armies in World War II. During the war the Soviet Union produced over 500,000 guns and mortars. The Russian arms industry produced more than enough weapons despite German occupation of its most industrialized

part of the country.

The Soviets established requirements and designed, selected, produced, and distributed all their weapons, especially artillery, on a few simple factors: what level of destructive power needed to be delivered by whom at what distance from the weapon. The bronze smooth bore cannon of the early 19th century cut swathes in the opposing ranks of infantry regiments beyond musket range, 100 yards. The cannon were placed at strategic points in the front line. In defense the guns broke up the attacking masses and in offense the guns disrupted the lines of defenders. One or two types of gun (a 3-pounder and a 12-pounder) could handle most situations. In World War II, the targets and gunners were far more diverse and so there was need for a large variety of weapons.

The destructive power of artillery dominated the battlefield. A 76mm shell created a crater 1 meter in diameter and 0.5 meters deep; a 122mm shell, 3 meters in diameter and 0.7 meters deep; and a 152mm shell 5 meters in diameter and 1.8 meters deep. If the average shell made a crater 2 meters in diameter, 74 guns firing a single round destroyed 231 square meters (1 meter (radius) x 3.14 (pi) = 3.14 square meters for each shell x 74 =231.1 square meters) of a 1,000 square meter area.[2] Seven shells from each gun could theoretically destroy the entire target, allowing for more than 60% overlap of craters (7 x 231 = 1,617 sq m).

During the 1930s the Russians had two objectives—better performance and greater production—but the technical skills and productive capacity limited the level of accomplishment. In 1941, these limitations led to a reduction in variety of types, stopping production of artillery heavier than 152mm. During the war the Russians concentrated on producing designs in existence in 1941, with minor improvements. The only three new weapons were the 152mm howitzer M1943 D-1, the 100mm field gun M1944 BS-3, and the 160mm mortar M1943 MT-13.[3]

The basic Soviet idea was to keep all matters as simple as possible, as opposed to the German predilection for complexity. The Russians strove to produce as few types of guns as possible, with the simplest design possible both in operation and manufacture. During the 1930s the Russians attempted to create "universal" guns—weapons to serve multiple purposes. The prewar weapons were of high quality. The one-piece barrels were easier to make than the complex barrels on some German artillery. Muzzle brakes reduced recoil and made lighter carriages practical. The semiautomatic sliding wedge breech system, developed by the Germans, increased the rate of fire. Many parts and ammunition were interchangeable. Use of identical carriages on several types of guns was common.[4]

The Soviets referred to artillery in terms of the size of unit that it would support—battalion guns (37mm and 45mm), regimental guns (76mm), division guns (76mm and 122mm), and corps guns (107mm to 152mm). A rifle battalion needed the ability to break up infantry attacks within 100 meters of the defenders and to destroy trenches and strong points immediately ahead when attacking. The guns had to be light enough to manhandle and need not deliver much destructive power at great range. Corps guns, on the other hand, destroyed fortifications with heavy shells and enemy artillery at great distances. Each user had his special requirements—how much destruction had to be, delivered at what distance.

The cannon companies in the rifle regiments had regimental guns, the divisional artillery regiment had light or field artillery, and corps and armies had medium and heavy artillery. Antitank guns defended against tank attacks and antiaircraft guns, air attacks. The field, medium, and heavy artillery included both guns and howitzers, all designated by the diameter of the bore. In Russia during World War I, the diameter was expressed in "lines" (a 42-line gun had ; a 107mm bore), inches, or millimeters. A 76mm gun had a bore 76mm in diameter and fired a projectile of the same diameter.

A gun had a flat trajectory and long range stemming from its high muzzle velocity. A muzzle velocity from 400 m/s to over 1,000 m/s resulted from a large powder charge. The gun had a large chamber to hold the powder and a long barrel (about 40 calibers) to allow the powder time to burn. The barrel of a gun was measured in calibers: a 40-caliber barrel on a 76mm gun was 40 times the diameter of the bore, or 3 meters.[5]

The howitzer had a lower muzzle velocity resulting from a smaller powder charge. A shorter barrel was sufficient as the powder burned in less time. A typical howitzer had a 27-caliber barrel. The advantage of the howitzer was that it could be fired with a high trajectory over hills and other obstacles. The plunging shell struck the target from a nearly

vertical angle, an advantage when shelling troops in dugout shelters. Gun-howitzers were a compromise and the ammunition was often adjustable. By removing some powder, the muzzle velocity decreased, allowing the gun to function as a howitzer.[6]

A mortar had a barrel of 12 calibers or less. Most mortars were simple tubes supported by a bipod and a base plate firing rounds of 50mm, 82mm, or 120mm. The 240mm mortars were heavy artillery pieces with short barrels. The 160mm mortar had a carriage with wheels and a recoil system but retained the base plate.[7]

The development of modern artillery began after the Russo-Japanese War in 1904. A Russian commission made a survey of Western European gun manufacturers looking for the best available products, including Krupp in Germany, Skoda in Austria-Hungary, and Schneider in France. The Russians selected Schneider designs for the bulk of the artillery used in World War I. Many of these guns with modifications were still in use in World War II.[8]

The Commission selected the following designs for production:

Schneider M1909 3-inch Danglis mountain gun
Schneider M1910-42-line (107mm) gun
Schneider M1912 11-inch (280mm) mortar
Krupp M1909 48-line (4.8-inch) howitzer
Schneider M1910 48-line (4.8-inch) howitzer
Schneider M1910 6-inch howitzer
Schneider M1909 6-inch fortress howitzer
Schneider M1912 11-inch mortar

The M1910 107mm gun was in production in Russia in 1914 and the M1909 6-inch howitzer in 1916. The French made the M1912 11-inch mortar for the Russians. The M1909 3-inch gun was produced with several adaptions for special purposes, including the light anti-storming gun M1910, for use in defensive positions, and the short gun M1913. The Russians also developed a 37mm trench gun M1915.[9] The most common was the M1902 76mm gun that continued in use until 1928.[10] The Russians also imported about a fifth of their artillery, primarily medium and heavy guns.[11]

During the Civil War following the Revolution, the Red Army used whatever was available: weapons left over from the czarist army, captured weapons, and some imports. In the 1920s, the Soviets designed and produced the 45mm M1929 howitzer and the 76mm M1927 regimental gun.[12]

As part of the First Five-Year Plan, the Soviet government in 1929 planned to provide the Red Army with a complete range of modern artillery. The objective was to modify existing artillery pieces with new metric fire control equipment and new ammunition. Some received both longer tubes and larger chambers to increase their range. Others had only a tube or chamber alteration. Most had their carriages reinforced and some had their elevation increased.[13]

The standard guns before 1929 and the modernized versions were as follows:[14]

World War I Model	1929 Program Model
	37mm AT gun M1930
	45mm AT gun M1932
76mm gun M1902	76mm gun M02/30
3-inch short gun M1913	76mm regimental gun M1927
	76mm antiaircraft gun M1931
76mm mountain gun M1909	

107mm gun M1910	107mm gun M10/30
122mm howitzer M1909/1910	122mm howitzer M10/30
	122mm corps gun M1931 A-19
152mm howitzer M1910	152mm howitzer M10/30
	152mm gun B-10
	152mm mortar M1931
	203mm howitzer M1931 B-4

The Russians also used some foreign-made heavy artillery pieces. The real contribution of the foreigners was providing designs, which eliminated the need for research and development. Foreign assistance accelerated the Red Army's artillery development beginning with the First Five-Year Plan. The Russians awarded similar foreign assistance contracts for the construction of heavy industry and for the armaments industry. Detailed records comparable to those of U.S. corporations concerning heavy industry are not available for the armaments industry, however scraps of evidence point to the same method of rapid development of the Soviet weapons industry with foreign assistance. As detailed in Chapters 1 and 6, heavy industry began with the selection of the best products made abroad—for example, the Caterpillar tractor. A contract was signed and the foreign corporation created a design or planning bureau in Moscow with foreign engineers working with Soviet engineers. The results were the improvement and expansion of existing plants and the building of entirely new, modern plants.

The records do show the selection of quality foreign weapons to serve as models—for example, the German 37mm antitank gun and the Czech Skoda 76mm mountain gun. The Skoda works was one of the outstanding arms manufacturers in Europe. In August 1935, B. M. Shaposhnikov visited the Skoda works with a delegation. The delegation was most interested in the Skoda 75mm mountain gun CS. The gun was licensed to the Soviets in March 1937 and adopted in September 1939 as the 76mm mountain gun M1938. There was a possible connection between the Skoda 105mm mountain howitzer D 9 and the Soviet 107mm mountain howitzer—specifications for the Soviet weapon were identical with the Skoda gun. The Russians were also interested in Skoda super heavy artillery, but the contract was not fulfilled before the Germans occupied Prague in May 1939.[15] The Russians also tested the Czech 105mm gun M1935 that may have influenced the design of the 107mm gun M1940 M60. The Soviets tested other weapons and sought technical assistance in the manufacture of ammunition. Although little is definitely known of the ties with Skoda, bonds did exist and had a strong influence on Soviet artillery.[16]

German assistance to the Soviet arms industry began in 1923 and proposals for direct assistance came from the Soviets in 1926. The Russians approached Zeiss (manufacturer of optical devices), Krupp, and Rheinmetall in 1928, but only Rheinmetall agreed to cooperate. In February 1930, I. P. Uborevich, chief of Red Army arms, went to Germany to visit Rheinmetall to see weapons demonstrations, including the secret 37mm antitank gun. In September 1930, Rheinmetall signed a contract to establish a design bureau with 20 German engineers to work with Russian engineers in the development of plants to manufacture six weapons. The weapons included the 3.7cm PAK (antitank gun, also used as a tank gun), the Solothurn 2cm *Maschinenkanone* (antiaircraft gun), the 15.2cm *Minenwerfer* (heavy regimental gun), the 7.62cm antiaircraft gun, the 3.7cm *Maschinenkanone* (antiaircraft gun), and the 15.2cm SFH (divisional medium howitzer). Rheinmetall also may have provided information on the 75mm *leIG* 18 (light regimental gun).[17] The Soviet arms designer, V. G. Grabin, was probably closely associated with the German design bureau and wrote a thesis on the German 15.2cm *Minenwerfer.* The contract with Rheinmetall ended in the summer of 1933, when Hitler came to power.[18]

Some Rheinmetall weapons were part of the 12 pieces in the 1929 program that formed the basis of the Soviet artillery in World War II. Although modifications and a few new pieces were introduced, the basic family of guns was established in 1929. By January 1932, the Red Army had 14,000 guns.

The characteristics of the major types of guns in production in 1932 were as follows:[19]

Weapon	Weight (kg)	Muzzle Velocity (m/sec)	Shell Weight (kg)
25 mm antiaircraft gun M1940	1,072	915	0.26
37mm antiaircraft gun M1939	2,000	880	0.72
37mm antitank gun M1930	406	762	0.82
45mm antitank gun M1932	520	762	1.54
76mm division gun M1902/30	1,350	680	6.2
76mm regimental gun Ml927	780	387	6.2
76mm antiaircraft gun M1931	3,750	815	6.5
107mm gun M1910/30	2,180	670	16.6
122mm howitzer M1910/30	1,465	364	21.76
122mm gun M1931 A-19	7,100	800	25.0
152mm howitzer M1930	2,580	390	40.0
152mm gun M1910/30	7,100	650	43.6
152mm mortar M1931	n/a	250	40.25
203mm howitzer Bm M1931	17,700	606	98.4

The 25mm antiaircraft gun M1940 was a copy of the Bofors 25mm automatic gun that was a scaled-down model of the 40mm Bofors. The Russians evidefirty preferred this design to the 20mm Solothurn gun offered by Rheinme-tall. The 37mm M1933 antiaircraft gun was a scaled-down version of the Bofors 40mm gun. The M1939 model was rechambered to take a standard Soviet cartridge.[20] Between the two World Wars, German engineers from Krupp worked with Bofors in Sweden, while Rheinmetall engineers worked on designs with Solothurn in Switzerland. The manufacturing techniques and some parts of the two Rheinmetall light antiaircraft designs might well have been applicable to the Bofors designs adopted by the Russians.

The 37mm antitank gun M1930 was a direct copy of the Rheinmetall 37mm gun provided to the German Army. Production began at artillery plant no. 8 near Moscow in 1931. The gun was adequate to deal with the armor on contemporary tanks, but a heavier gun was needed for the future. The 45mm antitank gun M1932 was the same design as the 37mm but was increased in size for the larger round. The semiautomatic feature was removed from the breech system to simplify production and the horizontal breech was changed to a vertical slide.[21]

The standard Russian divisional gun of World War I was the M1902, similar to the French 75mm gun of the same vintage. The 76mm divisional gun M1902/30 was a modernized version. Originally the gun retained its 30-caliber long tube and received better ammunition, but a second version lengthened the tube to 40 calibers, provided a stronger carriage with a box trail, and improved the elevation. The result was an increase in range from 8,530 meters to 13,290 meters. The muzzle velocity increased from 595 m/s to 680 m/s. The weight increased from 1,100 kg to 1,350.[22]

The M1927 76mm regimental gun was the M1913 3-inch short gun with a redesigned carriage, making it more mobile. The weapon was light in weight (780 kg) with a short 16.5-caliber barrel. Production began in 1928 and continued through 1944. Rifle regiment cannon companies used the gun for close support. The Rheinmetall design, the Light *Minenwerfer* 18 (designated the *leIG* 18 in the German Army), a 76mm regimental gun, was not adopted.[23]

The 76mm antiaircraft gun M1931 was another Rheinmetall design that had a short life because improved aircraft performance soon made it obsolete. The 76mm antiaircraft gun 34-K was a naval version. The 107mm M1910/30 was a modified 42-line 107mm M1910 gun with a larger chamber, making possible a heavier charge and better shell design. The gun had a muzzle brake to absorb some of the energy of the larger charge. The net result was a 28% increase in range.[24]

The 122mm howitzer M1910/30 was a modified Schneider 48-line M1910 howitzer with a larger chamber making possible a heavier charge and longer range. The 122mm corps gun M1931 A-19 was an excellent new design. Although much heavier than the 107mm gun originally planned as the corps gun, it had a split trail carriage, wide traverse, high elevation, a heavier shell, and longer range that made it far more effective than the 107mm.

The 152mm corps howitzer M1909/30 was a modified Schneider 6-inch fortress howitzer, again with a larger chamber that increased the range by more than 1,000 meters. The 152mm howitzer M1930 was a Russian design using a shortened tube from the 152mm gun M1910/30 and a box trail carriage. The result was a good gun, but it was too heavy and the box trail limited the elevation. The M1938 howitzer that replaced it may have been influenced by the Rheinmetall assistance.[25]

The 152mm gun B-10 was an improved Schneider 6-inch siege gun with a larger chamber, improved shell design, and a heavier charge that increased the range 38% but required a muzzle brake to absorb the recoil. The gun was used as a coastal defense and naval weapon and later mounted on a self-propelled mount, however it was too heavy for use as army artillery.[26] The 152mm mortar M1931 was a Rheinmetall design licensed for manufacture in the Soviet Union. In the German Army it became the 150mm infantry gun *sIG* 33 and was used by the cannon company of the infantry regiment.[27]

In 1927, the Russians began the design of an entirely new 203mm howitzer M1931 B-4 to serve as the most common heavy artillery of its class. The piece could be towed either assembled or separated into two loads that made it more maneuverable than most heavy artillery pieces. The range of 18,000 meters was not much greater than the 152mm gun-howitzer, but the 98.4 kg shell made it a potent barrage weapon.[28]

Of the 14 weapons in the First Five-Year Plan program, four were direct results of the Rheinmetall contract: the 37mm antitank gun, the 45mm antitank gun, the 76mm antiaircraft gun, and the 152mm regimental gun. Four had possible connections: the 25mm antiaircraft gun, the 37mm antiaircraft gun, the 76mm regimental gun, and the 152mm howitzer. The remaining eight were modernized versions of World War I guns of French design or completely new Soviet designs.

The Second Five-Year Plan also included an artillery component, the 1933 program. The second program was more ambitious than the foreign designs and modifications included in the 1929 program. With a growing heavy industry, the Russians planned an entirely new family of artillery, stressing use of standard parts among various types of guns, multiple-use guns, and increased range for all calibers.[29] The 1933 program included the following guns:[30]

Weapon	Weight (kg)	Muzzle Velocity (m/sec)	Shell Weight (kg)
45mm antitank gun M1937	560	335	1.43
76mm divisional gun M1933	1,600	706	6.23
76mm divisional gun M1936 F-22	1,620	706	6.23

122mm howitzer M1909/37	1,450	364	21.76
122mm gun M1931/37 A-19	7,117	800	24.4
152mm howitzer M1910/37	2,155	n/a	43.56
152mm gun howitzer M1937 ML-20	7,128	655	43.56
152mm gun M1910/34	7,100	655	43.56
152mm gun M1935 BR-2	18,187	880	48.77

The 76mm divisional gun M1933 was a product of cooperation with the German engineers of Rheinmetall. It was produced with a lengthened tube of 50 calibers, an improved breech, and standard ammunition.[31]

The new 76mm gun M1936 F-22 was an attempt to create a dual-purpose gun. The designer, Grabin, who had worked with the Germans from Rheinme-tall, used a slightly longer barrel than the M1933 but improved its performance and reduced the weight. The M1936 F-22 76mm gun was an entirely new weapon designed primarily as divisional artillery, but with a long barrel (51 calibers) and a high muzzle velocity of 706 m/s, making it an effective antitank gun. Although it weighed 1,620 kg, the carriage was not strong enough to absorb the heavy recoil caused by the high muzzle velocity and the 6.4 kg shell.[32] Greater elevation was made possible by the split trail. An increased! rate of fire from a semiautomatic vertical sliding wedge breech made it a good antitank gun. The design was simplified to make production easier, however the recoil was too much for the lighter carriage, and the gun was damaged after a limited number of rounds were fired.[33]

The M1931 A-19 122mm gun was approved in 1937 with a new carriage and designated the M1931/37. Weighing 7,117 kg, it was difficult to move, requiring a separate two-wheel limber to support the trail. The 25 kg shell and 20,800 meter range were better than average for medium guns. The long 46-caliber barrel and 800 m/s muzzle velocity made it a potent antitank weapon when mounted on a heavy tank chassis, as the JSU122.[34]

The 152mm gun howitzer M1937 ML-20 was a cross between a howitzer that could lob shells over hills and a gun that offered long range. The 152mm gun M1910/34 used the same carriage as the 122mm M1931 A-19 with its split trail, high elevation, and wide traverse. The breech mechanism was also improved.[35] The 152mm gun M1935 BR-2 used the same carriage as the 203mm howitzer M1931B-4 and, later, on the 280mm mortar M1939 BR-5, providing economies in manufacture.[36]

The 1938 program was part of the Third Five-Year Plan. The emphasis was on heavy artillery, and previous attempts to develop recoilless guns and rifled mortars were abandoned. The program envisaged a new 95mm gun to replace the 76mm gun in the rifle division artillery, but the 95mm was not developed. An improved 122mm howitzer replaced the older howitzer in the rifle division. Corps artillery retained the 122mm howitzer and added a new 107mm gun, a new 152mm howitzer, and a new 203mm howitzer. Army artillery included a new 210mm gun that was not developed and a new 305mm howitzer that was adopted. A new 76mm mountain gun and a new 107mm mountain howitzer were also part of the program. Antitank work was to be given to a new 45mm antitank gun, and the 76mm regimental gun was also to be improved. Some designs never worked out, but most already existed as prototypes and standard weapons.[37] The round of designs produced the following new guns:[38]

Weapon	Weight (kg)	Muzzle Velocity (m/sec)	Shell Weight (kg)
45mm antitank gun M1937	560	760	1.4
76mm mountain gun M1938	785	495	6.2
76mm division gun M1939 USV	1,483	676	**6.1**

76mm antiaircraft gun M1938	4,300	815	6.5
85mm antiaircraft gun M1939	4,330	800	9.2
107mm gun M1940 M60	4,000	737	17.1
122mm howitzer M1938	2,250	500	21.7
152mm howitzer M1938	4,156	510	40.0
152mm gun howitzer M1937 ML-20	7,130	655	43.5
210mm gun M1939	61,610	800	135.0
280mm mortar M1939	17,610	356	286.0
305mm howitzer M1939	62,110	530	330.0

The 45mm antitank gun M1937 modernized the M1932 by replacing the large wooden-spoked wheels designed to be horse drawn with wire wheels with sponge rubber tires designed to be towed by trucks. Sprung axles made it possible to tow the gun at high speeds (25 mph versus 3.5 mph). The semiautomatic breech system removed from the M1932 gun was restored to the M1937 version, making a higher rate of fire possible.[39]

The M1939 USV 76mm gun, also designed by Grabin, corrected the problems of the M1936, reducing the length of the barrel to 42 calibers, the muzzle velocity to 676 m/s, and the weight to 1,483 kg, making it easier to move. The new design strengthened the recoil system and the carriage. The gun was economical to produce and functioned well in combat. The M1939 adopted in September 1939 was the standard field gun of the Russian division in 1941.

In 1940 the M1940 M60 107mm gun provided the corps artillery with a lightweight long-range piece. The design was influenced by the German 10cm K18 gun, the Czech 105mm M1935 gun, and possibly the Bofors 105mm gun, however it fell short of expectations. Production began in the fall of 1941, but the plant was evacuated to the Urals and production never resumed. The recoil was too strong for the carriage. The 122mm gun replaced the 107mm in the corps artillery.[41] In 1941 the organization of the newly formed antitank brigades called for the M1940 107mm as a heavy antitank gun to equip one regiment in each brigade. As only a few 107mm guns were available, the Russians substituted the 85mm antiaircraft gun as an antitank gun. The Germans captured only eight of the 107mm guns.[42]

F.F. Petrov in Perm designed a new lightweight 122mm howitzer with a high muzzle velocity. The M1938 M30 122mm howitzer was adopted in September 1939 as the standard divisional medium artillery piece and was also used in corps and army artillery. The 21.8 kg shell was average. The howitzer had a 22,? caliber barrel, a high muzzle velocity for a howitzer (515 m/s), and an elevation of 63.5 degrees that gave it a range of 11,800 meters.[43]

The M1938 M10 152mm howitzer was also designed in Perm by V. A. Ilin. The new gun fired a 39.9 kg shell 12,400 meters, and weighed only 4,150 kg, compared to 5,500 kg for a comparable German howitzer. The 508 m/s muzzle velocity was appropriate for a howitzer.[44]

In 1934 the Russians had developed prototypes looking for a weapon to provide longer range than a howitzer without a radical increase in weight. The M1937 ML-20 152mm gun-howitzer had a long 32-caliber barrel and a moderate muzzle velocity of 655 m/s. It had a long range, 17,300 meters, compared to 12,400 meters for the comparable German howitzer with a muzzle velocity of 432 m/s. The chief of artillery, G. I. Kulik, appointed in 1937, opposed the howitzer, saying it was neither a gun nor a howitzer. Although the piece was in production, Kulik insisted on new trials... The trials were successful and production resumed. The 43.6 kg shell was on the heavy side. The piece was very heavy, 7,130 kg, making movement and emplacement difficult, but was much lighter than the M1935 152mm gun (17,200 kg) that it replaced.[45]

The 280mm mortar M1939 BR-5 made use of the carriage designed for 203mm howitzer M1931 B-4. Only a few of

the mortars were made, even though the carriage improved the mobility of the heavy weapons.[46]

The three artillery programs developed the standard weapons of the Red Army in June 1941. The enormous losses of artillery in the first six months of the war forced the Russians to search their depots for every serviceable weapon. Among the many older guns employed were the following:[47]

French Origin

75mm gun M1897
120mm gun M1878
155mm gun M1877
280mm Schneider mortar

British Origin

4.5-inch gun
6-inch gun
8-inch gun
9.2-inch gun
12-inch howitzer

Pre World War I Russian

76mm short gun M1913
107mm gun M1910
305mm Obukhov howitzer M1915

Other

Estonian and Latvian—Austrian 47mm Bohler 47mm antitank gun
Lithuanian— 105mm Skoda gun M1935

After June 1941, the Russians developed new guns to replace the heavy losses in the first six months of the war. To build the powerful artillery arm called for by Russian tactics, new guns were needed. New guns and mortars introduced during the war were as follows:[48]

Weapon	Weight (kg)	Muzzle Velocity (m/sec)	Shell Weight (kg)
45mm antitank gun M1942	570	820	1.43
57mm antitank gun ZIS-2 M1943	1,150	990	3.14
76mm divisional gun ZIS-3 M1942	1,115	680	6.2
76mm regimental gun OB-25	600	262	6.2
100mm gun BS-3 M1944	3,650	887	15.6
132mm rocket M20			
300mm rocket M30			
160mm mortar M1943 MT-13			
152mm howitzer M1943	3,600	510	39.9

In 1940-41 the Soviets designed the M1943 ZIS-2 57mm antitank gun to penetrate the heavier armor on new German tanks, replacing the 45mm gun. The gun was superior to the German 50mm antitank gun and equal to the British six-pounder. The new gun penetrated 100mm of armor at 1,000 meters Production difficulties delayed deliveries in 1941 and the gun was finally adopted in June 1943. The large powder charge that produced the high muzzle velocity required a long barrel and a substantial chamber, making it far more difficult to manufacture than the 45mm gun. The 1943 model was simpler to manufacture and used the same carriage as the 76mm M1942 division gun.[49]

The ZIS-3 76mm gun M1941 used the same carriage as the M1941 ZIS-2 57mm antitank gun and the barrel of the M1939 76mm gun. The M1942 version replaced difficult to manufacture box-section öveted trail legs with simple tubular legs. The ZIS-3 filled many roles: divisional artillery, antitank gun, and tank gun.[50] The weight decreased from the 1,620 kg of the M1936 to 1,116 kg, a major improvement. The 42.6-caliber barrel and the 680 m/s muzzle velocity increased the range and made it an excellent antitank gun using armor-piercing shot. With a 6.2 kg high-explosive shell, it was an efficient field gun.[51]

In 1944 the Soviets developed the BS-100mm gun with a 60-caliber barrel and a muzzle velocity of 887 m/s, making it a powerful antitank gun. The 160mm mortar M1943 MT-13 was introduced in January 1944. The heavy mortar was breech loaded and mounted on wheels. The mortar was designed for use against German fortification from firing positions near the front. The shell had more explosive power than a 152mm howitzer.[52]

In 1943 the M1938 152mm howitzer barrel, combined with the carriage of the M1938 122mm howitzer, produced the M1943 (D 1) 152mm howitzer, reducing the weight to only 3,600 kg but still firing a 39.9 kg shell. The barrel (25 calibers), muzzle velocity (508 m/s), and range (12,400 m) were similar to the M1938.[53] The 76mm guns made up nearly half the guns of 76mm or larger caliber in use in 1944, followed by the 122mm howitzer that made up 31%. Together the two guns that made up the divisional artillery accounted for 4/5 of Soviet artillery, as follows:

Type	% in use in 1944
76mm gun (M1936, M1939, ZIS-3, M1942)	48
122mm howitzer (M1909/37, M1938)	31
152mm howitzer (M1909/30, M1938)	8
107mm gun (M1940 M60, M1910/30)	1
122mm gun (M1931, M1931/37)	2
152mm gun-howitzer (Ml937)	3
152mm gun (M1934, M1935)	3
203mm howitzer (M1931)	4

Design of good artillery was only the first step. The guns had to be manufactured in great numbers. The Russians had a long tradition in artillery manufacture centered in arsenals located in St. Petersburg, Kiev, Bryansk, and Kazan. In the 19th century these arsenals had made bronze cannon. When steel came into use for the barrels, production moved to three plants in St. Petersburg, one at Perm, and others at Tsaritsyn (Stalingrad), Kolomna, Sormova, Helsingfors, and Abo during World War I. Some production and repairs took place at other arsenals. The three great factories in St. Petersburg were Putilov, Petrograd cannon plant, and Obukhov steel plant. The two other major plants during World War I were at Perm and Tsaritsyn. Most of the guns made were of 76mm caliber.[54]

During the Civil War, the Putilov plant in Petrograd made the 3-inch field gun M1902 for the Bolsheviks. The Perm factory made 3-inch field guns and 6-inch howitzers for the White forces, and the Sormovo factory near Nishnij-Novgorod made some cannon. After the Civil War, artillery production was practically at a standstill. In the 1920s

many factories began producing artillery that were predecessors of the 1929 program described above. By 1927 the Perm factory was making 6-inch howitzers M1927 and the Putilov plant was making the 76mm regimental gun M1927. The Petrograd cannon plant moved to Moscow and diversified.[55]

The First Five-Year Plan, which included the 1929 artillery program, expanded and modernized five factories: Perm, the Petrograd cannon plant in Moscow, the Putilov factory in Leningrad, the Bolshevik plant (formerly the Obukhov) in Leningrad, and the Stalingrad plant. In 1929 the Bryansk arsenal began repair work and made components. The Kiev arsenal began with repairs and then made components. The arsenal in Leningrad was converted to a manufacturing plant.[56]

In the 1930s productive capacity sharply increased and set the pattern for World War II production. By 1940 production of artillery was at a high level, as new guns replaced older designs and the Red Army increased in size. Additional factories, including the Red Putilov factory, were constructed in the late 1920s and early 1930s to manufacture artillery. By 1940 six major factories produced artillery: the Bolshevik and the Kirov factories (formerly the Putilov works) in Leningrad, the Stalin machine works in Kramatorskaya in in the Ukraine, the Kalinin factory no. 8 near Moscow, the Molotov factory at Perm, and the Ordzhonikidze factory at Sverdlovsk. Eleven other factories including one or more in Dnepropetrov, Mariupol, Nikolayev, Voroshilov, Gorki, Kolomna, Moscow, Stalingrad, Magnitogorsk, and Sverdlovsk also made guns along with 22 smaller plants.

By June 1941 there were 13 plants in five cities, listed in the table below.[58] The arsenal in Kiev began with repairs and then made carriages ot antiaircraft machine guns and 37mm antiaircraft guns M1939. In 1939 it began production of the Czech designed 76mm mountain gun M1938. In 1941 the plant, the major source of antiaircraft mount production, was evacuated beginning in June 1941 and was absorbed by the Votkinsk no. 235 plant.[59]

Name	City
Arsenal (no. 393)	Kiev
Bolshevik	Leningrad
Kirov (formerly Putilov)	Leningrad
Frunze no. 7	Leningrad
Kalinin no. 8	Kaliningrad (near Moscow)
Stalin no. 9	Sverdlovsk
Kirov no. 13	Bryansk-Ordzhonikidz
Stalin no. 92	Gorki
Molotov no. 172	Perm (later Molotov)
Barrikady no. 221	Stalingrad
Votkinsk no. 235	Votkinsk
Budennyi no. 352	Novocherkassk
Voroshilov no. 586	Kolomna

The Bolshevik plant in Leningrad that made naval guns and modernized 3-inch field guns M1902 (probably into 76mm guns M1902/30) in the 1930s turned to repair work after the city was surrounded. In 1941 it turned exclusively to regimental guns, as there was no further need for naval guns on the Baltic Sea.[60]

The Kirov plant in Leningrad made 76mm tank guns, 76mm regimental guns; and 76mm guns M1936 F-22; ten,

82mm, and 120mm mortars; 76mm mountain guns M1938; 45mm tank guns, and parts for other factories.[61] The factory also made KV tanks. Frunze no. 7 in Leningrad turned to repair work after the city was surrounded

Kalinin plant no. 8 at Kaliningrad made antiaircraft guns, 45mm antitank guns, and tank guns.[62] In the fall of 1941 some of its machinery was evacuat-ed to Molotov after an air attack and the Germans drew near the city. In September 1941 the number of shifts was reduced from three to two and the number of workers declined from over 12,000 to 10,600. However, the plant continued in production and the Germans retreated during the winter. Most of the personnel returned from Sverdlovsk. In April 1942 the factory was producing daily 40 85mm antiaircraft guns, 16 naval 76mm antiaircraft guns, 15 army 76mm antiaircraft guns, 43 automatic 45mm antiaircraft guns, and 70 45mm antitank guns. Over 180 guns were being assembled every day, or over 5,000 per month.[63]

The Stalin plant no. 9 at Sverdlovsk was built in 1937 as part of the URALMASH complex. It began producing 122mm howitzers M1910/30 and in 1940 shifted to the M1938 M-30 model. The design bureau was led by F. F. Petrov, who moved from Perm. During the war the plant had 25,000 workers, mostly women and youths. Part of plant no. 8 from Kaliningrad was evacuated to Sverdlovsk and added to the factory. In September 1943 the daily production included 20 45mm antiaircraft guns, 30 76mm antiaircraft guns, 45 76mm tank guns, 15 122mm howitzers, 4 85mm tank guns, 4 152mm howitzers, and 2 203mm heavy howitzers. Later it also produced the 100mm and 122mm SU guns. The Kalinin and Sverdlovsk plants worked together throughout the war.[64]

The Kirov plant no. 13 in Bryansk was evacuated to Ust-Katav in the Urals and made 82mm mortars and mounts for 85mm antiaircraft guns. Later the plant made rockets, 76mm tank guns, and in 1944 85mm tank guns.[65]

The Stalin plant no. 92 at Gorki was built under the First Five-Year Plan from 1931 to 1934 and production began in 1934. The location at Nowoje Sormovo was was influenced by the nearby Sormovo factory. Plant no. 92 had a new design bureau and specialized in field artillery and tank guns. During World War II, it was the leading producer of artillery. It employed 30,000 workers, of which 30% were women, 30% youths, 45% men unfit for the army, and 5% wounded men released from the army.

The daily production of one building alone was 9 122mm howitzers, 6 152mm howitzers, and parts for 15 more. Other buildings made the ZIS-3 76mm gun, the 76mm F-34 tank gun, and the ZIS-5 76mm tank gun. In March 1943 the building no. 1 was making more than 120 76mm guns per day. Buildings 13 and 27 assembled 140 guns of various calibers each day. Later the plant made 57mm antitank guns and 85mm tank guns. This plant played the major role in artillery production.[66]

Molotov plant no. 172 was the former Perm factory with its long history in artillery production. In September 1941 the plant was expanded by the addition of parts of Kalinin plant no. 8 evacuated from the Moscow area. In April 1943 the factory employed 40,000 workers, 60% women, and 10% youths, working two 12-hour shifts. The factory made 30 45mm antitank guns, 30 76mm field guns, 12 152mm howitzers, and 5 45mm antiaircraft guns each day in April 1943. The plant also made 122mm howitzers, 122mm guns, 152mm guns, M1838 76mm regimental guns, 25mm automatic antiaircraft guns M1940, and 152mm gun-howitzers also used on the SU 152 and JSU152. During the war the factory provided artillery for 116 artillery regiments. The complex included over 16 buildings with individual buildings producing carriages, barrels, and other parts, while several buildings (no. 11 and no. 16) were assembly lines.[67]

The Barrikady plant at Stalingrad had been built to make copies of the Skoda super-heavy artillery pieces contracted for before the Germans took Prague. Production had begun in 1936 of the 122mm corps guns M1931, the 203mm howitzer M1931 B-4, the 152mm gun M1935 BR-2, and the 280mm mortar M1939 BR-5. In 1939 the plant began the manufacture of 76mm division guns M1939 USV. During the war the factory also made 120mm mortars. When the Germans reached Stalingrad in August 1942, some workers and machinery had gone to Votkinsk, but the plant continued to make guns until occupied by Germans troops.[68]

Plant no. 235 in Votkinsk was developed in 1938 by converting a factory that had built narrow-gauge railroad locomotives. In 1941 it had acquired German machinery to manufacture the 107mm corps gun M1940 M60. In the fall of 1941 it absorbed the arsenal evacuated from Kiev and machine works no. 14 from Galevo on the Kama River. Some

equipment also came from the Budennyi plant no. 352 at Novocherkassk. In August 1942 additional workers and machines came from Stalingrad. In September 1942 the plant had 12,000 workers. Early in the war the main products were 152mm howitzers, M1938 M10. Later the plant made 45mm antitank guns, 76mm divisional guns, 57mm antitank guns, and 76mm tank guns. In June 1942 the factory was making over 1,500 guns per month and in February 1943 the daily production of the factory included 56 45mm antitank guns and 30 76mm field guns. The factory became the second largest artillery producer in the Soviet Union during the war.[69]

The Budennyi plant no. 352 at Novocherkassk began production of the 107mm gun M1940 M60 and the 122mm corps gun M1931/37 A-19 in 1941. The factory was evacuated to Votkinsk in the fall of 1941 and was absorbed by plant no. 235.[70]

Voroshilov plant no. 586 at Kolomna began as a repair facility, but in 1939 it was converted to the manufacture of the new automatic 37mm antiaircraft gun M1939.[7'] In the fall of 1941 it was evacuated to Krasnoiarsk along with a factory from Kaluga to form plant no. 4 making 37mm antiaircraft guns, 120mm mortars, and depth charges.[72]

Additional plants not mentioned in other sources included the Kunzevo plant no. 46 located near Moscow. The plant had been built in 1932 and expanded in 1941» In December 1943 the factory employed 15,000 workers making 50 45mm and 57mm guns and 30 76mm field guns daily.[73] Factory no. 183 at Nishnij-Tagil made 250 to 300 76mm guns per month in 1944.[74]

After the Stalingrad plant was destroyed, of the 13 plants in production in June 1941, there remained only 8 factories, excluding the plants in Leningrad that were in limited production. The three in Leningrad, the Kiev plant, and Stalingrad were no longer providing weapons to the main front. Of the eight remaining, five were in the Urals near the tank factories (Gorki, Molotov, Sverdlovsk, Votkinsk, and Novocherkassk); two were near Moscow (Kaliningrad and Kolomna); and one was close to the front at Bryansk. Three of the plants in the Urals had been built in the 1930s as part of the five-year plans, and all were among the major producers of artillery. After Stalingrad was retaken, the plant was restored and production of 122mm tank guns began late in the war. When the siege of Leningrad was lifted, the three plants there were restored and in 1944 made the 100mm field gun M1944 BS-3, among other weapons.[75]

The total number of guns and mortars produced during the war according to the latest published figures was 526,200. Of these 100,000 were used on tanks and SUs. The heavy losses of the first few months of the war put a heavy strain on stocks, while the many new formations needed artillery. In June 1941 the Red Army had 112,800 guns and mortars and in the next five months made 58,400. However, in that same period the Russians lost 101,100, leaving only 70,100 guns and mortars (including 21,500 50mm mortars) in December 1941. The number of guns and mortars over 50mm decreased from 76,500 to 48,600.[76] Russian production dropped drastically from 1940 to 1941. The loss of the western zone where most of the artillery had been made was major; evacuated industries did not get into production until 1942.

Production of artillery peaked in 1942 astonishingly enough and declined steadily during the remainder of the war, as production of the mortars and the 45mm antitank gun was sharply curtailed. The light and medium mortars and the 45mm gun were obsolete after 1942. These weapons made up 250,800 of the total of 287,700 in 1942 and only 6,100 of the total of 43,300 in 1944. The total of all other guns and mortars in 1942 was 36,900 compared to 37,200 in 1944. The prewar development of factories in the Urals had provided sufficient capacity to replace even the catastrophic losses of 1941, as shown below:[77]

Year	All Types
1941	53,600
1942	287,000
1943	126,000
1944	47,300

1945	11,300
TOTAL	525,200

Production came from five major plants. The totals may refer to guns and mortars of 76mm or more. Guns and mortars of smaller caliber accounted for 226,800 of the total of 526,200, leaving 300,600. The missing 55,000 could have come from other factories, as follows:

Plant	Number of Guns and Mortars
Gorki no. 92	95,000
Votkinsk no. 235	52,000
Molotov no. 172	48,600
Sverdlovsk no. 9	30,000
Kalinin no. 8	20,000
TOTAL	245,600

A comparison of Soviet and German production of antitank, antiaircraft, and field artillery showed steady gains by Germany. However, during the three years covered in the table below, 66% of German production went to antiaircraft guns while only 17.7% of Soviet production was used for that purpose.[79] The huge diversion of German production to heavy antiaircraft guns constituted a "true military industrial second front" in 1943 and 1944.[80] While Germany was subjected to heavy air bombardment, the German air attacks on the Soviet Union were minor in comparison.[81]

ANTIAIRCRAFT GUNS		
Year	**Germany**	**Soviet Union**
1942	40,574	56,148
1943	62,088	55,624
1944	90,782	42,600
TOTAL	113,372	153,372

The type of guns manufactured changed considerably during the war as heavier weapons were made in the later years to be used in demolishing German fortifications. Other than the reduction in mortars and 45mm antitank gun production, the only major change during the war was the heavy increase in antiaircraft guns, especially the light guns, which made up nearly one-third of total production in 1944. Total losses in guns and mortars exceeded 100,000 in both 1941 and 1942, but most of the pieces lost were mortars (60.500 in 1941, 82,200 in 1942), 45mm antitank guns, and 76mm field guns. Production of the 76mm guns was more than sufficient to replace the losses in 1942. The stock of 76mm guns at the beginning of the war was 15,300 and dropped to 9,500 in January 1942. By January 1943 the stock was at 23,000 and in January 1945 had increased to 41,100.[82] The following table lists annual production.[83]

Weapons	On Hand	1941	1942	1943	1944	1945	Total
Antiaircraft Guns	8.6	3.4	6.8	12.2	13.4	2.6	38.4

25mm	0.0	0.3	0.2	1.5	2.4	0.5	4.9
37mm,40mm	1.4	1.4	1.6	6.9	9.0	1.5	22.6
76mm, 85mm, 90mm	7.2	1.7	6.1	3.8	2.0	0.6	10.9
Antitank Guns	14.9	2.5	20.5	23.4	6.4	1.4	54.2
45 mm	14.9	2.1	20.5	21.5	4.1	0.6	48.8
57mm	0.0	0.4	0.0	1.9	2.3	0.8	5.4
Artillery	33.2	10.1	30.1	22.1	21.5	5.8	89.6
76mm	15.3	6.5	23.6	16.6	17.3	4.8	68.8
100mm, 107mm	0.9	0.1	0.0	0.0	0.0	0.3	0.7
122mm Guns	8.1	1.9	4.5 .	3.8	1.1	0.3	13.6
122mm Howitzers	1.3	0.3	0.3	0.5	0.2	0.1	1.4
152mm Guns	3.8	0.3	0.0	0.1	0.3	0.1	0.8
152mm Howitzers	2.8	0.9	1.7	1.1	0.3	0.2	4.2
203mm and over	1.0	0.1	0.0	0.0	0.0	0.0	0.1
Mortars	56.1	42.4	230.3	67.9	2.0	1.4 (Error in original table)	344.0
50mm	36.3	23.2	104.4	17.5	0.0	0.0	145.1
82mm	14.5	16.6	100.5	33.6	0.6	1.0	152.3
107mm, 120mm	5.3	2.6	25.4	16.8	1.4	0.4	46.6
160mm	0.0	0.0	0.0	0.0	0.6	0.8	1.4
TOTAL GUNS AND MORTARS	112.8	58.4	287.7	125.6	43.3	11.2	**526.2**
Rockets	0	0	3.3	3.3	2.6	0.8	11.0

German intelligence tended to inflate Soviet artillery production by about 20%.[84] In the intelligence reports made by the Germans there is seldom a reference to a Soviet artillery unit being short of guns. The supply was more than adequate for the needs of the artillery divisions, brigades, and regiments by the end of 1942, though the numbers of these units increased steadily throughout the war.

During the 1930s, when all Red Army weapons were developed, the mortar was not highly favored. In 1936 the mortar design bureau closed because there was no requirement for the weapon. In the late 1930s, interest revived though opposition remained as late as 1940.[85] The Russians made heavy use of mortars in 1941 and 1942, as they provided an inexpensive method of delivering explosives at short range, a pressing need in the first year and a half of the war. Mortars used by the Red Army during the war were as follows:[86]

Type	Weight (kg)	Bomb Weight (kg)	Range (m)
50mm M1938 and M1940	13.0	0.6	3,000
82mm M1937 and			

M1941	45.0	3.35	3,000
107mm mountain M1938	156.0	7.2	5,000
120mm M1938 and M1943	220.0	15.7	6,000
160mm M1943	1,080.0	41.1	5,700

When the Red Army moved to the offensive, it required more sophisticated guns and howitzers. Light and medium mortar production declined by the end of 1942. The heavier mortars were special-purpose artillery pieces, and their number grew in the final years. During the war new types were introduced—the M1941 82mm, the M1943 120mm, and a heavier model, the M1943 160mm. Production of 82mm and 120mm mortars increased in 1942. In the first half of the year, 45,485 82mm mortars and 10,183 120mm mortars were made; in the second half, 55,378 82mm and 15,164 120mm were manufactured.[87] In 1943 the production of all types of mortars declined to 69,500, and in 1944 only 7,100 were made. Losses on the battlefield were evidently minor and few rifle divisions were created after 1943. The new mortar regiments used heavy mortars.[88] Later mortar production also provided rifle divisons with heavier mortars and replaced losses. Total production from 1941 to 1945 was 351,800 compared to 79,000 produced by the Germans.[89]

The Russians had a long history of research in rockets. In November 1938 the first operational launcher was designed. A second design in December 1938 consisted of a frame that could launch 24 projectiles. In April 1940 a frame was placed on a truck and designated the BM 13 that fired eight 132mm projectiles. During the war three types of rocket launchers were used, all mounted on trucks: the BM 8-48 (82mm), the BM 13 (132mm), and the BM 30, later replaced by the BM 31-12 (300mm).[90] The BM 13 had a range of 8,470 meters and a 33 kg warhead. The total weight of the BM 30 rocket was 72 kg with a range of 2,800 meters. The improved BM 31 rocket weighed 92.4 kg and had a range of 4,325 meters.[91]

By early 1943 the Russians were manufacturing large numbers of guns and mortars sufficient to replace losses and to equip new units. However, artillery was of no value if there were no shells. During World War I, the armies on the Western Front had used prodigious amounts of shells in barrages that lasted for days. The barrage doctrine carried over from that war to 1939, and large stocks of shells had been accumulated by the major powers before war began. The Germans did not experience the extreme shortage of shells that marked the beginning of World War I. The quick campaigns from 1939 to April 1941 required smaller amounts of munitions.

The Russo-German conflict brought back the era of massive bombardments. The Soviets developed their chemical industry under the five-year plans to prevent a shortage of explosives in any future war. Attempts to build a reserve stock of artillery shells in the late 1930s failed because of the demands for training, exports to Spain and China, and conflict with Japan and Finland. In 1939 construction of new plants began and old plants were modernized. In 1940 production of shells had increased by 50% over 1939, and in 1941 production was increasing again.

However, shortages did develop because many plants were in the Ukraine and the Donbas, which were overrun by the Germans. In the second half of 1941, 303 ammunition plants with a capacity of 100 million artillery shells and 32 million mortar bombs ceased to operate. Added to this loss was the unexpected large quantity needed to break through German defenses.

A brief description of some factories that manufactured shells will assist in understanding the shortage of shells and Soviet attempts to solve the problem. Munitions plant no. 22 at Seredovina near Kuibyshev was the second largest munitions plant. The factory employed 20,000 workers in September 1942 working two 11-hour shifts. The factory had been built in 1905 and occupied a site of nearly 50 square km. The daily production was over 30,000 76mm shells, 50,000 45mm shells, 60,000 37mm shells; and shells for 122mm,, 152mm, and heavier guns.[92]

A factory near Chelyabinsk had been a railroad car repair works before the war. Workers and machinery were

evacuated from Bessarabia to the plant in late 1941. In 1943 the plant made 76mm and 122mm gun ammunition.

Plant no. 45 in Tashkent had received machinery and workers from the Kaganovitsch railroad repair works at Dnepropetrov in 1941. Tashkent became the major locomotive repair works in Central Asia, repairing 30 locomotives per month and overhauling 23 more. The plant also made 122mm shells. The plant had 7,000 workers—60% women and 15% youths working two 12-hour shifts.

Plant no. 62 at Schirschni near Chelyabinsk had been evacuated from Yaroslavl in October 1941. The factory employed 800 men working two 12-hour shifts making parts for antiaircraft guns and 12,000 shells per day using American copper.[95] Plant no. 259 in Zlatoust near Chelyabinsk had been built in 1917 and had 20,000 workers in 1942. The factory had been expanded by evacuated machinery and workers in 1941 and, in 1942, was producing rifle and artillery ammunition.[96] Plant no. 318 in Baku made machinery for the oil industry before the war, but by December 1942 was making 96,000 152mm shells per month.[97]

Ammunition production had a lower priority than weapons production in the competition for factories, steel, fuel, power, and machinery. The most serious shortages were the chemicals, cellulose and nitric acid.[98] Chemicals for the manufacture of explosives made up a significant part of lend-lease.

Although production increased slowly during the war, the Germans made more shells than the Russians in all categories. However, antiaircraft defense, and after June 1944, ground warfare in the West, diverted some German supplies. Compared to the other major powers, the Soviets fired fewer shells per gun. Instead, they assigned more guns for comparable missions (possibly to replace the ability to organize "time on target" barrages when all of the shells from many batteries would arrive simultaneously on a target area). Guns moved forward instead of adjusting the range, making it possible to aim directly at targets in place of indirect fire. The Red Army used one-third of its guns in direct fire. The resulting greater percentage of hits required less ammunition to achieve the same result, though at the expense of more work in moving the guns and greater danger to the gun crews.[99]

Even though the Soviets fired fewer rounds for each gun, the number of guns in use was far greater than any other nation. To supply the large number of guns even with a limited supply of shells required considerable effort. The consumption of artillery shells was immense. In 1944 the 3rd Ukrainian Front used 120 carloads (20 to 40 tons each) of ammunition daily. The apportionment by caliber was as follows:[100]

45mm	5%
76mm	65%
122mm	8%
152mm	7%
Rockets	15%

Although the evidence is far from complete, it can be assumed that just as American corporations developed the tank, auto, truck, and tractor factories and other heavy industry, Rheinmetall from Germany, Skoda from Czechoslovakia, Bofors from Sweden, and perhaps Krupp had the same role in the development of the Soviet arms industry in the 1930s. Foreign assistance explained the dramatic increase in weapons production in the Soviet Union from the early 1920s to the late 1930s. The weapons that were produced by this practically new industry were equal in quality to the best of any other major power and superior in quantity to all. This rapid advance in about 15 years could result only from assistance that eliminated or drastically reduced research and development of not only the weapons themselves but the means of making them. It is ironic that the major contributor to the Soviet development in arms manufacture was the Weimar Republic. When Hitler gained power, technical assistance ended but the harm had been done. Next to the American aid, technical assistance in the 1930s and lend-lease during the war, the German arms manufacturers in the 1920s and early 1930s did the most to ensure the defeat of Hitler by providing the Russians with the designs, manufacturing skills, and instruction of arms designers to produce a full range of modern weapons.

NOTES

1. Krivosheev, p. 349; Volz, XII, p. 217.

2. Ibid., p. 127.

3. Volz, XII, p. 223.

4. Vote, XII, p. 224.

5. Small-bore weapons were referred to by the diameter of the bore plus the word *caliber,* but this usage had no relationship to the length of the barrel. For example, a .50-caliber machine gun could have a barrel of any length. The *.50* refers only to the diameter of the bullet.

6. Konstantin P. Kazakov, ed., *Artilleriia i Raketi* (Moscow: Voenizdat, 1968), pp. 108-109.

7. Ibid., pp. 110-11.

8. Arthur G. Volz, "Soviet Artillery Weapons: I, The Imperial Heritage," *Soviet Armed Forces Review Annual* 10 (1985-1986), pp. 237-38.

9. Volz, X, pp. 238-240.

10. *Illustrated Encyclopedia,* XII, p. 1331.

11. Volz, X, p. 243.

12. Arthur G. Volz, "Soviet Artillery Weapons: B, 1918-1941," *Soviet Armed Forces Review Annual* 11 (1987-1988), p. 301.

13. Volz, XI, 303.

14. Kazakov, *Artilleriia,* p. 64; V. G. Grabin, *Oruzie Pobedi* (Moscow: Izdatelistvo, 1989), p. 31; *Illustrated Encyclopedia,* XII, pp. 1331, 1344; Volz, XI, p. 302.

15. Volz, XI, pp. 308-309.

16. Volz, XI, p. 309.

17. Volz, XI, p. 305-06; Bundesarchiv file RH 8/V.3531 quoted in letter to author, October 17, 1994 from Arthur Volz.

18. Volz, XI, p. 306.

19. *Illustrated Encyclopedia,* XII, pp. 1331, 1344; FHO, CGR, H 3/82, December 1, 1941, Roll 550, Frame 390; Volz, XI, p. 317-18.

20. *Illustrated Encyclopedia,* XII, p. 1337.

21. Volz, XI, p. 306.

22. *Illustrated Encyclopedia,* XII, pp. 1331, 1333; FHO, CGR, H 3/82, December 1, 1941, Roll 550, Frame 398; Volz, XI, p. 303.

23. *Illustrated Encyclopedia,* XII, pp. 1333-34, 1339; FHO, CGR, H 3/82, December 1, 1941, Roll 550, Frame 398; Volz, XI, pp. 301, 306; Krivosheev, p. 343.

24. Volz, XI, pp. 303, 306.

25. Volz, XI, pp. 303-04; *Illustrated Encyclopedia,* XII, pp. 1341-43.

26. Volz, XI, p. 304.

27. Volz, XI, p. 304.

28. *Illustrated Encyclopedia,* XII, p. 1344; Volz, XI, p. 304.

29. Volz, XI, p. 302.

30. Volz, XI, pp. 315-19.

31. Volz, XI, p. 307.

32, Illustrated Encyclopedia, XII, pp. 1334, 1336; Krivosheev, p. 343.

33. *Illustrated Encyclopedia,* XII, pp. 1333-34; Volz, XI, p. 307.

34. Brian Blunt and Tolley Taylor, *Brassey's Artillery of the World* (New York: Bonanza Books, 1979), p. 49; Volz, XI, p. 304.

35. Volz, XI, p. 304.

36. Volz, XI, p. 305.

37. Volz, XI, p. 303.

38. Kazakov, *Artilleriia,* p. 65; Chris Bellamy, *Red God of War* (London: Brassey's Defence Publishers, 1986), p. 132; Stepan A. Tiushkevich, *Sovetskie Vooruzhennye Sily* (Moscow: Voenizdat, 1978), p. 187; *Illustrated Encyclopedia,* XII, p. 1334; Volz, XI, pp. 316, 318.

39. Volz, XI, pp. 306-07.

40. *Illustrated Encyclopedia,* XII, pp. 1334, 1336; B. L. Vannikov, "Iz Zapisok Narkoma Vooruzheniia," *VIZh* 2 (February, 1962), p. 78; Volz, XI, p. 307.

41. Tiushkevich, *Vooruzhennye Sily, p* 237.

42. FHO, CGR, H 3/340, October 23, 1944, Roll 562, Frame 85; H 3/78, January 1, 1944, Roll 550, Frame 47; Anfilov, *Krushenie,* p. 51; Volz, XI, P- 310.

43. Blunt and Taylor, p. 50; *Illustrated Encyclopedia,* XII, pp. 1334, 1336; Volz, XI, pp. 310, 318.

44. Blunt and Taylor, p. 57; *Illustrated Encyclopedia,* XII, pp. 1343-44; Volz, XI, pp. 310, 318.

45. Blunt and Taylor, p. 55; *Illustrated Encyclopedia,* XII, pp. 1343-44; Vannikov, p. 79.

46. Volz, XI, p. 305.

47. Volz, XII, p. 210.

48. Kazakov, *Artillerii,* p. 82; *Illustrated Encyclopedia,* XII, p. 1331; Krivosheev, p. 348.

49. Kazakov, *Artilleriia,* p. 65; Volz, XI, p. 311; Volz, XII, p. 215.

50. Blunt and Taylor, p. 32; *Illustrated Encyclopedia,* XII, pp. 1334, 1336.

51. Blunt and Taylor, p. 32; *Illustrated Encyclopedia,* XII, pp. 1334, 1336.

52. Volz, XII, p. 215.

53. Blunt and Taylor, p. 56; *Illustrated Encyclopedia,* XII, p. 1344; Volz, XII, p. 215.

54. Volz, X, pp. 240-41.

55. Volz, XI, p. 312.

56. Volz, XI, p. 312.

57. FHO. CGR, H 3/1689, September 1940, Roll 587, Frames 810 ff.

58. Volz, XI, p. 320.

59. Volz, XI, p. 312; Volz, XII, p. 210.

60. Volz, XI, p. 313; Volz, XII, p. 210.

61. Volz, XI, pp. 312-13.

62. Volz, XI, 313.

63. FHO, CGR, H 3/1339, Roll 585, Frames 403-14; Volz, XII, p. 13. 64. FHO, CGR, H 3/1339, Roll 585, Frames 396-98; Volz, XI, p. 313;

Volz, XII, pp. 210-11.

65. Volz, XII, p. 210.

66. FHO, CGR, H 3/1339, Roll 585, Frames 379-95; Volz, XI, p. 313; Volz, XII, p. 211.

67. FHO, CGR, H 3/1339, Roll 585, Frames 415-16; Volz, XII, p. 211; *VOVE,* p. 554.

68. Volz, XI, pp. 313-14; Volz, XII, p. 210.

69. Volz, XI, p. 313; Volz, XII, p. 211.

70. Volz, XI, p. 313; Volz, XII, p. 210.

71. Volz, XI, p. 313.

72. Volz, XII, pp. 210-11.

73. FHO, CGR, H 3/1339, Roll 585, Frame 421.

74. FHO, CGR, H 3/818, August 1944, Roll 578, Frame 562.

75. Volz, XII, p. 211.

76. Harrison, p. 264; Krivosheev, pp. 353-55. 37. Krivosheev, p. 349.

78. Volz, XII, p. 218.

79. Volz, XII, pp. 218-19.

80. Volz, XII, p. 219.

81. Volz, XII, p. 222.

82. Krivosheev, pp. 352-56.

83. Krivosheev, pp. 352-56.

84. FHO, CGR, H 3/1508, Roll 587, Frames 20-21; H3/340, Roll 562, Frames 85, 161-62, 206, 213, 258; H 3/118, Roll 552, Frame 248; H 3/118, Roll 552, Frames 342-43.

85. Vannikov in Bialer, p. 157.

86. FHO, CGR, H 3/82, December 1, 1941, Roll 550, Frame 390; *VOVE,* p. 447; *Illustrated Encyclopedia,* XXI, p. 2352; *Tanks and Weapons of World War II* (New York: Beekman House, 1973), p. 25; Bellamy, p. 133; Krivosh-eev, p. 343 gives slightly different numbers.

87. Rokossovsky, *Velikai,* p. 210.

88. Harrison, p. 250.

89. *VOVE,* p. 447; *Illustrated Encyclopedia,* XXI, p. 2352; *Tanks and Weapons,* p. 25; Bellamy, p. 133.

90. *VOVE,* p. 606.

91. Bellamy, p. 133.

92. FHO, CGR, H 3/1711, Roll 588, Frame 269.

93. FHO, CGR, H 3/1711, Roll 588, Frame 311.

94. FHO, CGR, H 3/1711, Roll 588, Frame 290.

95. FHO, CGR, H 3/1711, Roll 588, Frame 261.

96. FHO, CGR, H 3/1711, Roll 588, Frame 280.

97. FHO, CGR, H 3/1711, Roll 588, Frames 273-74.

98. Volz, XII, pp. 220-221.

99. Volz, XII, p. 222.

100. FHO, CGR, H 3/73, Roll 549, Frame 542; The source was a prisoner who had been in the munitions supply headquarters for the front.

8 Antitank Guns

The Red Army made greater use of antitank guns than any other nation in World War II. By the end of the war there were 66 towed tank destroyer brigades with over 198 regiments and an additional 89 independent regiments with a total of nearly 7,000 guns. Additional battalions were assigned to rifle divisions and other units. Light artillery brigades and regiments and divisional artillery regiments equipped with 76mm guns performed antitank work as a secondary mission.

The Soviet development of antitank guns was not unique, but the number of towed guns was far greater than other armies that relied more heavily on self-propelled guns. Most strategists agreed that an antitank gun was the best method to stop a tank. There were three types of projectiles: high-velocity armor-piercing, tungsten-cored, and shaped-charge.[1] The ordinary armor-piercing shell penetrated the armor by the force of the impact and exploded inside the tank. Even when the projectile did not penetrate, the impact flaked Pieces of steel in the interior of the tank. The hot pieces of metal ricocheted, causing havoc with the crew and equipment. When a tungsten-core shell hit the exterior of the tank, it transferred all of the momentum to the small core made of tungsten steel. The core, being tougher than the armor and having increased energy, penetrated thicker armor than a similar armor-piercing shell. The shaped-charge shell mashed against the exterior and the indentation on the explosive charge created a powerful explosive stream that pierced the armor.

The explosive stream, fragments of armor, and high pressure caused by the explosion destroyed the crew and equipment. The advantage of the shaped charge was that it worked better at low velocity. Rapid spinning reduced the effectiveness of a shaped charge. Another advantage of the shaped-charge projectile was that it was less likely to ricochet when striking armor at an angle.[2]

The high-velocity gun was the mainstay of the Russian defense. Higher velocity, not a heavier projectile, improved penetration. To punch a hole in armor with the least amount of energy, the energy had to be concentrated in the smallest possible area. A heavy projectile was counterproductive because the greater area spread the momentum (measured in meter kilograms per second) and increased air resistance. The area could not be reduced to the point where the penetration did no harm—for example, the antitank rifle bullet did little harm even after penetrating the armor.[3] On the other hand, a large projectile with a comparatively low velocity had sufficient momentum to knock the turret off the tank without penetrating the armor. That was the advantage of the heavy-caliber Russian SUs from July 1943 to the end of the war.[4]

The impact can be measured in meter kilograms per second per square millimeter. Computations for the three most common Russian guns revealed that the 45mm M1937 gun hit with .68 m/kg/sec per square mm, the 57mm M1941, 1.22 and the ?6mm M1939, .92. The larger projectile lost its velocity much quicker than the smaller shell because of air resistance. The 45mm M1937 gun pierced 43mm of armor at 500 meters; the 57mm M1941, 100mm; and the 76mm M1939, 70mm.[5] Although the 76mm gun had a performance near the 57mm at close range, the effect of air resistance reduced its power at 500 meters.

To increase the muzzle velocity of a gun of a given caliber, the designer had to increase the amount of powder. Increasing the powder required a larger shell and a larger chamber to fit the larger shell, A longer barrel gave the powder time to burn. A heavier carriage or more efficient recoil mechanism was needed to absorb the increased recoil. All of the changes increased the weight of the gun, but a gun weighing over a ton became difficult to move by hand. The M1937 45mm weighed 560 kg, the M1939 76mm gun weighed 1.48 tons. At 1.25 tons the M1943 57mm gun could still be moved by hand.[6]

The Germans rejected the idea that the best antitank weapon was another tank. The most effective gun carried on German tanks of 1939 to 1941 was the 37mm gun on the Mk III. The 75mm howitzer on the Mk IV had a very low muzzle velocity designed to fire high-explosive shells at infantry positions. To the Germans, tanks were offensive weapons, not defensive. Their role in elastic defense was to counterattack.[7] The German doctrine before the war placed great stress on the antitank gun. The Germans developed the 37mm antitank gun that was adequate to deal with most Western tanks in 1940.

The German formula to calculate needs was similar to the French and Russian. One author tested the formula by assuming the following variables: (1) a regiment held a 3 km front, (2) a regiment had only the nine antitank guns in the regimental antitank company, (3) tanks would attack in a density of 100 per km, (4) the 37mm gun could destroy tanks at 800 meters, and (5) the tanks could move the 800 meters in 4 minutes.

With guns spread evenly over the front, the German calculation showed that the three guns per km would destroy only 18 tanks, leaving 82. If the guns were held in reserve and rushed to threatened sectors, the guns arrived too late.

Natural obstacles and man-made obstacles (minefields and antitank ditches) channeled attacks into selected sectors, but not always. The proposed solution was a self-propelled gun with a heavy gun, high speed, and adequate armor to react to a tank attack.[8] As early as 1940 the Germans began to develop self-propelled tank destroyers.

The Russians selected the number of guns using an equation based largely on the rate of fire of the guns and the speed of the tanks. The formula provided an excellent outline of the factors related to an effective antitank gun line, although the weight assigned to each factor was debatable. A 1972 publication apparently based on Soviet military manuals used the formula. In November 1945, TM 30-430, based on World War II German intelligence sources, summarized the formula as follows.[9]

T = number of enemy tanks expected to attack 1 km of front
K = number of rounds required to stop one enemy tank
S = number of rounds fired per minute
A = maximum distance at which a tank can be destroyed
B = distance a tank can move in one minute
X = number of guns required
(A/B) = time of engagement during which a tank can be destroyed.

$$X = \frac{T \times K}{S \times (A/B)}$$

The number of guns for an effective defense is equal to the number of tanks expected to attack 1 km of front, multiplied by the number of rounds needed to stop one enemy tank, divided by the rounds fired by one gun in one minute, multiplied by the time of engagement. For example, if 50 tanks were expected on 1 km of front, 12 45mm rounds were needed to destroy a tank, a 45mm antitank gun fired 15 rounds per minute, a tank moved at 18 km per hour or 300 meters per minute, and a 45mm gun could destroy a tank at 600 meters, the following equation results:

$$\frac{50 \times 12}{15 \times (600/300)} = 20 \text{ x 45mm Guns Per Km of Front}$$

The example probably related to Mk III tanks, as the 45mm gun was not effective against other German tanks at 600 meters. The same equation using 76mm guns is:

$$\frac{50 \times 6}{10 \times (600/300)} = 15 \text{ x 76mm Guns Per Km of Front}$$

Note that the number of rounds required had dropped to six, but the rate of fire had also dropped.

Another calculation based on the formula assumed that the Germans would use 100 tanks on a 1 km front. This calculation reduced the tank speed to 15 km/hour, giving the guns 2.5 minutes to fire. The changes increased the number of 45mm guns needed to 32 per km.[10] The Russians used the term *effective range* to denote the distance at which most crews would hit the target 50% of the time. Effective fire against a given tank was the distance at which the projectile penetrated the armor.[11]

There were variations within the factors, but the Russian parable was that the law crashed through all accidents and variables. Despite any variations, there was a definite relationship among the six factors in the equation. In other words, the variables tended to cancel out one another. Accuracy of fire by a skilled crew reduced the number of rounds needed to destroy a tank, but the next crew might not be as skillful. During the war the average number of rounds required to destroy a tank by all guns was six to eight including two or three direct hits. Range made a great difference: only one or two shots at 300 meters, but eight to ten at 1,000 meters.[12]

Additional frontal armor on German tanks reduced the range at which they could be destroyed and increased the number of guns needed to destroy them. The German goal was a combination of armor and gun that would enable the tank to destroy any antitank gun beyond its effective range. Tigers and Ferdinands could halt 1,500 to 2,000 meters from the PAK line and destroy the antitank guns beyond the effective range of the guns.[13] Increasing the number of tanks, improving the performance of the guns, or any other change in the factors altered the equation. The six factors—the number of tanks per km, the] number of rounds needed to destroy a tank, the rate of fire of the antitank guns, the speed of the tank, the effective range of the antitank guns, and the armor on the tanks—determined the choice of guns and organization in the Russian antitank defense system.

The Russian goal was to design an antitank gun that was light enough to be moved by hand, had a low profile that would fit in a shallow gun pit, was easy to camouflage, and had sufficient range to destroy tanks in front of the HKL, even from positions at the rear of the HKL.[14] In the 1929 program under the First Five-Year Plan, the 37mm antitank gun M1930 and the 45mm antitank gun were manufactured under the Rheinmetall contract discussed in the previous chapter. More antitank guns were developed in the 1933 and 1938 programs. The guns used in the antitank role during World War II were as follows:[15]

SOVIET ANTITANK GUNS			
Gun	**Weight (kg)**	**Muzzle Velocity (m/sec)**	**Shell Weight (kg)**
37mm antitank gun M1930	406	762	.82
45mm antitank gun M1932	520	762	1.54
45mm antitank gun M1937	560	760	1.43
45mm antitank gun M1942	570	820	1.43
57mm antitank gun M1941		990	3.17
57mm antitank gun M1943 ZIS-2	1,150	990	3.17
76mm division gun M1902/30	1,350	680	6.2
76mm division gun M1933	1,600	706	6.23
76mm division gun M1936 F-22	1,620	706	6.23
76mm division gun M1939 USV	1,483	676	6.2
76mm division gun ZIS-3 M1942	1,115	680	6.2
76mm antiaircraft gun M1931	3,750	815	6.5
85mm antiaircraft gun M1939	4,330	800	9.2
100mm antitank gun M1944	3,454	900	15.8
107mm gun M1940	4,000	737	17.1

The 37mm gun was effective against the 30 to 40mm of armor on the existing light tanks. In 1932 the Russians redesigned the gun, making it larger, to fire a 45mm shell with superior characteristics. They decided to increase the size, anticipating that armor on tanks would increase and that the 37mm would no longer be effective. The Germans

and the United States stayed with the 37mm until after 1941. The M1932 45mm increased armor penetration only 4mm from 36mm to 40mm. The longer barrel on the M1937 did not improve the performance markedly. The M1937 45mm gun had a muzzle velocity of 760 m/s and fired a 1.43 kg shell that penetrated 43mm of armor at 500 meters.

However, experience in Spain showed the superiority of the 45mm gun against the Mk I German tank.[16]

The Russians manufactured 12,200 45mm M1937 guns from 1937 to 1940 and, by June 1941, had 14,500 antitank guns.[17] Production was about 1,800 per month in 1942. The 45mm gun was first issued to rifle battalions in 1935. In the fall of 1939, each rifle regiment had a battery of 45mm guns and each rifle division had a battalion of 45mm guns.[18] The 45mm gun remained in use until the end of the war." With the German invasion, production concentrated on the existing designs. The 45mm M1937 remained in production until 1943. In late 1941, a new design produced at plant no. 172, die M1942, had a stronger carriage, a longer barrel (increasing the length from 46 calibers to 68!), and a muzzle velocity of 820 m/s, firing the same shell. The tungsten-core shell penetrated 70mm of armor at 500 meters and 51mm at 1,000 meters.[20]

The second artillery program made little impact on antitank weapons. The 1938 program still carried the 45mm gun as the primary antitank gun, but in April 1940, Grabin at plant no. 92 began designing a more powerful antitank gun. The result was the 57mm antitank gun ZIS-2 M1941. The 57mm gun was similar to the 45mm with an increased bore, chamber, and barrel length. The 57mm M1941 had a muzzle velocity of 990 m/s and fired a 3.17 kg shell. The shell penetrated 100mm of armor at 500 meters.[21] With a tungsten-core shell it penetrated 96mm at 1,000 meters. Despite problems, production began in April 1941 at plant no. 92, but all the guns had to be reworked because of defects. Production halted after the war began. Productive capacity was concentrated on proven 76mm designs.[22]

In 1943 an improved 57mm gun pierced 105mm of armor at 1,000 3 meters.[23] The 57mm gun destroyed German tanks at 600 meters as late as June 1944.[24] The 57mm gun penetrated even Tiger frontal armor at 400 meters and side armor at 1,000 meters.[25] The 57mm gun made the antitank gun line twice as effective with the same number of guns. The new gun doubled the effective range and maintained a high rate of fire because of the light-weight shell, however production (1,900 in 1943 and 2,300 in 1944) never met demand. The Germans considered the 57mm an excellent gun.[26]

The gun was very similar to the British six-pounder and the American 57mm. Ample supplies of both were available, but few went to the Soviet Union. The British sent 96 guns and in late 1942 offered the Russians more, trying to convince them of the gun's value. The Russians refused them, stating that their 57mm was a better gun. The Russians said that the ballistic properties of the six-pounder were inferior, that the ability to penetrate armor was less, and that the Russian gun was more durable.[27]

The two guns were very similar in performance and appearance. The problem was possibly confusing two similar shells. The six-pounder shell was about the same length and the casing was about the same diameter as the Russian 57mm shell. However, the Russian shell had a pronounced shoulder a few inches from the top of the casing, while the six-pounder shoulder was barely perceptible. The six-pounder shell probably would have fit in a Russian 57mm gun, but when fired, the case would have ruptured in the area of the shoulder where the Russian chamber was larger than the British casing. The ruptured casing would not extract and the gun would jam. In October 1942 the 103th Rifle Brigade exchanged English six-pounders for Russian 45mm guns because the British guns were not operable, according to a Russian prisoner of war.[28] That event reinforced the possibility that the Russians refused the British guns because the Russian 57mm used similar ammunition. The Russian supply service might have delivered the wrong ammunition, and gun crews might use the wrong shell. Stalin refused British rifles in 1941 because confusion would result from two different cartridges. The Russians, on the other hand, were willing to accept 650 American 57mm guns mounted on half-tracks and British tanks with six-pounders. The chance for error was reduced, as Russian 57mm guns were not mounted on vehicles after 1941.[29]

Given the checkered experience with the 45mm and 57mm guns in the 1930s and early 1940s, emphasis turned to the

76mm. The early decision to use a 76mm gun in the antitank role was wise. The 76mm gun was the most commonly used antitank gun and came in many different models. A gun of 76mm was the heaviest that could be manhandled, a requirement for an antitank gun. The M1933 was heavy for use as an antitank gun and its replacement, the M1936, was no lighter. In 1936 the Russian designers increased the size of the 76mm powder charge and the length of the barrel. The M1936 76mm gun had a muzzle velocity (706 m/s) that improved its armor-piercing performance, but the recoil was too heavy for the carriage. The recoil either broke up the carriage or bounced the entire piece to the rear. Even if the crew stood clear, the movement required sighting the gun again and drastically cut the rate of fire. The Russians manufactured few guns of this design.[30]

The M1939 was 140 kg lighter. The M1939 USV became the standard division artillery piece and the best antitank gun. The gun had a muzzle velocity of 676 m/s and fired a 6.1 kg shell. When the piece served as an antitank gun, the crew had 60 rounds of armor piercing ammunition and 80 rounds of high explosive. When assigned as divisional artillery, the gun crew carried 120 rounds of high explosive and 20 rounds of armor piercing. The armor-piercing shell penetrated 70mm of armor at 500 meters.[3'] The gun, originally designed as a dual-purpose antiaircraft and antitank gun, did not work well as an antiaircraft piece and was used only against ground targets. Production as an antitank and divisional gun began in 1940.[32] Production of all 76mm guns increased from 6,500 in 1941 to 23,600 in 1942. In 1943 production dropped to 16,600 with the destruction of a factory in Stalingrad that had previously made about 1,000 guns per month.[33]

All 76mm guns were used extensively as antitank weapons. The Germans captured many of these guns in 1941 and 1942 and used them as antitank guns. They modified some to take more powerful charges and fitted them with a muzzle brake to reduce the recoil.[34] The Russians gave antitank guns high priority during the war. The only modifications were to simplify the guns and cut the cost of production. The designers substituted cheaper steel where possible and replaced forged parts with castings. They reduced the number of parts dramatically. The major improvement was the ZIS-3 M1942, which weighed 360 kg less than the M1939. The gun used the carriage designed for the 57mm gun M1943. The ZIS-3 became the standard weapon of the tank destroyer regiments and thousands were produced.[35] The M1942 had 719 parts in comparison to 1,057 for the M1939 and 2,080 for the M1936. The number of hours of machining was reduced from 2,034 for the M1936 and 1,300 for the M1939, to only 475 for the M1942 in 1944.[36]

The Soviets designed the 107mm gun as a corps artillery gun. When it proved unsatisfactory, they tried it as a successor to the 76mm guns as an antitank weapon. In the spring of 1941 a near disaster occurred. Kulik, the chief of artillery, convinced Stalin to cancel production of 45mm and 76mm antitank guns because the heavy armor on new secret German tanks would make the guns useless. Instead, all productive capacity was to be used to make the 107mm gun that was still having problems.

The 107mm gun had the muzzle velocity and the shell weight, but the gun was too heavy for the carriage. Increasing the weight of the carriage would have made the gun too difficult for the crew to move. The 122mm gun replaced the 107mm in the corps artillery because the latter's performance (range and weight of shell) was not satisfactory. The Russian made very few 107mm guns and only eight were captured by the Germans. After the Germans invaded, production of the 45mm and 76mm guns resumed.[37] When the artillery administration formed the antitank brigades in 1941, it originally assigned each brigade a battalion of 107mm guns. Some guns were available in the depots, and there was no other gun to fill the requirement to penetrate heavy armament. Because of its poor performance and the lack of guns, the 85mm antiaircraft gun replaced the 107mm in the antitank brigades before June 1941.

B. L. Vannikov, the commissar of armaments, in spring 1941 proposed using antiaircraft guns on field carriages as antitank guns. The heavy weight was a problem in using antiaircraft guns in the antitank role. The 76mm antiaircraft gun was three times as heavy as the ZIS-3 76mm gun. The 85mm antiaircraft gun weighed over four tons and delivered a 9 kg shell. The 100mm antitank gun developed late in the war was nearly a ton lighter and fired a 15.8 kg shell. Clearly any use of antiaircraft guns was only as an expedient.

Using antiaircraft guns for antitank work created several problems. The antiaircraft gun was designed to fire in a near vertical position that transferred the recoil to the ground. In antitank use, the barrel was practically horizontal and the

carriage had to absorb all of the energy. A carriage that could not absorb the energy would break or bounce back. The success of the German 88mm gun resulted from a sturdy platform and an excellent recoil system, making it possible to fire horizontally. The silhouette was low and the Germans were able to place the gun far enough forward to be effective without excessive losses. The Russian 85mm antiaircraft gun was similar in characteristics and design to the German 88mm and was used as a heavy antitank gun in 1941 and 1942. However, when adequate supplies of other guns became available, the 85mm guns returned to their original function.

In October 1941 a proposal was made to place an 85mm antiaircraft M1939 barrel on a 122mm howitzer M1938 carriage. The combination cut the weight of the standard antiaircraft gun in half and was easier to produce. The idea was not adopted because of the great need for both antiaircraft guns and the 122mm howitzer, and productive capacity for neither component was available.[38] However, later in the war the 85mm antitank gun M1943 and M1945 used the M1939 antiaircraft barrel on a split-trail carriage.[39]

In 1944 the 100mm antitank gun M1944 appeared to counter the heavier armor on the German tanks. The 100mm was the successful marriage of the barrel of a prewar naval high-angle fire gun design (intended for the JS heavy tank) and a split-trail carriage. The gun had a very low silhouette, an essential characteristic for an antitank gun, and a high muzzle velocity. The gun could penetrate 181mm of armor at 1,000 meters. The heavy charge resulted in a recoil that had to be absorbed partially with a muzzle brake. The gun was nearly equal to the German 88mm L/71 gun, and was lighter in weight.[40]

In June 1941, the Soviet antitank defense was still in the formative stage. In the summer and fall of 1941, the overwhelming strength of the German panzers swept the Soviet antitank defenses aside. Faced with a severe shortage of antitank weapons in 1941 and 1942, the Russians reverted to the antitank rifle, the PTRS41 and PTRD41. The rifles fired a 14.5 mm bullet at 1,000 m/s and penetrated 35mm of armor at 300 meters. The rifle weighed 22 kg and required a crew of two. In 1942 the Soviets formed over 20 antitank rifle battalions each with three or four companies of 27 rifles each.[41] Each "destroyer" brigade had two antitank rifle battalions.

The Russians compared the efficiency of antitank guns according to the average number of tanks destroyed by the average gun, as shown here.

ANTITANK GUN EFFICIENCY	
Guns, all types, grouped by caliber	**Number of tanks destroyed per gun**
57mm	3
76mm	2.5
122mm	2
45mm	0.25

Obviously the 57mm was the most effective weapon, and the 45mm was comparatively ineffectual. However, there were many more 45mm guns, and they did have a deterrent effect.[42]

By 1941 heavier German tank armor made the 37mm ineffective and the M1937 45mm gun marginal. The Mark IV had the heaviest armor. The Mark IVC had 30mm of frontal armor, the Mark IVE had 60mm in the front, using added plates, and 40mm on the sides. A few Mark IVFs appeared in 1941 with 50mm of frontal armor. The contemporary German Mk III tank had 30mm of armor. All of the heavier Russian antitank guns penetrated the front armor of the Mk I, II, and III, and all but the 45mm gun penetrated the Mk IV frontal armor.[43]

As the following table shows, most of the guns used by the Russians in 1941 could penetrate the armor of German tanks at a range of 500 meters.

ARMOR PENETRATION OF SOVIET GUNS	
Gun	**mm/Armor**
37mm antiaircraft gun M1939	50
45mm antitank gun M1937	42
57mm antitank gun M1941	100
76mm gun M1936 and M1939	70
85mm antiaircraft gun M1939	110
107mm gun M1940	130

The Red Army divisional artillery functioned both in the usual indirect fire role and as a direct-fire weapon against tanks. Before the war, 66% of divisional artillery gunnery practice was antitank direct fire.[44] Most models of the 76mm divisional gun had sufficient muzzle velocity to work well as antitank guns.

Although the guns were of sufficient quality, there were not enough available in 1941. A division had 54 45mm guns (6 in each rifle regiment, 2 in each rifle battalion, and 18 in the divisional antitank battalion), plus 18 76mm guns in the artillery regiment. Spread over a 10 km front, these guns were not adequate to resist a concentrated attack on 1 km supported by a battalion of 50 German tanks. They would have been overwhelmed by two panzer divisions with over 200 tanks.[45]

An anecdote during the crisis at Moscow in late 1941 illustrated the improvisation taking place. In October 1941 Voronov suggested to Stalin that he form 10 new antitank battalions using guns in the Moscow depots, providing each battalion with 16 76mm guns. Stalin approved, but ordered that the units be called regiments to give their commanders more status and prevent the misuse of the guns. Later, Stalin stated, additional batteries could be added to raise them to the regimental level of 20 or 24 guns. Stalin gave Voronov 10 days to form the regiments. Voronov formed 12 regiments in the time allotted. Stalin himself assigned the regiments to the armies.[46] In the description of the battle for Moscow, there are frequent references to an army receiving two or three antitank regiments from the Stavka reserve.[47] The increasing number of regiments made in-depth defense possible and creation of antitank strong points in September 1941. However, not enough guns were available to create an effective defensive zone.[48]

During the unusually severe winter of 1941-42, German tanks were unable to operate effectively in the deep snow at sub-zero temperatures. The Russians made strenuous efforts to create an effective antitank force over the winter, to no avail. With the return of good weather in the spring and summer of 1942 the German tanks again penetrated the Russian lines. Even during the successful winter campaign that followed, Soviet antitank defense was marginal. Only in the spring of 1943 did improvements in doctrine, guns, and organization reach a level sufficient to stop the German tanks. The Russians crushed the greatest concentration of German armor in the war at the Battle of Kursk in July 1943. Thereafter, despite German advances in tank design, the Soviet defense not only kept pace but became even more dominant.

In July 1942 the Russians were still short of antitank guns and units. In the defensive battles in the Don bend in July 1942, the 62nd and 64th Armies had only 4 or 5 antitank guns and 12 to 18 antitank rifles per km of front. The 63rd Army had 6 to 8 antitank guns and 1 or 2 antitank rifles per km.[49] This shortage allowed the German tanks to break through the Russian lines.

Independent antitank regiments continued to be formed. On July 1, 1942, the antitank regiments were redesignated as tank destroyer regiments (IPTAP, for Istrebitjelnij Protivotankoii Artillerie Polk). The 76mm regiments had 50 trucks and 24 tractors to pull the guns.[50] The table of organization of the antitank regiment on April 15, 1942, included five batteries of four guns, either 45mm or 76mm. Antitank weapons in the rifle division were reduced to 30 45mm guns and 117 antitank rifles plus the divisional artillery regiment.[51]

The new formations received improved guns. The M1942 45mm gun penetrated thicker armor, 70mm with a tungsten-core shell. The new ZIS-3 76mm gun was lighter than the M1939 and easier to handle with no sacrifice in performance. The ZIS-3 was used in the divisional artillery regiment, the light artillery brigades, and the tank destroyer regiments and brigades. The ZIS-3 had a muzzle velocity of 680 m/s and fired a 6.2 kg shell that penetrated 70mm of armor at 500 meters—the same as the 45mm gun, though less than the 57mm gun.[52] More 57mm guns were becoming available, most of which went to antitank regiments instead of the rifle divisions. The mainstay of the antitank gun line in the rifle division remained the 45mm gun.[53]

During 1942, the Red Army formed 180 new tank destroyer regiments. By November 1942, 240 tank destroyer regiments were active. The official distribution called for one tank destroyer regiment for each army, two regiments for each tank army, and a tank destroyer brigade for each front.[54] In November 1942, the 1st Guard Army in the Ukraine had three times the established allotment, including the 426th Tank Destroyer Regiment with 16 45mm guns, the 1249th Regiment with 20 45mm guns, and the 870th Regiment with 20 76mm guns.[55] The five rifle divisions in the army each had about 48 76mm guns and 30 45mm guns on their division front. The army regiments could be concentrated in the areas most likely to be attacked and used to support Soviet advances.[56] The 1st Guard Mechanized Corps attached to the 1st Guard Army had 48 76mm guns and 33 45mm guns to add to the defensive line. Though adequate, these numbers did not compare to the impressive lines created later in the war.

In the spring of 1943., the Germans usually counterattacked with tanks and drove back the Russian forces after a Soviet breakthrough. German tanks broke through Soviet lines, as the Red Army did not advance the antitank guns quickly enough. In the resulting tank vs. tank battles, the Germans, with superior battle skills, usually won. Therefore, the Soviets had to solve the problem of protecting the advancing troops from German counterattacks. German doctrine stressed the value of the immediate counterattack after an enemy breakthrough with whatever forces were available. Immediate counterattacks prevented the enemy from digging in and establishing a solid defensive line that would be almost impossible to dislodge.

German tank-supported counterattacks drove back Russian advances in 1942 and 1943 with heavy losses. In December 1942 the Red Army suffered heavy losses, first from the Stalingrad relief forces under Manstein, next by the "fire brigade" tactics of the panzer divisions holding open the Rostov escape route in early 1943, and finally by the massive counterattack launched by Manstein in the spring of 1943.

The setbacks of early 1943 and the appearance of the Tiger tank in November 1942 called for major improvements in the Red Army antitank forces. In the later years of the war, the Red Army became adept at quickly consolidating their gains. In preparing for an attack, the Russians created a mobile antitank reserve with both towed and self-propelled guns. These guns created an instant PAK front behind advancing troops and tanks to block the inevitable German counterattack.

During 1943 the arrival of American lend-lease trucks enhanced the mobility of the tank destroyer regiments. In May 1943 the 543rd Tank Destroyer Regiment had 20 76mm guns, 25 Stalin tractors, and eight trucks, far short of the authorized number of trucks.[57] At the end of 1943, the 1644th Tank Destroyer Regiment had 24 76mm guns and 45 trucks. American Dodge trucks towed the guns. The regiment also had 12 GAZ-AA and 11 ZIS-5 Russian trucks to carry munitions and supplies and a Willys Jeep. The regiment was 18 men over strength with a total of 514 officers and men, but was short a few

officers and NCOs. The regiment refitted in early October 1943, receiving 117 replacements. In late November the regiment loaded on 63 railroad cars at Kiev, complete with two units of fire and two fills of fuel, and went back to the front.[58]

Imported American trucks improved the flexibility of the tank destroyer regiments. Once unloaded from the railroad cars, the 543rd Regiment in May 1943 would have had limited mobility, reduced to the speed of the farm tractors pulling the guns, about the same as a tank. The 1644th Regiment in December 1943 was completely mobile with the guns towed by trucks at high speed on paved roads, and then directly into positions cross country using the six-wheel

drive of the American trucks.

The trucks made the tank destroyer regiments more maneuverable than the tank regiments. The tank destroyer regiments therefore could be held in reserve until a threat developed and then moved quickly into position.[59] The Russians gave tank destroyer regiments high priority for the 2.5-ton Studebaker trucks, relegating tractors to the medium and heavy artillery regiments and the two-wheel-drive Russian trucks to rear-area supply duty.[60] With American trucks the tank destroyer brigades moved faster than the panzer divisions both on and off the road, and did not require rail transportation for long moves. The trucks kept the antitank guns close behind the advancing tanks and riflemen, carrying both guns and ammunition.

The Germans commented on the change in tactics made possible by the large numbers of antitank guns. Panzer divisions could no longer play the role of fire brigades in driving back Soviet penetrations, as in the spring of 1943. Studebaker 2.5-ton trucks from the United States played an important part in the formation of the tank destroyer regiments. American trucks were the most frequently used vehicle for towing antitank guns.[61]

At the battle of Kursk in July 1943, Soviet antitank guns were an important element in the defense in depth system. The antitank defense was the major change in Soviet tactics employed at Kursk. In tank-sensitive areas, a fire zone was created in front of the forward line and in the entire depth of the tactical defense zone, 15 to 20 km in depth. The antitank defense zone was sometimes 30 to 35 km deep. Company antitank strong points had four to six antitank guns, 15 to 20 antitank rifles, and several tanks or SUs. The Russians placed six company antitank strong points per km of front in areas favorable for tank attacks, providing 25 to 30 guns per km. In addition, an antitank reserve of one or two batteries (four or eight guns) was provided for each rifle regiment, a tank destroyer battalion (12 guns) for each division, and a tank destroyer regiment (20 guns) for each rifle corps. The result was a very heavy PAK front.

The 307th Rifle Division at Ponyri had 70 antitank guns per kilometer, more than enough to deal with an attack of over 100 tanks per kilometer. To provide more mobile reserves, tank and SU battalions were available to set up ambushes for tanks that broke through the defense line.[62] Despite the depth of the defense, the Germans broke though in the south of the salient, and the Russians had to commit tanks to halt the offensive. However, the defenses had made drastic reductions in the number of German tanks and the Russians prevailed.

Tank destroyer performance continued to improve during the following offensives. In the race to reach the Dnieper before the Germans could create a substantial defensive position, the 69th and 80th Guard Divisions crossed the river on a 6 km wide front on October 7, 1943. On the 8th and 9th, 50 45mm and 76mm guns were brought across the river. When the German 11th Panzer Division counterattacked, it was driven back and the bridgehead was preserved. In 1942 and early 1943, the Russians had been slow to advance the antitank guns, and as a result counterattacks by German panzer divisions were very effective. After March 1943 the German tank counterattacks were seldom effective.[63]

The increasing number of Panthers and Tigers and improved Mk IV tanks called for improving the antitank guns. By 1944 the Russians had a greater variety of guns, as follows:

ANTITANK EFFICIENCY OF GUNS IN 1944	
Gun and Type of Shell	**Armor Penetration at 500 meters**
100mm gun M1944	200mm
122mm gun M1931 and M1937 armor piercing	155mm
57mm gun M1943 tungsten	145mm
122mm howitzer M1939 shaped charge	120mm
57mm gun M1943 armor piercing	100mm

76mm gun M1942 tungsten	90mm
45mm gun M1942 tungsten	80mm
76mm regimental gun shaped charge	75mm
76mm gun M1942 armor piercing	70mm
45mm gun M1942 solid armor piercing	70mm
45mm gun M1942 armor piercing	45mm

The frontal armor on the German tanks of the time (except the Ferdinand) was vulnerable to the first five, and all could destroy the Mk III and Mk IV, as shown here.[64]

GERMAN TANK ARMOR IN 1944		
German Tank	**Side Armor**	**Front Armor**
Mk III	30mm	50mm
Mk IV	40mm	60mm
Panther	45 mm	85mm
Tiger	85mm	100mm
Ferdinand	85 mm	200mm

By the end of 1943, the towed antitank force was superior to the German armor. On January 1, 1944, the Stavka reserve alone had 289 regiments with 6,692 guns.[65] Additional regiments were assigned to armies, corps, and divisions. Most tank destroyer brigades had a 57mm regiment in place of a 45mm regiment. The 47th Tank Destroyer Brigade formed in June 1943 at Kolomna had two regiments (478th and 578th) with 57mm guns, one regiment with the high-velocity 76mm guns, and one regiment with self-propelled U.S. 57mm guns.[66] The 53rd Tank Destroyer Regiment had 24 American 57mm guns towed by Studebaker 2.5-ton trucks in 1944.[67] The 28th Tank Destroyer Brigade, however, still had a 45mm regiment along with two 76mm regiments in 1944. The 57mm gun was still scarce, and the 45mm gun continued in use.[68]

During 1944 the improved guns went to the tank destroyer units. A mechanized artillery regiment with SU85s was added to some tank destroyer brigades in 1944.[69] In August 1944 a regiment of 100mm guns substituted for some 57mm gun regiments in the tank destroyer brigades.[70] The improved 57mm replaced the 45mm gun in the rifle divisions. The tank corps tank destroyer regiment replaced its 45mm guns with 76mm guns.[71]

The Studebaker 2.5-truck was the preferred towing vehicle for the antitank regiments. However, the 1071st Tank Destroyer Regiment used Willys Jeeps to tow its 24 76 mm guns.[72] The 26th Tank Destroyer Brigade used 37 1-ton Chevrolet trucks in each regiment to tow both 76mm and 57mm guns. At the brigade level 30 2.5-ton Studebakers carried munitions and supplies. The brigade formed in 1944 at Gorochevez near Ivanovo and the more recent formation probably accounted for its ample supply of American trucks.[73]

The tank destroyers were effective. During the war two-thirds of the German tank losses resulted from direct fire of antitank guns and artillery. This achievement resulted from massing antitank forces in the decisive sectors, increasing the depth of antitank defense, increasing the activity of the antitank guns, and integrating all of the arms into a single battle formation.[74] Massing was achieved with the new tank destroyer brigades and regiments.

At Kursk the artillery destroyed 1,900 tanks of the total of 3,000 destroyed. The 28th Tank Destroyer Brigade claimed

50 tanks destroyed or damaged; the 3rd Brigade claimed 75; and the 31st Brigade claimed 88 destroyed or damaged.[75] At the battle of Shauliai in August 1944, the 2nd Guards Army had 1,112 guns of which 871 were employed for direct fire. Between August 16 and 29, the army destroyed 469 German tanks for the loss of 191 guns.[76]

The ratio of losses suffered by the Germans was echoed in Soviet losses. The most effective weapon against the Russian tanks was the German artillery. In a survey of tank losses by the Russians in five operations, the Soviet tank armies lost an average of 7% to aircraft, 5% to mines, 14% to hand-held weapons *(Panzerfausts* and others), 5.5% to miscellaneous causes, and over 68% to artillery fire. The highest percentage of air loss was to the 4th Tank Army at Orel in 1943, when 17.7% of tank losses resulted from air attack. The lowest percentage related to artillery fire (59%) was at Berlin in 1945, when the losses to *panzerfausts* increased to 24%.[77]

The danger was two-way, and service in the tank destroyers had its risks. In four months in 1944 two tank destroyer regiments had 34 killed, 96 wounded, and 3 missing—very heavy casualties for artillery units during a comparatively quiet period. The regiments also lost nine guns, four tractors, and two trucks.[78] A deserter in February 1945 told his captors that the 3rd Tank Destroyer Brigade attached to the 38th Army lost 39 of its 72 antitank guns in three days.[79]

Losses of antitank guns in 1944 varied sharply from month to month, ranging as high as 3,169 in August 1944, according to German estimates. The Germans estimated monthly production of the 45mm, 57mm, and all types of 76mm at 2,000, 500, and 2,000, respectively, or a total of 4,500.[80] Actual production in 1944 was 4,100 45mm guns, 2,300 57mm guns, and 17,300 76mm for a total of 23,700. Losses were 8,200 45mm guns, 1,100 57mm guns, and 10,800 76mm guns for a total of 20,100. At the end of 1944 the Red Army had 26,400 45mm guns, 2,900 57mm guns, and 41,100 76mm guns for a total of 70,400.[81]

The allowance of munitions was generous. The standard first issue for ZIS-3 76mm guns in October 1944 was 120 rounds of high-explosive and 20 rounds of armor-piercing. For other 76mm models the allowance was 128 rounds of high-explosive and 12 rounds of armor-piercing. The 1643rd Regiment had 50 armor-piercing rounds for use against tanks and 150 rounds of high-explosive shells for use against infantry emplacements.[82] Other regiments entered battle with a different mixture and number. The 764th Regiment, in August 1944, had 60 rounds for each gun, 45 of which were armor-piercing. The 529th Regiment in November 1944 had 80 rounds of high-explosive, 10 rounds of shrapnel (for use against infantry in the open), 5 hollow-charge rounds (for use against tanks), and 20 tungsten-core rounds that gave maximum armor penetration.[83]

The allocation of 76mm guns and 100mm guns showed the importance of towed antitank guns. By the end of the war, 73% of the artillery regiments were primarily antitank, compared to 27% whose primary function was divisional artillery. For each divisional artillery regiment, there were about three antitank regiments.[84]

In 1944 the number of tank destroyer regiments continued to increase. On January 1, 1944, the Stavka reserve had 50 brigades and 289 regiments with 6,692 guns.[85] In March 1944 the Germans estimated that there were 354 tank destroyer regiments at the front with up to 2,360 57mm guns and 4,720 76mm guns, plus 71 light artillery regiments in the artillery divisions with an additional 1,704 76mm guns, a total of 8,784 antitank guns (more than two for each German tank) not counting the 9,124 76mm guns in the divisional artillery regiments.[86]

The density of guns per kilometer increased from 4 to 9 at Stalingrad to 20 to 25 in the defensive battles in Hungary.[87] The depth of the Soviet antitank zones increased from 8 to 12 km in 1942 to 30 to 35 km in the battle of Kursk in 1943 and Lake Balaton in 1945. A revised doctrine called for more active defense. In the later years enemy tanks were subjected to artillery barrages before attacks, barrages and concentrated fire on assembly areas during an attack, shifting guns during an attack to repel tanks in threatened areas, building antitank fronts in various directions, and launching counterattacks on tank penetrations.[88] These changes required more guns, more tank destroyer units, and more mobile guns.

With a generous supply of tank destroyer regiments, the Russians were able to keep antitank guns close behind the

advancing infantry. The towed antitank guns advanced close behind the riflemen and quickly set up a PAK front as soon as the advance met resistance. These new tactics prevented the German panzer divisions from driving back the Russian penetrations, as they had done so well in the spring of 1943. The counterattacking tanks were met with a deadly barrage of fire and could no longer destroy unprotected riflemen. A German intelligence report on February 29, 1945, stated the following:

3. Combat Methods and New Weapons of the Enemy a. ft was observed in recent battles that Russian AT units follow directly behind the infantry, occasionally even accompanying it, immediately establish AT nests, and that therefore several of our armored counter thrusts did not succeed. This new tactic must be taken into account in counterattacks by assault guns and tanks, by detailed reconnaissance of AT nests and barriers, and by making sure of friendly artillery support to pin down enemy AT guns.[89]

During the last four months of the war the guns were upgraded. The M1937 45mm gun was seldom seen as supplies of the 57mm gun improved. The 57mm gun continued to form the third regiment of most brigades.[90] Many tank destroyer regiments were using the long-barreled M1936 76mm gun, while the shorter barreled ZIS-3 model continued as divisional artillery. Some tank destroyer brigades were reinforced with SU regiments. The 33rd Tank Destroyer Brigade had two regiments of 76mm and one regiment of 57mm guns, and a regiment of SU85s.[91] The 37th Brigade had two towed 76mm regiments, one regiment with American SU57s (T48s), and a regiment of SU85S.[92] More 100mm guns were available to cope with the Panthers and Tigers.[93] The organic antitank units of the mechanized brigades were provided with the 57mm gun in place of the 45mm. Tank brigades were given a battery of towed 76mm guns to provide antitank defense. Rifle divisions were also given 57mm guns, although not all of the 45mm guns were replaced.[94]

There was comparatively little expansion in the towed antitank force in the last year of the war. On January 1, 1945, there were 59 tank destroyer brigades including 350 tank destroyer regiments with an authorized strength of 8,400 guns.[95] The powerful defense provided by the towed antitank guns of the Red Army after March 1943 ended the dominance of German armor on the battlefield. From that time on, the Russian infantry were protected from the German tank-supported counterattacks. The German panzer divisions could no longer restore a break in the line with a concerted attack. Instead the German counterattacks met with the concentrated fire of dozens of antitank guns that followed the attacking infantry closely. Despite the increase in production and quality of German tanks from 1943 on, the Russian antitank defenses kept pace.

NOTES

1. Richard E. Simpkin, *Antitank An Airmechanized Response to Armored Threats in the 90s* (Oxford: Brassey's Publishers Limited, 1982), p. 62.

2. G. Biryukov and G. Melnikov, *Antitank Warfare* (Moscow: Progress Publishers, 1972), p. 16. Because the spotting reduced the effect so drastically, shaped charges were originally used only by 76mm regimental guns and 122mm howitzers that had the lowest muzzle velocity, Biryukov and Melnikov, p. 41; Kazakov, *Artilleriia,* pp. 129-31; Simpkin, pp. 60-61, 94-95.

J, Simpkin, p. 93. 4. Simpkin, p. 54.

5. The computations are based on the following statistics:

Projectile	45mm	57mm	76mm
Muzzle velocity (m/sec)	760	990	662
Projectile weight (kg)	1.43	3.14	6.3
Area of projectile (sq	1,590	2,550	4,534

mm)			
Momentum (mass x velocity)	1,086.8	3,108.6	4,170.6
meter/kg per sq mm	0.68	1.22	0.92

6. *VOVE,* p. 285; V. Budur, "Razvitiye Protivotankovoy Artillerii b Godi Velikoy Otechestvennoy Voynoi," *VIZh* 6 (June 1973), p. 79.

7. Timothy Wray, *Standing Fast: German Defensive Doctrine on the Russian Front During World War II. Prewar to March 1943,* Combat Studies Institute Research Survey No. 5, U. S. Army Command and General Staff College (Washington, DC: Government Printing Office, 1987), p. 18.

8. Adolf Von Schnell, "Antitank Defense," *Infantry Journal* 4 (July-August 1936), pp. 340-41, 343.

9. Biryukov and Melnikov, p. 98; United States, War Department, *Handbook on USSR Military Forces. November 1945 Technical Manual 30-430* (Washington, DC: Government Printing Office, 1946), p. V-71.

10. FHO, CGR, H 3/374, September 1944, Roll 562, Frame 1031; R. A. Savushkin, *Razvitie Sovetskikh Vooruzhennykh sil i Voennoga Iskusstva y Mezhvoennyi Period 1921-1941* (Moscow: Lenin Military-Political Academy, 1989), p. 162.

11. Biryukov and Melnikov, p. 43.

12. Biryukov and Melnikov, p. 45.

13. Biryukov and Melnikov, p. 43.

14. Biryukov and Melnikov, p. 47.

15. *Illustrated Encyclopedia,* XII, pp. 1331, 1333-34, 1339; CGR, FHO, H3/340, October 23, 1944, Role 562, Frames 92-93.

16. Aryukov and Melnikov, pp 38-39; Zaloga and Grandsen, p. 53.

17. F. Samsanov, "Iz Istorii Razvitiia Sovetskoi Artillerii," *VIZh,* November 1971, p. 65.

18. Samsanov, "Istorii Razvitiya," p. 65; Krivosheev, pp. 352-56.

19. FHO, CGR, H 3/69, March 4, 1945, Roll 549, Frame 008.

20. *Illustrated Encyclopedia,* XII, pp. 1327-31; Budur, p. 79; Biryukov and Melnikov, p. 39; Volz, XII, p. 213.

21. *Illustrated Encyclopedia,* XII, p. 1331; Budur, p. 79.

22. Volz, XI, p. 311; Volz, XII, p. 213; *Illustrated Encyclopedia,* XII, pp. 1328-1331.

23. Biryukov and Melnikov, p. 39.

24. FHO, CGR, H 3/69, June 15, 1944, Roll 549, Frame 41.

25. FHO, CGR, H 3/69, February 24, 1945, Roll 549, Frame 016.

26. The Germans estimated production in 1943 as 4,000 and 8,000 in 1944; FHO, CGR, H 3/1007, May 25, 1944, Roll 580, Frame 301; Krivosheev, pp. 352-57.

27. Beaumont, pp. 133, 153.

28. FHO, CGR, H 3/67, October 8, 1942, Roll 460, Frame 6438874.

29. During the Battle of Moscow in August 1941, the Red Army used a few ZIS-30 vehicles mounting ZIS-2 57mm antitank guns; Andrei I. Eremenko, *Stalingrad Zapiski Komanduyushchego Frontom* (Moscow: Voenizdat, 1961), p. 26.

30. *Illustrated Encyclopedia,* XII, pp. 1334-1336; FHO, CGR, H 3/118, 1943, Roll 552, Frame 342.

31. Budur, "Razvitiye Protivotankovoy," p. 79; FHO, CGR, H 3/340, October 23, 1944, Roll 562, Frame 80.

32. Grabin, pp. 108-110.

33. *Illustrated Encyclopedia,* XII, pp. 1334-1336; FHO, CGR, H 3/118, 1943, Roll 552, Frame 342; Krivosheev, pp. 352-57.

34. Volz, XI, p. 308; FHO, CGR, H 3/340, October 23, 1944, Roll 562, Frames 92-93.

35. FHO, CGR, H3/340, October 23, 1944, Roll 562, Frames 92-93.

36. Volz, XII, p. 212.

37. Volz, XI, p. 311.

38. Volz, XII, p. 213.

39. *Illustrated Encyclopedia,* XII, p. 1336.

40. Volz, XII, p. 216; *Illustrated Encyclopedia,* XII, p. 1330.

41. Biryukov and Melnikov, p. 39.

42. Biryukov and Melnikov, p. 42.

43. Biryukov and Melnikov, p. 40; F. M. Von Senger und Etterlin, *German Tanks of World War II* (New York: Galahad, 1969), pp. 44-45.

44. Biryukov and Melnikov, p. 55.

45. *VOVE,* p. 67; Budui, "Razvitiye Protivotankovoy," p. 80.

46. Vawnov, pp. 197-202.

47. A. Vassilevsky, et al., *Moscow Stalingrad 1941-1942: Recollections Stories Reports* (Moscow: Progress Publishers, 1974), pp. 78, 87; Malanin, p. 31; In October 1941 there were 71 antitank regiments, Samsanov, "Iz Istorii," p. 65.

48. Biryukov and Melnikov, pp. 58-59.

49. Rokossovsky, *Velikaia,* pp. 42-43.

50. FHO, CGR, H 3/468.2, October 2, 1943, Roll 564, Frame 1007; H 3/104, Roll 551, Frame 246; *VOVE,* pp. 67, 310.

51. VOVE, p. 67; Samsanov, "Iz Istorii," p. 65.

52, *Mustrated Encyclopedia,* XII, pp. 1334, 1336; Skorobogatkin, p. 305.

53. FHO, CGR, H 3/340, October 23, 1944, Roll 562, Frame 92.

54. Budur, p. 82-83; *VOVE*, p. 285.

55. FHO, CGR, H 3/126, December 24, 1942, Roll 552, Frame 942.

56. FHO, CGR, H 3/126, December 24, 1942, Roll 552, Frame 945.

57. FHO, CGR, H *3*/69, May 5, 1943, Roll 549, Frame 232.

58. FHO, CGR, H 3/69, January 1, 1944, Roll 549, Frame 214.

59. Biryukov and Melnikov, pp. 45-46.

60. FHO, CGR, H 3/69, November 5, 1943, Roll 549, Frame 94.

61. Many references in the FHO files, including FHO, CGR, H 3/69, May 5, 1943, Roll 549, Frame 105.

62. Ivan Parotkin, ed., *The Battle of Kursk* (Moscow: Progress Publishers, 1974), p. 163; Biryukov and Melnikov, pp. 60-61.

63. T. F. Vorontsov, et al., *Ot Volshskik Stepei do Austriskik Alip* (Moscow: Voennoe Izdatelistvo, 1971), p. 48.

64. Biryukov and Melnikov, p. 44.

65. Biryukov and Melnikov, p. 56.

66. FHO, CGR, H 3/69, April 23, 1944, Roll 549, Frame 191.

67. FHO, CGR, H 3/69, February 27, 1944, Roll 549, Frame 208.

68. FHO, CGR, H 3/69, March 2, 1944, Roll 549, Frame 208.

69. *VOVE*, p. 285.

70. FHO, CGR, H 3/340, January 22, 1945, Roll 562, Frame 126; *VOVE*, p. 285; Budur, p. 83.

71. Malanin, p. 37.

72. FHO, CGR, H 3/69, January 2, 1944, Roll 549, Frame 207.

73. FHO, CGR, H 3/69, November 27, 1944, Roll 549, Frame 148.

74. Biryukov and Melnikov, p. 55.

75. Parotkin, p. 200.

76. Biryukov and Melnikov, p. 41.

77. Simpkin, p. 179.

78. FHO, CGR, H 3/69, January 19, 1945, Roll 549, Frame 176.

79. FHO, CGR, H 3/118, February 23, 1945, Roll 552, Frame 252.

80. FHO, CGR, H 3/118, Roll 552, Frame 248 and 1943, Frame 342. 11. Krivosheev, pp. 352-56.

82. FHO, CGR, H 3/69, October 3, 1944, Roll 549, Frame 152; H 3/374, October 23, 1944, Roll 562, Frame 986.

83. FHO, CGR, H 3/67, September 4, 1944, Roll 549, Frame 162 and November 24, 1944, Roll 549, Frame 149.

84. *VOVE*, p. 67.

85. Biryukov and Melnikov, p. 56.

86. FHO, CGR, H 3/277, March 26, 1944, Roll 561, Frame 382; Malanin, p. 36.

87. Biryukov and Melnikov, p. 56.

88. Biryukov and Melnikov, p. 58.

89. United States, War Department, *German Military Intelligence 1939-1945* (Frederick, MD: University Publications of America, 1984), p. 130.

90. FHO, CGR, H 3/69, February 10, 1945, Roll 549, Frame 20 and February 24, 1945, Roll 549, Frame 16.

91. FHO, CGR, H 3/69, February 10, 1945, Roll 549, Frames 134-35.

92. FHO, CGR, H 3/69, January 1945, Roll 549, Frame 137.

93. FHO, CGR, H 3/340, January 22, 1945, Roll 562, Frame 126.

94. FHO, CGR, H 3/123.1, March 1945, Roll 552, Frame 435; H 3/69, February 10, 1945, Roll 549, Frame 134.

95. Samsanov, "Iz Istorii," p. 65.

9 The Railroads

Much of the Soviet climate is cold, 47% of the subsoil is permanently frozen, and only a shallow layer of top soil thaws during the summer. The cold climate makes farming, construction, and transportation formidable. Although lake, river, and canal traffic was significant for many commodities during the warmer months, these waterways froze in the winter. Surfaced roads (gravel or better) were scarce. Most of the roads were dirt—dusty in the summer, muddy in the spring and fall, and impossible when the snow fell. As a result, road and water transport were secondary in the transportation system. The railroads carried the bulk of the traffic.[1]

The transportation system echoed national priorities. In the 19th century, lines were built from the source of raw materials to seaports to facilitate exports. Other lines were built to support the development of new lands in Siberia. In the 1920s and the 1930s, rail design promoted a more self-sufficient economy that linked consumers, industrial centers, and sources of raw material and fuel.[2]

The basic idea of all railroads is the reduction of friction by using a smooth wheel on a smooth rail on a nearly level roadbed. Reducing the friction makes it possible to pull a maximum load with a minimum amount of energy. In contrast, the automobile uses friction between the road and the tire to provide traction, and so roads have steeper grades than are practical on railroads. The major task in building a railroad is creating a nearly level right of way, the path on which the track is laid. An efficient train has very little excess power to move up grade and comparatively little braking power on a steep down grade. When steep grades are unavoidable, extra locomotives have to be attached to the front or the rear of each train. The grade is reduced by filling in valleys, cutting through hills, and creating curves on rising ground. A major contribution of American railroad engineers to Soviet railroads in the 1930s was the implementation of a major program to reduce the maximum grades on main lines.

Maintaining the right of way is also a major problem, especially the ballast. Ballast does five things, all crucial to the rail.

1. The ballast transfers the weight of the passing train from the tie to the earth foundation.

2. It holds the ties in place, preventing them from sinking or changing position.

3. It can be moved to level the track.

4. It provides an elastic base allowing the track to bend under the weight of a train.

5. It allows water to drain away quickly from the ties to resist rot.[3]

Dirt accomplishes none of these roles well. Dirt holds the moisture and leads to rotted ties. Once the ties rot, the loose spikes cannot hold the rails. One loose rail could derail a train and stop traffic for hours or days. Although gravel and sand provide good drainage, both are unstable and move, leaving the ties unsupported. Crushed rock is the best roadbed, providing good drainage (keeping the ties dry) and stability to hold the ties in place. In the Soviet Union, the ballast that supported the ties was often of poor quality, gravel, sand, or dirt.

The rail itself functions like a string on a bow. When the train passes over the track, the rail bends under the weight of each axle and then springs back. The upward movement pulls at the spikes, gradually loosening them. The heavier the weight on each axle and the lighter the rail, the greater the vibration, the quicker the spikes will loosen. The job of the track walker or section hand is to walk the track and pound down loose spikes. If not done regularly, loose spikes can cause loose rails and derailments. The Soviet railroads had far more employees per kilometer of track than Western countries; probably many were section hands.

Western European railroads mounted the rails on elaborate steel structures and screwed them on the ties, making a very firm track. In the United States a tie plate (a rectangular piece of steel with four holes for spikes) was placed between the rail and the tie. The plate spread the impact of the weight over a greater area and located the correct place for the spikes. In the Soviet Union, plates were used on the main lines, but the rail on the feeder lines was laid directly on the ties. The base of the rail would bite into the tie and cause early failure by loosening the spikes.[4] As military operations developed, the feeder lines would sometimes be used to carry heavy traffic—for example, the lines east of the Volga leading toward the Stalingrad area in 1942.

The strength of the rail is measured in weight per meter. The heavier the rail, the greater the ability to withstand the weight of the wheels with less vibration. The Soviet Union rail was very light compared to rails in Western Europe and the United States. In 1941 only 2% of the track was 43 kg per meter or more and 16% was 38 kg/m or more. In Germany all of the main lines used track of 49 kg/m or more. In the United States in 1983, 40% was 65 kg/m or greater, and all but 11% was 45 kg/m.[5] Russian ties were more widely spaced, reducing the strength of the track. In the Soviet Union there were 1,440 ties per km, in Germany 1,600, and in the United States 2,000 per km.[6]

Once an obstacle is sighted, the lack of friction makes it difficult to stop a train. Early in the development of the railroads, several systems ensured that the track ahead was clear of stopped or slow-moving trains. The block system signaled oncoming trains to stop at the beginning of a block (a section of track) had the previous train not yet cleared the other end. Once the block was clear, the oncoming train was signaled to proceed.

A minimum block was barely long enough for the train to stop for an obstacle. Most blocks were longer, creating long distances between trains. The longer distance reduced the amount of traffic a railroad could carry to about one train every half-hour. The Russians adopted American techniques in the 1930s, and American engineers directed the installation of automatic block signals on the main lines. However, most of the Russian railroads had poor signaling equipment. In the buildup for the Stalingrad offensive in the fall of 1942, the Russians used men with flags to create very short blocks, reducing the space between trains.

The combination of poor signaling and poor track reduced the amount of traffic that a railroad could carry. Even with

good signals, a double track could carry only 48 trains per day in each direction. To increase capacity, the weight carried by each train had to be increased, either with bigger freight cars or more cars per train. The light Russian track prevented the use of heavier cars or the heavy locomotives needed to pull longer trains. It was possible to use two small locomotives to pull a longer train, but the Russians had a limited supply of locomotives. Longer trains were more difficult to start and stop and were bigger targets for air attacks. Russians trains early in the war consisted of about 60 cars but later only 45 cars.

The Russian gauge (the distance between the rails) was 8.9 cm wider than the standard European gauge, adding to the stability of Russian rolling stock.[7] The difference in gauge also made it impossible for German trains to operate on Russian railroads until one rail had been moved closer to the other. The Russians had done this deliberately as a defensive measure. Unfortunately, when the Russians advanced they had to reverse the process. When they entered other European countries, the ties were shorter and spreading the rails a further 8.9 cm reduced the stability of the track, as one rail was too close to the end of the tie. Holes between the rails from the previous spikes or screws weakened the tie. As a result the Russians had far more difficulty converting the tracks in 1944 and 1945 than the Germans had in 1941 and 1942.

Most of the problems of the Russian railroads dated to before World War I. The limited development of the railroads, the lack of railroad management techniques, and the shortage of rolling stock were major factors delaying mobilization of the army in 1914 and restricting movement in later operations. The railroads in 1914 had been planned with military needs in mind and had extra sidings, double tracking, and additional block posts. Detailed plans covered the first two weeks of war. By the 15th day of the First World War, half the Russian infantry mobilized and by the 20th day, 75 %. However, many divisions were ready before the railroads could move them.[8]

In the early years of World War I the railroads functioned well. Tonnage per km moved per month increased from 5.6 billion in 1913 to 7.6 billion in 1916. However, in 1917 chaos began. The number of serviceable locomotives dropped from 16,400 in 1916 to 15,700 in 1917. One-fourth of the engines were awaiting repair and the number of cars awaiting repair doubled.[9]

The Civil War created further problems. After the Revolution in 1917 and the removal of most of the railroad managers and technicians the system lacked skilled direction. Combined with the Civil War, the lack of direction led to a severe decline in operations. In 1913 the railroads carried 132 million tons of freight. Total cargo was reduced to 30 million tons in 1919. In 1913, the railroads moved 18 million tons of grain and 26 million tons of coal; in 1919, they moved only 2 millions tons of grain and 2 million tons of coal. The result was famine in the cities and people freezing to death.[10] In September 1920, only 7,296 of 17,577 locomotives were operational. The railroads barely functioned because of lack of maintenance since 1914 and destruction from the Civil War. Thirty million ties needed replacement. Twelve thousand locomotives were awaiting repair in 1921. Men would not work in the repair shops. The track was old and weak: only 10% was 38 kg/m or heavier, and half was less than 33 kg/m.[11]

Lenin in the 1920s decided to disperse industry, moving factories closer to the sources of fuel and raw materials. The idea was to reduce the burden on the railroads by placing the new factories closer to needed supplies. However, the dispersion of industry caused a greater burden on the rails because of the need to ship parts long distances. To meet the demands of new heavy industrial sites in the 1930s, construction concentrated on new heavy—volume lines connecting the new centers with the old industrial centers.[12]

The NEP (New Economic Policy) of 1921 restored some activity. On the railroads the emphasis was to run trains with little concern for maintenance or improvement of the right of way. After the Treaty of Rapallo with Germany, some assistance came from German engineers in reconstruction of the railroads between 1922 and 1924. Over half the locomotives were out of service in 1924.

In 1926 the Soviets hired American engineers to study the operations and make recommendations.[13] By 1928 the repair system began to function. Only 18% of the locomotives and 7 % of the cars were awaiting repair. The main lines received priority in repair work, removing rails from secondary lines to replace worn track on the main lines. The number of car loadings increased and, by 1926, exceeded the 1913 number. Although the railroads were handling as

much traffic in 1928 as in 1913, the equipment was old and the track was in poor condition.[14]

The accumulated problems and needed expansion required radical measures. In January 1928 at the beginning of the First Five-Year Plan, the Soviets had 76,887 km of track, 15,758 locomotives, and 480,000 cars.[15] In the early years of the First Five-Year Plan, efforts to improve the railroads achieved little. The development of heavy industry came first, forcing the railroads to carry heavy traffic with little improvement in equipment or tracks. From 1931 to 1933, the railroads began to falter and backlogs of freight accumulated awaiting shipment.[16] The railroad work under the First Five-Year Plan concentrated on modernization. To replace the lost technical expertise needed to rebuild the old lines and construct new ones, the Soviet Union turned to the west, mainly Germany and the United States.[17]

In February 1930, 34 Soviet engineers came to the United States to study the Pennsylvania Railroad and began negotiations for technical assistance. Later in 1930, Ralph Budd, president of the Great Northern Railroad, went to Russia to prepare a study and suggest a program. Budd made many recommendations, including increasing the strength of the rails to a standard of 110 pounds per yard (55 kg/m), similar to American standards. He also recommended that grades be reduced from an average of 0.6 to 0.8 to a level closer to American standards of 0.3 to 0.4. These two changes were extremely important. With heavier rail, heavier locomotives and cars could be used and operated at higher speeds. The reduced grades permitted a locomotive to pull longer trains at greater speed.[18]

The Russians accepted the recommendations and to implement them, hired engineers from the Baltimore and Ohio Railroad. The major problem was the light rail that limited the size of the locomotives. Heavier locomotives were needed to haul longer trains, making better use of the track. A train used the same amount of time in the scheduled use of a track, whatever its length or the weight of the cars and locomotive. Heavier equipment would result in more tonnage carried during a 24-hour period. Only 39% of the rail was Class IIIa, 33 kg/m, which could support 16 tons per axle. Less than 2% was Class Ia which could support 23 tons per axle. These conditions dictated the maximum size of the locomotive.[19] The standard locomotives adopted were either the 2-10-2 or the 2-10-4 type. The three numbers refer to the pilot wheels, the driving wheels, and the trailing wheels. The driving wheels transmit the power from the steam engine to the track and put the most stress on the track. The trailing wheels support the weight of the fire box. The pilot wheels pivot to enable the locomotive to travel around curves at higher speeds without derailing. Employing 10 driving wheels, compared to the 8 more common on much heavier locomotives on American railroads, reduced the pounding action of the driving wheels on the track.[20]

With the greater number of axles, the weight of a locomotive could be increased and remain within the limits imposed by the track. For example, with 8 axles (2-10-4), Class IIIa rail could support a 128-ton locomotive (8 times 16 = 128). The FD type locomotive (2-10-2) weighed 134 tons, a little heavy for the 33 kg/m rail. The IS type (2-8-4) weighed 133 tons, also a little heavy for the 33 kg/m rails. These were the heaviest of the common locomotives. The So (6 axles) and E (5 axles) types weighed 96 tons and 85 tons—well within the limits of the 33 kg/m rail—and could work well on much lighter rail.[21]

Another serious problem was the ballast on the right of way. In 1917 only the main lines had gravel ballast.[22] In 1931 only 250 km of track had crushed stone ballast, 5,000 km had gravel, and 80% had only fine sand or dirt. An unstable track limited the weight of the locomotives and the speed of the trains.[23]

From 1935 to 1940 many improvements were made under American guidance. Grades and curves were reconstructed, allowing higher speeds and heavier trains. Key routes were double tracked to increase the number of trains. Automatic block signal systems permitted trains to run closer together, and new sidings enabled trains to pass one another with less delay. Some heavier rails were laid on the main lines. New operating procedures included centralized despatching of trains, stricter regulations on loading and unloading cars, and inspection of the cars. Automatic brakes and automatic couplers were put on the older two-axle cars. Enough refitted cars with automatic air brakes were placed in trains to stop the other cars. These and other improvements resulted in increased loads, greater average speed, and faster turnaround of cars and locomotives on the main lines. But little progress was made on the secondary lines.[24]

Automatic block signals increased the capacity of the railroads. In 1930 there was only one section of 30 km equipped

with German automatic signals. In 1928 the American company Union Switch and Signal provided equipment and the engineers to install it. The Russians copied the American system and expanded its use.[25] By 1940, 8,500 km of track was controlled with automatic block signals.[26]

A major step forward was the unit train—an entire train carrying one type of cargo from one point to another. The unit train eliminated the bottleneck of switching yards where incoming trains were divided and reassembled with cars going to the next destination. By 1938 one-fourth of the trains were unit trains, mostly coal, oil, iron and steel, ore, timber, grain, and building materials.

During the First Five-Year Plan, the number of locomotives increased by 2,954. The capacity of the railroads doubled by the end of the plan to 169.3 million km/tons (a 20-ton boxcar pulled 100 km would equal 2,000 km/tons). The Second Five-Year Plan increased the capacity to 302 million km/tons, and by 1937 capacity passed 400 million km/tons. Over 86,300 km of track was in use in 1937.[28] By 1937, 119,000 cars (equal to 2,970 trains) were loaded daily, compared to 38,601 in 1929 and 55,717 in 1934. By 1940 the average number of cars loaded daily had decreased to 95,150, but the cars were traveling longer distances. The average turnaround time for cars dropped to 7 days in 1940 compared to 10.6 days in 1929 and 8.8 days in 1934.[29] From 1928 to 1940 freight ton/km increased from 93 billion to 415 billion.[30]

TOTAL TRACK IN USE 1928-1945[31]

Year	Total km of Track at End of Year
1928	76,923
1929	76,938
1930	77,861
1931	80,958
1932	81,815
1933	82,614
1934	83,493
1935	84,367
1936	84,911
1937	84,889
1938	84,950
1939	91,850
1940	106,102
1941	74,000
1942	62,900
1943	81,646
1944	106,000
1945	112,868

In 1928, 77,000 km of track was in use. During the First Five-Year Plan, 4,777 km of track was constructed. Very little rail construction took place until 1938, when projects were started that had previously been deferred to make steel and labor available for the factories under the first two five-year plans. Most of the new line was directly related to defense needs. The acquisition of the Baltic States and Bessarabia added track to the total as well. In 1939, 86,400 km was in use before the acquisition of new territory. The new areas added about 20,000 km to the system.[32] The Germans estimated that the Soviet Union had 90,000 km of track in 1939 and 102,000 km in June 1941.[33]

The railroads played an essential role in the beginning of the war, bringing troops from the interior to the front. The mobilization plan in 1938 was to transport 112 rifle divisions and 10 cavalry divisions an average of 250 km. To move these troops about 5,000 trains were required. Thanks to the improvements of the previous 10 years, the capacity of a single track line was 25 trains each way and a double track line 50 trains each way.[34]

The rail system in European Russia consisted of three sectors in 1938. Most of the army was in the first sector west of Smolensk that included the military districts of Leningrad, White Russia, and Kiev. From this area to the front were 17 lines, including 8 double-tracked, with a daily capacity of 625 trains each way.[35]

The second sector was east of Smolensk and west of Moscow with the Moscow and Kharkov military districts. This area had 5 double tracks and 11 single track lines, with a daily capacity of 475 trains each way. The third sector was east of Moscow to the Volga including the Volga, North Caucasus, and Transcaucasus military districts. From this area to the front were 14 lines (five double track and nine single track) with a capacity of 385 trains daily.[36]

The first sector could send 1,000 trains to the frontier, moving all the troops located in the sector in one to five days. The second sector moving 2,000 trains needed four to five days to load all of its troops. The third sector required five to six days to load its troops in 2,000 trains. In approximately 15 days about 135 rifle divisions and 35 cavalry divisions could be concentrated on the front.[37]

These computations applied to the Red Army as it existed in 1938. In 1941 the bulk of the divisions were farther west. However, the computations reveal the limits of the Russian rail network, the inflexibility of a rail system, and the impact of heavy movement. The Germans captured most of the first two sectors in 1941 and a good part of the third sector in 1942. By January 1943, only 58,000 km remained in Soviet hands.[38]

From December 1941 until near the end of 1943, the Russians had to rely on the railroads east of Moscow. There were 12 through lines that carried much of the heavy traffic linking the industrial centers. Nine lines emanated from Moscow. Two of these lines ran south from Moscow, the first via Yelets to Rostov where it connected with the Caucasus network. This line was the prime connection between Moscow and the Donets Basin, two major industrial centers in the Soviet Union. The battle for Yelets in the fall of 1941 marked a major effort by the Russians to prevent the Germans from cutting this line. The second line was a double-track line from Moscow via Kharkov to the Crimea used for troop movements to the southwest. The Germans seized the lower portion of the line in 1941.

The third line was the Transiberian Railroad from Moscow to Vladivostok, linking the Far East and Europe. Branch lines connected the Siberian railroad to industrial centers in the Urals and Central Asia. The fourth major line from Moscow went east to Kazan. The fifth line went north to Archangel, the major port on the White Sea, by way of the industrial center at Yaroslavl. The sixth line went northwest to Leningrad with connections to Murmansk, the port used by the lend-lease convoys. The remaining three lines led from Moscow to the front—one west to Veliki Luki, another southwest to Smolensk and Minsk, and a third south to Bryansk and Kiev. Moscow was the essential hub of most rail traffic.

Three major lines linked the Urals, the major industrial center with the new tank factories, and the Donets Basin, a rich source of coal and iron ore. The first linked Sverdlovsk, the site of the T34 factory, via Kazan, Penza, Balashov, and Valuiki to Rostov. The second linked Chelyabinsk, also the site of a tank factory, via Ufa and Kuibyshev to Penza, joining the first line. A new third line from Saratov, another tank factory town, linked the area east of Moscow directly to Millerovo and the Donets Basin. A new railroad continued east from Saratov to Uralsk, Iletsk, and Central Asia.[39]

West of the rail line from Moscow, Yelets, Kupyansk, to Rostov there was a dense pattern of railroads between the major cities providing good connections both east-west and north-south. East of Moscow there were very few lines other than those radiating from Moscow. The exceptions mentioned above were the two lines passing through Penza and the new line through Saratov. When the Germans cut the railroad line leading into Stalingrad in late 1942, that was the last direct link to the south and the Caucasus from Moscow. From then on rail traffic had to travel southeast through Saratov to Astrakhan and from there by water on the Caspian Sea or by a rail line threatened by the Germans at Elista. There was no direct rail link from Moscow to Stalingrad under Russian control. While the Germans were able to repair the railroads and enjoy excellent north-south and east-west rail communications, the Russians lacked good rail connections.

Russian rail problems included both the right of way and rolling stock. The capacity of the major rail lines increased to 24 trains per day on single-track lines and 48 on double-track lines because of the improvements in track quality and signal equipment in the 1930s. The secondary lines still lacked good signals, and many had poor ballast. Light rail limited the speed, the weight, and the number of trains that could use the track.

The Russian climate was a severe handicap to operations by the Germans. Russian locomotives had extra insulation around the boilers to deal with extreme cold. German locomotives did not and lost excessive amounts of energy during cold weather. The Germans encountered many other problems, too. The coal mined in the Donbas would not work in German locomotives unless mixed with some high-grade German coal or oil. Steam locomotives required a system of water towers and equipment for loading coal into tenders. The Soviets destroyed trackside structures when they retreated, severely handicapping German operation of the lines. Such problems pointed out the difficulty of rail operation in the hostile Russian climate.[40]

The availability of a sufficient quantity of locomotives and cars was essential to the operation of the railroads. During World War I, Russia purchased 875 2-10-0 engines from the Baldwin Locomotive Works in the United States.[41] Fully operational, the locomotive weighed 180 tons with an average weight of 30 tons per axle that limited its use to the main lines. In 1921 almost half the Russian locomotives were 1893 models Class 0, 6-8-0, with a light weight per axle making them usable on the poor track. The Russians built only 473 locomotives from 1921 to 1927. Locomotives were ordered from Germany, the United States, and Sweden. In 1920 the Russians bought 1,500 0-10-0s from Germany. For repair, locomotives went to Latvia, Estonia, and Germany. Under two contracts, 3,800 locomotives were repaired in Tallin, Estonia.[42]

In 1925 the Russians built a few of the Su type, 2-6-2, at the Putilov Works in Leningrad. The load per axle was about 17 tons, usable on 40% of the track. In 1929, 40% of the locomotives were the old "O" 0-8-0 class, and 25% were the newer "E" 0-10-0 type introduced in 1926 with a 21-ton per axle load. Before 1930 there was a demand for heavier locomotives for more efficient operation, but the track was too poor. By the mid-1930s improvements in the track made possible wider use of heavier locomotives on the main lines.[43]

More powerful locomotives were built during the five-year plans. New factories manufactured and repaired railroad rolling stock. In 1931 production began at Voroshilovgrad (Lugansk) on the FD locomotive, a 2-10-2 based on the Baldwin Locomotive Company design. By 1941, 3,220 had been completed. In 1933 production began of the IS type, a 2-8-4 with a 21-ton per axle load based on an American design for passenger trains. By 1941, 650 had been made. In 1936 production of the So type, 2-10-0, based on a pre-World War I design, began and by 1954, 5,000 were manufactured.[44] By 1938 production of the FD and the Su was under way at five plants producing a total of 1,035 of both types.[45] In 1940 production of the Su type, 2-6-2, increased and 2,830 were built by 1951. During the war 9,500 of the E type, 0-10-0, were made beginning in 1943, and 2,400 Baldwin 2-10-0 types were imported under lend-lease.[46]

In 1938 the number of locomotives increased to 24,200 and the number of cars to 784,200 by the Second Five-Year Plan.[47] The Russians did not invest in diesel locomotives and made little use of electric lines. They built only four diesel locomotives in 1940.[48] The steam locomotives were made in the Komintern works in Kharkov, the October Revolution plant in Voroshilovgrad, the Novocherkassk works, the Sormovo works in Gorki, the Kolomna plant in

Moscow, and the Stalin plant at Omsk.[49] Many of these plants turned to war production after 1941. The Omsk plant made tanks.

During the debacle of 1941, most of the locomotives escaped. The German captured only 15% of the stock, and most of those lost were the older type.[50] The Germans estimated that in January 1941 the Soviet Union had 22,000 locomotives and at the end of the year 25,000.[51]

The supply of railroad cars was also crucial. The car shortage began in the 1920s after a long period when no cars were built. In 1913 there were 400,000 freight cars in service and more were built during the war. However, construction stopped after the Revolution and in 1923 the stock was 405,000, but one-third needed repair.[52] Repair and construction were neglected during the early 1920s. In 1927-28 9,550 cars were made, but they were still the old two-axle design. In 1928 production of four-axle cars began, but only one-fourth of the cars made that year were of the four-axle design. Only 3% of the cars had air brakes.[53]

The newer four-axle cars could carry twice as much while maintaining the same tonnage weight per axle as the older cars. In 1928 there were 341,400 cars, mostly two-axle types. The older two-axle cars carried 16.5 tons, the newer type two-axle cars, 20 tons. In 1929 the average American freight car had a capacity of 46.3 tons. In 1939 the American average increased to 49.7 tons, as older smaller cars were replaced by new larger cars. The same process of replacement occurred in the 1930s in the Soviet Union.[54] From 1937 to 1941, the Russians built 145,000 four-axle box cars.[55] By 1940 there were 721,000 cars, many with four axles. The basic car types were 40- or 50-ton four-axle box cars, 50-ton four-axle hopper cars, 50-ton four-axle open steel-bodied cars, and 50-cubic-meter tank cars. Special cars (flat cars, self-loaders, tank cars, and coal cars) carried comparable amounts. The two-axle 20-ton cars carried 40 men or 8 horses, the 50-ton cars 80 men or 14 horses. The smaller two-axle flat cars carried one to three artillery pieces, two armored cars or light tanks, or one medium tank. The larger four-axle flat cars carried two trucks, three armored cars or light tanks, two medium tanks, or one heavy tank.[56]

The average quality of the rolling stock was not high in 1941, as the replacement program was still in progress. In 1941 a German analysis of 543 cars revealed the state of Russian rail cars. Only 37% were modern four-axle cars of 40- or 50-ton capacity, the majority were old two-axle cars with 16- to 19-ton capacity. In a Soviet study of 397 cars on the Transiberian Railroad, 161 cars (41%) were less than 6 years old (modern cars); 52 (13%) were 6 to 10 years old, 51 (13%) were 11 to 20 years old, and 133 (33%) were over 20 years old.[57] The two studies provided similar results—about 40% of Soviet freight cars were modern 40-ton types. The remainder were older 20-ton or less types.

In January 1941 the Germans estimated that the Russians had 33,000 Passenger cars and 646,000 freight cars.[58] By December 1941 the Germans estimated that the Russians had 500,000 two-axle cars, 225,000 four-axle cars, and 35,000 passenger cars along with 25,000 locomotives.[59]

With approximately 725,000 freight cars available, 914,380 carloads were moved from August to November 15, 1941, to evacuate industries eastward.[60] The average turnaround time for a freight car in 1940 was 7.4 days and in 1942, 13.8 days. Data for 1941, though not available, was probably considerably higher as trains loaded with machinery moved east (sometimes without a destination) and were left standing on sidings as attempts were made to find factory buildings or even warehouses to store the machines. The turnaround time for evacuation freight cars may have been 20 days or more, or nearly 20,000,000 freight car/days out of a potential of 65,250,000 (725,000 cars times 90 days) during the three months of evacuation.

The massive movement of industry absorbed nearly a third of the rail freight capacity over a period of three months when the Red Army desperately needed trains to move troops to the front. The situation was eased by the fact that the machinery was moving east while the troops were moving west, but the combined movements were a gigantic undertaking.

The inventory of locomotives, passenger cars, and freight cars did not improve a great deal during the war. The Soviets lost large numbers of their rolling stock by 1943. The Germans believed that they had captured or destroyed about

25% and a further 30% was lost to air attack. By January 1, 1943, the Germans had captured 1,338 locomotives, 2,315 passenger cars, and 81,817 freight cars. Russian locomotive factories were then building tanks which meant that few replacements were available from Soviet sources.[61] However, some production of rolling stock continued, and lend-lease played a major role in supplying rolling stock. By 1945 lend-lease provided 1,900 steam locomotives, 66 diesel locomotives, 9,920 flat cars, 1,000 dump cars, 120 tank cars, and 35 heavy machinery cars.[62] The Americans supplied 2-10-2 locomotives designated as class "Ea" by the Russians.[63] Lend-lease played a major role in improving the railroads toward the end of the war, providing signal equipment for 3,000 km of track.[64]

The military had two needs: moving troops and bringing up supplies. A 900 cargo-ton military train usually consisted of 59 two-axle cars, two locomotives, and two tenders. A 1,250-ton train had 84 two-axle cars.[65] The average train had a mix of 40 to 60 two-axle and four-axle cars carrying about 1,000 tons.[66] Moving units from training camps in the interior or from one front to another was a complex operation. In late 1941 entire armies were moved from the interior to replace armies that had been destroyed by the Germans. Moving an army with three corps headquarters and nine divisions in 1941 required over 600 trains and would tie up a double track line for nearly 13 days and a single track line for 25 days.

In January 1941 requirements for moving Red Army units were as follows:[67]

TRAIN REQUIREMENTS FOR VARIOUS UNITS IN JANUARY 1941	
Unit	**Number of Trains**
Army Headquarters with Army Troops	40
Corps Headquarters with Corps Troops	40
Rifle Division	50-55
Cavalry Division	35-40
Mountain Cavalry Division	25
Mechanized Corps	40
Mechanized Brigade	18-20

On December 1, 1941, the declining size of Red Army units reduced the need for trains for each unit, although the number of units continued to increase, as follows:[68]

TRAIN REQUIREMENTS FOR UNITS IN DECEMBER 1941	
Rifle Division	33 trains
Cavalry Division	28-30 trains
Tank Division	50 trains

In March 1943 a motorized brigade with 4,000 men used seven trains with a total of 449 cars—an average of 64 cars per train. Equipment included 10 tanks, 10 reconnaissance cars, 5 automobiles, 254 1.5-ton trucks, 79 2.5-ton trucks, 39 special vehicles, and 8 motorcycles.[69] In August 1943 the Russians moved an army headquarters, a corps headquarters, and six rifle divisions from the Kuban bridgehead to the Ukraine in about two weeks.[70] Keeping in mind

the maximum number of trains that could use a line (24 trains on a single track, 48 on a double track), moving a single motorized brigade would tie up a single track for one-third of a day for each day the unit was in transit. For example, if the brigade moved from Moscow to Kursk in three days, that line would be tied up for eight hours for three days. Moving a tank corps and a mechanized corps 1,000 km would effectively stop any other movement on a double-track line for a week.

By April 1944 the decrease in the number of men in Red Army units further reduced the need for trains, as shown here:[71]

TRAIN REQUIREMENTS FOR UNITS IN APRIL 1944	
Rifle Division	15 trains
Guard Rifle Division	16 trains
Rifle Brigade	7 trains
Cavalry Division	18 trains
Cavalry Corps	57 trains
Tank Corps	20 trains
Tank Brigade	3 trains
Mechanized Corps	33 trains
Mechanized Brigade	8 trains

The Russian railroads were having considerable difficulty in 1942. Freight car turnaround time increased from 7.4 days in 1940 to 13.8 days in 1942. The problem resulted from longer hauls from the armament factories in the east and inefficient use of rolling stock. Cars were not unloaded promptly, and twice as many cars were needed to carry the same cargo.[72] Trains moved very slowly and delays were frequent. In May 1942, the 1092nd Artillery Regiment took 11 days to make a 1,500 km rail journey, an average of fewer than 140 km a day. The trains passed through Kirov, Gorki, Penza, Povorino, and Khrenovoye. In March 1942 the 117th Rifle Division took six days to move from Vladimir to Ostachov.[73]

The buildup of troops and supplies for the Stalingrad offensive severely strained the Russian rail system. Railroads were under air attack as far as 150 miles east of Stalingrad. The Germans had cut the lines leading to Stalingrad west of the Volga. The nearest line east of the Volga was a spur leading east from a single track passing from the north to Astrakhan. All of the supplies and men for the Stalingrad front flowed along this slender thread. The station nearest Stalingrad, Akhtuba, was incapable of handling the large amount of supplies and troops, therefore the trains unloaded along the stretch of railroad north of the station. The troops marched the rest of the way and trucks or horse-drawn wagons carried the supplies.[74]

Despite the difficulties, the Russians made a supreme effort. Trains ran every 12 to 15 minutes instead of every half—hour by using men with flags replacing the block system. Over 1,300 cars arrived, unloaded, and moved to Astrakhan to the street car rails to avoid blocking incoming traffic. Some cars were pushed off the tracks. More than 27,000 trucks moved the supplies from the railroad. From November 1 to November 20, 160,000 men, 10,000 horses, 430 tanks, 600 guns, 14,000 vehicles, 6,700 tons of ammunition, 4,000 tons of rations, and thousands of tons of other supplies were delivered to the Stalingrad front.[75]

Restoration of rail connections assumed a high priority during offensives.[76] The lack of good rail connections hampered the buildup before the battle at Kursk. A single track led from Kastornoe to Kursk. Some track was so poor that horses pulled the freight cars because the rails could not support a locomotive.[77] But corrective measures made in

1943 improved railroad performance. Railroad employees were placed under military discipline and sentenced to penal battalions if they failed to work. The penal battalions cleared minefields under enemy fire and did other dangerous assignments. Control of loading and unloading cars improved and freight train speed increased. The result was a slight reduction of the turnaround time from 13.8 days in 1942 to 12.6 days in 1943, still far more than the 7.4 days of 1940.[78] Traffic bottlenecks were reduced on the routes from the eastern factories to accommodate the increasing production of war material. During the war the Russians laid 10,000 km of new track including a new line from Saratov to Stalingrad. During 1943, the rolling stock increased by 2,000 locomotives and 56,000 freight cars.[79]

Regaining control of the railroad network was a factor in the strategic planning of the Soviet General. Staff. After July 1943 the Soviets began to regain the north-south lines, which gave a higher degree of flexibility in moving units and supplies. Before the summer of 1943 a movement of supplies or troops usually involved going first to Moscow and then to the threatened area in what was essentially one-way traffic, fully loaded cars one way and empties returning. The farther west the Russians moved, the better the rail network and lateral movements became easier. Massive transfers of units from one sector to another became possible—for example, from the Crimea to the main front after Sevastopol fell. A similar move occurred from Finland when that country surrendered. Both moves provided the Soviets with large operational reserves that could be inserted at will.

The railroads faced new problems in 1943 and 1944 as the Red Army advanced. The retreating Germans had destroyed some track with a large plow that broke the ties in half as it was pulled behind a locomotive. In 1943 the Russians restored 19,000 km of track in liberated areas. In February 1943, the Russians established railroad brigades to repair tracks behind the advancing armies with operating battalions, bridging battalions, and mechanization battalions.[80] Once the Polish and Roumanian borders were crossed, the change in gauge became more difficult, as the ties were shorter. However, more troops were available to work on restoration. By 1945 there were 253,000 railroad troops working on repairs and 250,000 men building roads for the trucks that carried much traffic. About 4 million civilian workers worked on the Russian railroads; an increasing number were women. In 1945 women made up 81% of car porters, 43% of conductors, and 8% of the engineers.[81]

By the summer of 1943, the Soviet railroads had regained the flexibility to transfer large forces along the front and to supply the army. The critical rail situation of 1942 eased with the advances that began in November 1942. Direct lines to all areas of the front were reestablished. After July 1943 more north-south lines came under Russian control. The number of ton-km (1 ton carried 1 km) increased from 217 million in 1942 to 281 million in 1944 and 314 million in 1945. Main-line track in use increased from 68,900 in 1942 to 93,800 in 1944.[82] The hundreds of thousands of American trucks provided by lend-lease solved the new problems created by the changing gauge that emerged in 1944. By mid-1943 transportation was no longer the critical area, as in 1941 and 1942.

The first six months of the war had been catastrophic to the Soviet rail system. While the advancing Germans deprived them of essential rail connections, the trains had to use about a third of their capacity in evacuating industry, while moving millions of troops and huge quantities of supplies and weapons to the front. During 1942 the transportation system stabilized; the Germans held the north-south lateral lines and inhibited Soviet troop movements by the lack of good rail connections, especially in the battles in the south. But the offensive operations in 1943 resulted in the reconquest of north-south lateral lines. With each advance and subsequent repair of the railroads, the Russians gained greater flexibility in moving troops and supplies. Building a few kilometers of new right of way took months in 1942, while repairing hundreds of kilometers of track took only weeks in 1943 and 1944. Repairing track, despite the extent of the damage, was easier than building completely new rail lines. Despite the German efforts to destroy the tracks in their retreat, the Soviet railroads, supplemented by American trucks, gave the Red Army operational flexibility and solid logistical support from the spring of 1943 to the end of the war.

NOTES

1. Hunter and Seymour, pp. 10-12.

2. Hunter and Seymour, pp. 1-2.

3. R. S. Deshpande, *A Textbook of Railway Engineering* (Poona: United Book Corporation, 1962), p. 39.

4. Hans O. Pottgiesser, *Die Deutsche Reichsbahn im Ostfeldzug 1939-1944* (Neckargemund: Kurt Vowinckel Verlag, 1960), p. 26.

5. Pottgiesser, p. 27; *Railroad Facts* (Washington, DC: Association of American Railroads, 1984), p.53.

6. Pottgiesser, p. 27.

7. Pottgiesser, p. 28.

8. Westwood, pp. 167-71.

9. Westwood, pp. 176-177, 193.

10. Westwood, pp. 178-79.

11. Westwood, pp. 192-93, 200.

12. Hunter and Seymour, p. 7-9.

13. Sutton, I, pp. 239-41.

14. Westwood, pp. 201-05; Holland Hunter, *Soviet Transport Experience: Its Lessons for Other Countries* (Washington, DC: The Brookings Institution, 1968), p. 57.

15. Theodore ft. Makhine, *L'Armee Rouge* (Paris: Payout, 1938), pp. 14-15; Westwood, p. 221.

16. Hunter, *Soviet Transport,* pp. 57-58.

17. Hunter, *Soviet Transport,* p. 60.

18. Sutton, II, 195-97.

19. Westwood, pp. 192, 247.

20. Sutton, II, 188.

21. I. V. Modzolevskii, et al., *Obshii Kurs Zheleznikh Dorog* (Moscow: Gosudarstvennoe Transportnue, 1954), pp. 103-04; Sutton, II, p. 199.

22. Westwood, p. 179.

23. Westwood, p. 248.

24. Sutton, II, p. 198; Hunter, *Soviet Transport,* pp. 58-60; Westwood, p. 231.

25. Sutton, II, p. 206.

26. Westwood, p. 249.

27. Westwood, p. 231.

28. Makhine, p. 15.

29. Westwood, pp. 229-30, 233; Voznesenskii stated that daily car loading in 1940 was 97,900, Voznesenskii, p. 83; Makhine, p. 229.

30. Westwood, p. 226.

31. Westwood, p. 242; Hunter and Seymour, p. 142.

32. Westwood, p. 242.

33. Voznesenskii, p. 83.

34. Makhine, p. 230-31.

35. Makhine, p. 234.

36. Makhine, p. 234.

37. Makhine, p. 235.

38. FHO, CGR, Report, 1944, H 3/1521, Roll 587, Frame 368.

39. Makhine, pp. 227-28, 235-36,

40. Pottgiesser, pp. 30-35.

41. One of these engines that was not delivered because of the Revolution has been preserved at the National Museum of Transport, St. Louis, Mo.

42. Westwood, pp. 221-22; Sutton, I, pp. 168-70.

43. Westwood, p. 279; Modzolevskii, p. 104.

44. Makhine, p. 226-27.

45. Sutton, II, p. 204; Westwood, p. 222.

46. Sutton, II, 199.

47. Makhine, p. 226-27. A report from a Japanese Military Attache stated that in 1937 the Soviets had 22,000 locomotives, 710,000 freight cars, and 30,000 passenger cars. FHO, CGR, Report, February 1943, H 3/ 582, Roll 567, Frame 738; Another source listed the number of new locomotives as 23,600.

48. Sutton, II, p. 201; Westwood, p. 278.

49. Sutton, II, p. 205; Westwood, p. 277.

50. Sutton, II, p. 199.

51. FHO, CGR, *Der Kriegwehrmacht der Union der Sozialistischen Sowjetrepubliken, Stand: 1.1.41*, H 3/83.3a, Roll 550, Frame 739; FHO, CGR, H 3/1521, Report, April 30, 1944, Roll 587, Frame 368.

52. Westwood, pp. 22-23.

53. Westwood, p. 223.

54. *Railroad Facts*, p. 48.

55. FHO, CGR, H 3/1521, Roll 587, Frame 368.

56. FHO, CGR, H 3/380, Fassungsvermogen von Eisenbahnwagen, *Faustzahlen fuer den Ic-Dienst ueber die Rote Armee,* November 16, 1944, Roll 562, Frame 1054; Westwood, p. 249.

57. FHO, CGR, H 3/582, Report, June 7, 1941, Roll 567, Frame 735.

58. FHO, CGR, H 3/83.3a, Roll 550, Frame 739.

59. FHO, CGR, H 3/1521, Roll 587, Frame 368.

60. Erickson, *Stalingrad,* p. 235.

61. FHO, CGR, H 3/1334, Russische Eisenbahnen, July 18, 1943, Roll 585, Frame 50; H 3/582, Report, March 26, 1943, Roll 567, Frame 743.

62. Sutton, II, 202.

63. Sutton, D, p. 200.

64. Hunter and Seymour, pp. 181, 183; Van Tuyll, p. 98.

65. FHO, CGR, H 3/582, Russische Eisenbahnen, Report, April 22, 1942, Roll 567, Frame 737.

66. FHO, CGR, M 3/380, Russische Eisenbahnen, Report, November 16,1944, Roll 562, Frame 1053; This figure was confirmed by air reconnaissance, which indicated the average train was 45 cars with 900 tons, FHO, CGR, H 3/1522, Report, no date, Roll 587, Frame 370.

67. FHO, CGR, H 3/83.3a, Manual, January 1, 1941, Roll550, Frame 739.

68. FHO, CGR, H 3/72, Kriegsgliederungen der Roten Armee, Report, December 1, 1941, Roll 550, Frame 462.

69. FHO, CGR, H 3/67, Report based on Red Army movement order, March 30, 1943, Roll 460, Frame 6438917.

70. FHO, CGR, H 3/193, December 22, 1943, Roll 556, Frame 718; The units were the 47th Army and 10th Corps headquarters and the 337th, 30th, 29th, 409th, 353rd, and 223rd Rifle Divisions.

71. FHO, CGR, H 3/1521, Russiche Eisenbahnen, Report, April 30, 1944, Roll 587, Frame 368; The same data is contained in *Faustzahlen fuer den Ic-Dienst ueber die Rote Armee,* November 16, 1944, H 3/380, Roll 562, Frame 1055.

72. Voznesenskii, pp. 86-87.

73, FHO, CGR, H 3/69, May 6, 1942, Roll 549, Frame 108; H 3/197, March 17, 1942, Roll 556, Frame 1021.

74. Erickson, *Stalingrad,* p. 411; G. A. Kumanev,

Na Sluzhie Fronta i Tila 1938-1945 (Moscow: Izdatelistvo Nauka, 1976), pp. 172, 192.

75. *IVOVSS* (German), VII, p. 26; Ely, p. 100; Erickson, *Stalingrad,* p. 448.

76. Shtemenko, *General Staff,* pp. 97-98.

77. Parotkin, pp. 78-79.

78. Voznesenskii, pp. 87-88; FHO, CGR, H/3 1334, July 18, 1943, Roll 585, Frames 50-70; Harrison, pp. 178-79.

79. FHO, CGR, H 3/582, Russiche Eisenbahnen, Report, March 29, 1944, Roll 567, Frame 758; Voznesenskii, pp. 84-

86; The Germans obtained a report that listed 2,580 locomotives, 64,000 freight cars, and 2,800 passengers car added to the rolling stock in 1943; FHO, CGR, H 3/582, March 29, 1944, Roll 567, Frame 758.

80. Tiushkevich, p. 321.

81. Westwood, p. 268.

82. Hunter and Seymour, pp. 181, 183; Van Tuyll, p. 98.

10 Motor Transport

The Russians made a conscious decision in the 1920s to limit the development of motor transport in favor of railroads. Heavy industry used the rails, and even the farmers moved their crops by rail. Truck transportation concentrated on local delivery, with very little of the long distance hauling common in the U.S. Given the Russian policy to develop heavy industry at the expense of consumer goods, it is not surprising that building roads or making trucks and cars received little attention during the 1930s.[1] In 1940, total truck capacity was only 1.7 million tons compared to 15.4 million tons for the railroads.[2] However, one must keep in mind that this ratio was closer to Western European levels than U.S. practice.

The decision to limit the growth of motor transport to European levels had important effects on other elements of the economy. The decision prevented the diversion of steel, rubber, machine tools, and glass away from heavy industry and military production. Materials that would have been used for the construction of autos, trucks, and roads instead went into new factories. Production of gasoline and oil remained at comparatively low levels and at a small cost to the economy. Military considerations influenced the decision. Stalin told the 17th Party Congress in January 1934 that Germany and Japan were threats, and that defense must take priority over consumer needs. Good roads would have benefited the farmer but their welfare was sacrificed. Defensively the poor highways and the wide-gauge railroads were obstacles to an invader.[3]

The generally poor quality Russian roads were of little value for longdistance movement until 1943, when large numbers of four- and six-wheel-drive lend-lease U.S. trucks carried heavy cargos of supplies over long distances. The Soviet Union possessed few all-weather roads compared to other European countries. In 1928 there were 32,000 km of hard-surfaced roads and 1,400,000 km of dirt roads. But the five-year plans intended to make some improvements. The First Five-Year Plan included construction of 117,000 km of roads, including 15,000 km of paved roads. In 1933 the Russians had 40,000 km of paved roads, .5 km per 100 square km. The Second Five-Year Plan included construction and repair of 210,000 km of roads, including 30,000 paved, 22,400 recovered with gravel, 77,600 graded, and 80,000 improved. By 1937 there were 400,000 km of graded roads including 70,000 km of paved roads. However, Russia still had less than 1 km per 100 sq km, compared to 104.9 km per 100 sq km in France and 48.6 in Germany. Other sources stated that the Soviet Union had 7,100 km of concrete or asphalt roads and 136,300 km of hard-surfaced roads (presumably gravel) in 1940.[4] The comparison was misleading because most of the Russian paved roads were in the west, where most of the population lived and the military action took place.[5] The vast undeveloped areas east of the Urals reduced the average km per sq km to a meaningless figure. From 1933 to 1937 the Russians doubled the mileage of improved roads almost all in the developed area west of the Urals.

More than 50% of the new roads were built to access the railroads. The remainder substituted for railways in less populous areas. In 1940 the Soviets had reconstructed highways radiating out of Moscow to Minsk, Leningrad, Kiev, Gorki, and Kharkov and built highways linking Leningrad and Kiev and Kiev and Zhitomir.[6] The terms *hard-surfaced* and *improved roads* are open to interpretation and make the statistics difficult to relate. No matter what was a good road and whether a gravel road could be considered a good road, the Soviet Union had a poor road network. Lack of paved roads made it difficult for the invading Germans to supply the panzer divisions using rear-axle-drive trucks. The unimproved Russian roads were impassable for several weeks in the spring and in the fall during the rainy seasons. In winter, snow drifts blocked the roads. Alternate freezing and thawing severely damaged Russian improved roads, a condition common in the northern United States but seldom encountered in Western Europe. Western Europeans had little experience with this phenomena because the temperate climate had few days with overnight freezing and

afternoon thawing. The Russian climate was more like that of the United States, but the Russians lacked the resources for preventive maintenance and timely repair of damage.[7] The Road Maintenance Law of 1936 required members of collective farms to do six days of work annually with their own equipment to maintain roads.[8] That idea of local impressed road maintenance had ceased in industrialized countries in the 19th century.

Given the few roads passable for cars and trucks, it was not surprising that there were few motor vehicles in the Soviet Union before World War II. In 1922 there were 5,600 cars and 5,000 trucks. In 1928 the number had increased to 7,500 cars, 7,900 trucks, and 1,100 buses.[9] An objective of the five-year plans was to replace the horse and cart with trucks for short-distance hauling. Annual production of trucks increased to 23,743 in 1932, 131,546 in 1936, and 178,769 in 1939. Automobile production increased from 700 in 1928 to 145,400 in 1940. But truck production declined to 136,000 in 1940 as industry turned to war work. By 1940 there were a total of 850,000 trucks, and over one-fourth were on the farms.[10] In June 1941, the army mobilized 234,000 motor vehicles and 31,500 tractors.

The Soviets saw the advantage of motorization on the farm. From 1922 to 1926 the Ford Motor Company sold 20,000 tractors to Russia. By 1927, Ford had built in Detroit 85% of all the trucks and tractors in Russia. And Ford had equipped the Krasnyi Putilovets factory with U.S. machinery by 1927 to produce Ford tractors." Development of tractor factories was tied to future tank production. Other companies provide assistance in developing Soviet auto production as shown below.

SOVIET AUTO PLANTS

Plant	Product	Source of Assistance
Nishnij - Novgorod	GAZ	Austin and Ford
AMO (Stalin, Moscow)	AMO, ZIS	Brandt
Molotov, Gorki	GAZ	Austin and Ford
Stalin, Miass	ZIS	Stalin Moscow
Vlianovsk	ZIS	Stalin Moscow
Stalin, Yaroslavl	YAZ	Hercules
Kuznetsk	ZIS	Autocar and Brandt
Kim, Moscow	GAZ	Ford

In January 1926 negotiations began with the Ford Motor Company for technical assistance in the construction of an automobile plant. On May 31, 1929, Ford signed an agreement to build a plant at Nishnij-Novgorod to build GAZA cars and GAZ-AA trucks, copies of the Model A Ford car and truck. American engineers would direct the construction and equip the plant, while Russian engineers went to the River Rouge plant in Detroit to study methods.

The Austin Company of Cleveland, Ohio, and other American companies provided technical assistance for manufacturing auto parts. The parts were manufactured for the Nishnij-Novgorod plant and the AMO plant that made the AMO-3 2.5-ton truck.[12] The Austin Company directed the Nishnij-Novgorod project under a contract approved in August 1929. The complex included two large buildings for stamping, tool making, machinery, and assembly; three small foundry buildings; a spring shop; a forge shop; a woodworking shop; and a powerhouse. In 1938 the Nishnij-

Novgorod plant was producing 84,000 copies of the Model A.[13] During the war the Nishnij-Novgorod plant converted to the production of T34 tanks.

Practically all production of trucks by the Russians benefited from American assistance. The major auto plants in 1941 were located in Moscow (2), Gorki, Miass, Ulianovsk, and Yaroslavl, producing 211,000 vehicles per year.[14] The largest was plant no. 1, the Molotov, located in Gorki, which accounted for 34% of truck production in the Soviet Union in 1944. The plant made the GAZ-A, the GAZ-AA, and the GAZ M (a copy of the 1934 Ford). Construction of the plant had begun in 1930 as part of the First Five-Year Plan and was in production in 1933.

In the fall of 1941, weapons factory no. 185, Kirovskii from Leningrad, and part of the Stalin auto plant from Moscow were evacuated to Gorki and added to the Molotov plant. In May 1941 the factory had begun production of the T60 light tank, making as many as 30 per day in 1942. In June 1942 production turned to the T70. At the end of 1943 the plant was producing T34s, SU76s, Degtyarev-armored cars, and 1.5-ton GAZ trucks. It employed 60,000 workers—45% women, 10% young men under military age, 5% invalids, and 40% old men. The factory worked two 12-hour shift, although workers with heavier jobs worked three 8-hour shifts. In 1944 monthly production at the plant included 550 SU76s, 2,700 GAZ trucks, 350 armored cars, 2,700 American trucks assembled from imported parts, Katusha rocket-launcher vehicles, and mortars. The plant also assembled imported English and U.S. tanks.

Parts came from many sources. The imported parts for trucks and tanks came from overseas. The tank bodies and turrets came from the Dzherzhinsk railroad repair plant in Murom. Steel came from the Kirov steel works in Kulebaki near Gorki, and machined parts came from the Dro machine factory in Uksa. Guns and armor came from artillery factory no. 92 in Gorki.[15]

The Stalin ZIS auto plant no. 2 in Moscow made light tanks and SUs during the war. The factory had made the AMO F-15, a 1.5-ton truck copied from the Italian 1912 Fiat until mid-1929. Ü1929, the plant received technical assistance from the A. J. Brandt Company. The Brandt company received a contract to redesign, expand, and reconstruct the plant to manufacture the ZIS-5 and ZIS-6, copies of the American Autocar 2.5-ton truck, The ZIS-6 was a 4-ton truck patterned after the Autocar model. Constructed as part of the First Five-Year Plan, the plant began production in 1932 and was designed to make 50,000 trucks and autos per year. The machinery was of the latest design, which came from the Budd Company of Detroit. Although the scheduling of parts was still a problem in 1937, the factory in 1938 made 59,724 ZIS-5 (2.5-ton) trucks, 3,169 ZIS-6 (6-ton) trucks, 3,900 ZIS 101 and 102 autos (designed by Budd), and 1,335 buses. The factory had 40,000 workers in 1940.

In the fall of 1941, the machinery and workers were evacuated. Over 80% went to the Ulianovsk plant and the others went to auto plants in Gorki and Miass. In November 1941 the factory received new machines from smaller Moscow-area factories that had not been evacuated, and in February 1942 production resumed. The major products were 3-ton ZIS trucks and Studebaker, Ford, and Dodge trucks assembled from imported parts. The factory also made half-tracks, motorcycles, 76mm guns, and machine pistols. Suppliers included the auto plant at Gorki and other small Moscow factories. In 1944 the plant employed up to 25,000 workers, mostly women with some boys and older men.[16] Manufacture of the ZIS-5 and ZIS-6 continued until 1944.[17] The Stalin ZIS auto plant was the second largest producer of vehicles, with 24% of the production in 1944.

The third largest auto plant in the Soviet Union during the war was the Stalin auto plant in Miass near Chelyabinsk. The factory made 3-ton ZIS trucks, 18% of all truck production. The factory was built in 1938 as a ball bearing plant and continued to make only bearings until June 1941. In the fall of 1941, machinery from the Stalin auto works in Moscow was evacuated to Miass, and in January 1942 some workers arrived. During the winter an assembly plant was constructed. In February 1942 production began in some departments, and in March 1942 assembly of trucks began, although the engines came from other suppliers. In March 1943 a huge assembly building was completed and more workers came from Moscow.

In 1944 the plant employed 7,000 to 8,000 workers. Women made up 70% of the workforce, boys 20%, and invalids the remaining 10%. The employees worked two 12-hours shifts except those in heat-treating and other strenuous jobs, who worked in three 8-hour shifts. In 1944 the plant made 1,900 ZIS trucks per month and 60 to 80 engines, some of

which supplied the auto plant at Ulianovsk.[18]

The Ulianovsk factory machinery and workers came from the Stalin auto plant near Moscow that had originally been equipped with U.S. machines. The motor shop had been shipped to Miass and the Ulianovsk plant continued to received motors from Miass and other parts from Moscow. The factory assembled 3-ton ZIS trucks—the same type built in Miass and in the reconstituted Stalin plant in Moscow. The output in 1944 equaled about 8% of total truck production and employed about 3,000 workers, 75% of which were women. The plant made 800 ZIS trucks per month and assembled American trucks with imported parts."

The Yaroslavl auto works no. 3 was the fourth largest auto plant, making 11% of the total production of trucks. During World War I the factory had made copies of the British Crossley and Wolsey trucks. In 1917 production ceased and the plant was a repair shop from 1918 to 1931. The Hercules Motor Company, a U.S. truck engine manufacturer, modernized, equipped, and expanded the factory during the First Five-Year Plan.[20] The YAZ trucks were copies of the Hercules Motor Company trucks. Production increased from 200 per year before modernization to 2,500 vehicles per year. Under the Second Five-Year Plan, the plant was enlarged with the intent of producing 25,000 vehicles annually. Construction began in 1934 and was still under way in 1941 when the war started. The Yaroslavl plant made trucks and the chassis for buses assembled in Moscow and Leningrad. In 1938 the plant had 15,000 workers and produced 826 3-ton trucks and 1,289 5-ton trucks.[21]

During the war the factory made heavy 5- and 8-ton YAZ trucks, light tanks, and specialized vehicles. After 1941, the factory assembled British tanks from imported parts and repaired thousands of trucks. The plant also made mortars and artillery shells.[22] The Yaroslavl factory produced 1,100 YAZ trucks monthly in 1944.[23]

The smallest of the six plants was the Kim auto assembly plant no. 2 in Moscow, producing 5% of the total output. The Ford Motor Company directed the construction of the plant in 1930-31 with a capacity of 24,000 cars per year. The factory originally assembled vehicles from parts made at the Gorki plant. In 1940 the plant had 10,000 workers and assembled 50,000 cars from parts made elsewhere.[24] Under the Third Five-Year Plan the factory was redesigned to manufacture small automobiles and produced 3,000 in 1941.

Part of the plant was evacuated in the fall of 1941, but some machinery remained. In September 1942 production resumed using parts left behind and from cannibalizing damaged trucks. The factory was also repairing ZIS, GAZ, and foreign vehicles. The Kim plant had 3,500 workers in 1944, over half women and some girls as young as 13 years of age. In mid-1944 the production of small cars resumed, reaching a total of 550 per month. The plant continued to make parts for other factories and for maintenance.[25]

American contractors also established a host of parts factories to supply the auto industry with components. The Holley Carburetor Company (a Detroit manufacturer of automobile carburetors) provided the carburetor copied and manufactured at the Samara carburetor and motor plant in 1932. Electrical equipment plants made copies of spark plugs, ignition systems, and other parts produced by the Electric Auto Lite Corporation of Toledo. A tire plant was built at Yaroslavl using the designs of the Seiberling Rubber Company of Akron, Ohio. In 1932 the plant was in production and had 22,000 workers.[26]

All six of the plants were producing trucks during World War II and made a substantial contribution to the truck supply of the Red Army. While Britain and the U.S. provided nearly 380,000 trucks and over 50,000 Jeeps during the war, the Russian plants were turning out nearly 100,000 per year. While the U.S. trucks went to combat units, the Russian trucks were used in supply units.

Fremde Heer Ost estimated monthly production of trucks by factory and type in 1944 as follows:[27]

Factory	YAZ	ZIS	GAZ	Total
Molotov no. 1, Gorki			2,700	2,700

Stalin ZIS, Moscow		1,650		1,650
Yaroslavl	1,100			1,100
Ulianovsk		800		800
Miass		1,900		1,900
Kim				
MONTHLY TOTAL	1,100	4,350	2,700	8,150
ANNUAL TOTAL	13,200	52,200	32,400	97,800

The major types of trucks used by the Red Army were all copies of American types or lend-lease imports, as follows:

Type	Maximum Load (kg)	Normal Speed (km/h)	Drive	Capacity (men)
GAZ-AA	1,500	20.5	4x2	16-18
GAZ-AAA	2,000	25	6x4	16-18
ZIS-5	3,000	34	4x2	24
ZIS-6	4,000	41	6x4	
YAZ	8,000			30
Studebaker	3,500	40	6x6	
Ford	5,000	40	6x4	
Chevrolet	500			
Dodge	500			

The GAZ types towed 45mm guns and carried 82mm and 120mm mortars. The ZIS and YAZ types towed 76mm, 122mm and 152mm guns.[28]

The complete truck picture was summarized by Fremde Heer Ost as follows:[29]

Trucks	1941	1942	1943	1944
Production	100,000	70,000	80,000	100,000
Imports	10,000	50,000	110,000	130,000
TOTAL	110,000	120,000	190,000	230,000

The United States sent 77,972 Willys Jeeps, 151,053 1.5-ton trucks, and 200,662 2.5-ton trucks to the Soviet Union. Soviet production during the war was 343,624 trucks and cars.[30] The Russians thought that the American trucks were better than the Russian trucks, especially off the roads. The American vehicles had better motors. The Gorki plant halted production of Russian trucks late in the war and devoted all capacity to the assembly of American trucks with parts sent from the United States.[31]

The Red Army had a total of 272,600 trucks in June 1941, mostly GAZ-AAs and ZIS-5s, not enough to complete the table of organization. The 9th Mechanized Corps had one-third its allotment of tanks, but no trucks or even horse-drawn wagons in June. In June 1941, 17 divisions in the southern sector in the 5th, 6th, 26th, and 12th Armies had a total of 902 motor vehicles and 62 tractors. The number of vehicles in each division varied from 10 in the 60th Rifle Division to 433 in the 72nd Mountain Rifle Division.[32] The disasters in the first five months had reduced the size of the rifle division and cut deeply into the number of trucks assigned to the division. The division could no longer move all of its supplies and equipment with the assigned transport, as before the war.[33]

At the beginning of the Great Patriotic War the Red Army had 19 truck regiments, 38 independent truck battalions, 2 companies, and other units. The truck regiments had been formed in 1937 and included four to six battalions each with 169 trucks. A six-battalion regiment would have 1,062 vehicles.[34] In 1941 new truck battalions were formed and in early 1942 road maintenance battalions.[35] During 1942 and 1943 each army had three to six truck battalions and each front one or two battalions. The Stalingrad offensive called for larger motor units. Truck brigades and truck maintenance battalions were formed to serve armies and fronts.[36]

A document outlining the daily supply of the 3rd Guards Army, the 5th Tank Army, and the 2nd Guards Army in January 1943 presented an overview of the use of trucks in the supply. The Soviets were on the offensive, driving German Army Group B and Army Group Don back into the Ukraine north of Rostov, and therefore required large amounts of fuel and ammunition.

The units of the 2nd Guards Army were supplied from depots east of the Volga and southeast of Stalingrad with 1,386 trucks moving in each direction. The 5th Tank Army depots were north of the Don, northwest of Stalingrad with 1485 trucks on one route and 1386 on another about 150 km north. The 3rd Guards Army had depots north of the Don with 165 trucks, using a route about 75 km north of the 5th Tank Army northern route and another route with 165 trucks due north.

The depots were about 240 to 300 km from the armies. The trucks supplying the 2nd Guards Army made a round-trip journey in six days, while the others took four days. A total of 9,174 trucks with a capacity of 27,522 tons were employed. The three armies had a total of 106 units (rifle division, mechanized corps, or equivalent) with an average requirement of 75 tons per day and a total for the three armies of 7,950 tons per day. Eighteen trains per day were needed to supply these units, plus 3,370 3-ton trucks to move the supplies forward from the railhead each day, making an allowance that all trucks could not be loaded to capacity because of the nature of the cargo. With a four-to six-day turnaround for the trucks, 16,850 trucks (3,370 times 5) would be required. With only 9,174 trucks, the Russians were in a difficult supply situation. Even with a four-day turnaround (3,370 times 4) 13,480 trucks were required to deliver 75 tons per unit. The units had to make do with an average of 50 tons that limited their activity.

The computation was based on an average unit requirement of only 75 tons, which was low considering that the units were involved in offensive operations.[37] The estimate of 450 tons per train was also low; the average was usually 900 tons per train. However, the single rail line that had been extended to the east bank of the Volga near Stalingrad was probably in poor condition because of heavy use ta the buildup for the November 1942 offensive. The normal capacity of a single-track line was 24 trains per day, but its capacity had been doubled when flagmen were posted at frequent intervals, permitting the trains to run much closer together but causing heaVy wear on the tracks and allowing no time for maintenance. These factors may have led to shorter trains. The rail example points out the difficulty the Russians had in sustaining their offensives once they had penetrated several hundred kilometers beyond the German line before large numbers of American trucks arrived.

Soviet supply capability improved dramatically in the spring and summer of 1943, mainly as the result of lend-lease American trucks that were arriving in large numbers. Total truck imports more than doubled from 1942 to 1943. In October 1943, the 5th Army and attached mechanized forces with a total of 40 units and daily requirements of 79 tons each (total, 3,160 tons) had a total truck capacity of 11,900 tons. That compared favorably to 27,522 tons for 106 units in the previous example. The 5th Army used 6,320 tons of its truck capacity for daily supply with a two-day turnaround, 1,200 tons were in repair, and 4,380 were free for moving troops or any other purpose.[38] Three armies in the previous example with 106 units had only 27,000 tons capacity with a four- to six-day turnaround—not sufficient

to deliver basic maintenance (4 days times 8,100 tons = 32,400 tons of capacity required for 75 tons per day to each unit).

In 1944 truck brigades were assigned to armies. They consisted of three battalions, each with 100 1.5-ton GAZ-AA trucks. Truck regiments were also under army command. Each army had two truck battalions (tank armies had three), each with three companies. Most battalions had about 100 ZIS-5 and GAS-AA trucks. Army truck units had a capacity of about 1,200 tons. At the front level were one to three transport brigades with a capacity of about 3,000 tons. Rifle divisions had a transport company with 45 GAZ-AAs and 15 to 30 ZIS or Studebakers. The trucks could carry 80 tons of supplies. The tank corps had a company with 100 trucks and 10 fuel tankers that carried 93 tons. The mechanized corps company carried 174 tons of supplies.[39]

In December 1944 the 61st Army had three independent truck battalions carrying supplies to the division depots from army depots. The army truck battalions each had three companies with 40 to 60 trucks, mostly Studebakers and ZIS-5s. The total number of trucks assigned to a rifle division was about 140. On November 21, 1944, the 154th Transport Company of the 152nd Rifle Division had the following trucks:

Chevrolet, 1.5-ton, new	5
Studebaker, 2.5-ton, new	4
ZIS, new	9
GAZ, 1.5-ton, overhauled	4
Henschel, 3-ton, German	1
Renault, 2.5-ton, French (captured)	3
Tractors, German	2
ZIS and GAZ, old, in need of repair	14
TOTAL	42

There were about 100 men in the company.[40] The captured trucks and Soviet-made vehicles had two-wheel drive—that is, only the rear axle provided traction. The Studebakers were 6 x 6; the two rear axles and the front axle all provided traction. The Chevrolets had 4x4 drive, only one rear axle but with traction on both front and rear. The divisional truck companies varied in size and equipment.[41] Each division of the army had a truck transport company with about 70 trucks to carry supplies from the division supply depot to the regiments.[42] The authorized strength in 1944 was 45 GAZ-AA and 15 to 30 ZIS or Studebakers. The company had a capacity of 80 tons of supplies and 5 tons of fuel.[43] The U.S. trucks were used in the combat units, while the two-wheel-drive trucks were used in the rear areas where most of their driving would be on roads. The medical battalion of the rifle division had 13 trucks and 90 men. The other service elements of the division were horse drawn: the field bakery, the horse hospital, and the field post office.[44]

A tank corps had 1,000 trucks and a mechanized corps about 2,000. Tank and mechanized corps had truck companies as corps troops plus a column of fuel tankers. The company was authorized at 100 trucks and the column, 10 fuel tankers. The tank corps company had a capacity of 93 tons of supplies and 51 tons of fuel, and the mechanized corps company could carry 174 tons of supplies and 83 tons of fuel.[45] Tank brigades had a truck transport company with 30 trucks and six or seven tankers carrying 18 tons of supplies and 11 tons of fuel.[46] The allotment of trucks to mechanized units was seldom more than enough to carry about one day of supply. The mechanized units, like the infantry, relied heavily on the ability of the army supply units to make daily deliveries to the corps supply depot. The

mechanized corps trucks were responsible for carrying supplies from the corps depot to the brigades and battalions, but in the event of an emergency the trucks picked up supplies at the army depots.

Some other heavily motorized units were the artillery divisions with 1,800 trucks, the artillery brigade with 350, the tank destroyer brigade with 180, the antiaircraft division with 280, and the mortar brigade with 350. The motorized rifle brigade had 280 trucks.[47] The artillery used American tractors to tow the heavy guns. Medium and light artillery batteries had five trucks, one to tow each gun and carry ammunition for the gun, and a fifth truck as a reserve with additional ammunition.[48]

Some examples illustrate the high degree of motorization made possible by lend-lease trucks. In October 1943 the 15th Tank Destroyer Brigade was equipped with Studebakers to tow 76mm antitank guns in two regiments and Willys Jeeps to tow 45mm guns in a third regiment.[49] The eight-man crew of a 45mm gun rode on the Jeep, the limber, and the gun. Four men were in the Jeep with one hanging on the back; two rode on the limber; and the last man straddled the trail of the gun.[50]

The 530th Tank Destroyer Regiment in November 1943 had one TSH TS tractor, 13 scout cars used to tow the 57mm guns, 12 GAZ-AA trucks, 11 ZIS-5 trucks, 2 Studebakers, and 8 captured trucks.[51] In December the 46th Light Artillery Brigade was completely motorized with Studebaker trucks towing the 76mm guns.[52] Some Soviet units were equipped entirely with Russian-built trucks. The 1101st Artillery Regiment had 24 TS tractors, 24 GAZ-AA trucks, and 7 ZIS-5 trucks in November 1943. The 133rd Guard Mortar Regiment equipped with 120mm mortars had 43 GAZ-AA trucks and 13 ZIS-5 trucks, but no American or captured equipment.[53]

In February 1945 the 32nd Artillery Regiment of the 31st Rifle Division had 20 76mm guns and 12 122mm howitzers. The motor vehicles included the following:[54]

NATI-5 tractors	4
NATI-3 tractor	1
Vorspann tractor	1
Studebaker trucks	29
Chevrolet truck	1
ZIS-5 trucks	3
GAZ-AA trucks	2
Opel Blitz trucks, German	3
Ford truck	1
Mercedes-Benz truck, German	1
TOTAL	46

Maintaining seven or more different kinds of trucks from three different countries employing two measuring systems (American and metric) made maintenance a nightmare. French trucks were also captured, further complicating the problem. Stocking spare parts seemed impossible. In 1944 the Russians established 12 "SPAMs," or repair facilities for vehicles. On the average in April 1944, 124,000 vehicles were being repaired at all times. The SPAM at Rushkovo, 90 km from Moscow, had 7,500 vehicles undergoing repair in October 1944.[55]

Most of the trucks used by the Red Army were assigned to combat units, about 75%, including trucks in service units in artillery and mortar formations. The artillery regiments used over one third of the total number of trucks according

to German estimates based on captured documents and prisoner-of-war statements. The Germans captured few documents that would have revealed the transport situation in the rear areas. In making their estimates of Soviet truck numbers, the FHO based their estimate on the limited number of trucks available to the German Army. In addition, the Germans tended to place their transport in the hands of the combat units which went back to the army railheads to pick up supplies, rather than having the army service units deliver the supplies to the divisions as did the Soviets. A calculation made by the Germans in January 1945 was as follows:[56]

Rifle Divisions	66,500
Tank and Mechanized Corps	46,000
Independent Tank Units	15,000
Cavalry Corps	3,500
Artillery Regiments, Including AA, TD, Mortar, and Guard Mortar Regiments	120,500
Service Units in Artillery and Mortar Divisions and Brigades	38,000
Subtotal trucks in combat units	289,500
Army and front truck units	53,000
TOTAL	342,500

The total number of trucks was on the low side, not including enough for army and front service units.

By 1943 the Red Army had sufficient trucks to provide an alternative to hauling supplies from army railhead with horse-drawn carts. With the trucks, the distance that the divisions could advance beyond the railhead without running short of supplies was extended from about 30 km (the distance a horse-drawn wagon could cover in one day) to over 300 km. Because the horse had to be sheltered and cared for every night, the use of horse drawn-wagons was limited to one-day trips, whereas the trucks could be parked in the open at night, fully loaded, and proceed the next day. In an emergency, shifts of drivers could keep the truck moving night and day.

By January 1, 1944, the Red Army had 496,000 trucks of which 78% were Russian. This total grew to 664,500 by the end of the war, of which 58 % were Soviet made, 32.8% were American and British, and 9.1% were captured.[57] The high level of motorization of the Red Army was made possible first by American technical assistance in building factories in the 1930s for the mass production of Russian trucks and later through imports of American trucks under lend-lease. The increased mobility provided by the trucks enabled the Red Army to continue the advance into Poland and Germany unconcerned by the difficulty of rail conversion that would have sharply reduced the flow of supplies over the rails.

NOTES

1. Hunter, *Soviet Transport,* p. 33.

2. Ibid., p. 81.

3. Ibid., pp. 49-51.

4. Ibid., p. 178.

5. Makhine, p. 237.

6. Makhine, pp. 234-36.

7. Ibid., p. 91.

8. Ibid., p. 95.

9. Ibid., pp. 102-03.

10. Ibid., pp. 166, 171, 173; USSR, *National Economy*, p. 71.

11. Sutton, I, pp. 140-41.

12. Sutton, I, p. 248.

13. Sutton, I, pp. 245-48; II, p. 259.

14. FHO, CGR, H 3/804, Roll 578, Frame 191.

15. FHO, CGR, H 3/807, Roll 578, Frames 276-280; Sutton, II, p. 180.

16. CGR, FHO, H3/807, Roll 578, Frames 288-291; Sutton, II, p. 180.

17. Zaloga and Grandsen, pp. 43-44; Sutton, II, pp. 177-79.

18. CGR, FHO, H3/807, Roll 57, Frames 309-12; Sutton, II, p. 180.

19. CGR, FHO, H3/807, Roll 57, Frame 303; Sutton, II, p. 180.

20. Sutton, II, p. 180; *VOVE*, p. 38.

21. Sutton, II, pp. 179-81.

22. CGR, FHO, H3/807, Roll 578, Frame 294; Sutton, II, p. 180.

23. FHO, CGR, H 3/807, Kraftfahrzeugfertigung in der SU, 1944, Roll 578, Frame 274; H 3/1522, Roll 587, Frame 375.

24. Sutton, II, p. 182.

25. CGR, FHO, H3/807, Roll 578, Frames 298-99; Sutton, II, p. 180.

26. Sutton, II, pp. 182-84.

27. FHO, CGR, H 3/807, Roll 578, Frame 274,

28. *VOVE*, p. 39; FHO, CGR, H 3/380, November 16, 1944, Roll 562, Frame 1052; H 3/807, Roll 578, Frame 274.

29. FHO, CGR, H 3/1508, Übersicht über die Sowjetrussische Wehrkraft, February 28, 1945, Roll 587, Frame 28.

30. Zaloga and Grandsen, p. 219.

31. FHO, CGR, H 3/828, Roll 578, Frame 1142.

32. Gurov, *Boyeviye," p. 33.

33. Tiushkevich, p. 280; Ivanov, p. 225; *VOVE*, p. 39; FHO, CGR, H 3/73, Roll 549, Frame 765.

34. *VOVE*, p. 39; FHO, CGR, H 3/73, Roll 549, Frame 765. 15. Tiushkevich, p. 283.

36. Tiushkevich, p. 321; *VOVE,* p. 39.

37. FHO, CGR, H 3/193, January 9, 1943, Roll 556, Frame 729.

38. FHO, CGR, H 3/468.2, October 24, 1943, Roll 564, Frame 940.

39. FHO, CGR, H 3/380, November 16, 1944, Roll 562, Frame 1056; H 3/104, March 24, 1944, Roll 551, Frames 51-42.

40. FHO, CGR, H 3/64.1, Report, January 1, 1945, Roll 460, Frame 6438247.

41. FHO, CGR, H 3/380, Faustzahlen fuer der Ic Dienst, November 16, 1944, Roll 562, Frame 1056.

42. FHO, CGR, H 3/64.1, Report, December 12, 1944, Roll 460, Frame 6438240.

43. FHO, CGR, H 3/380, Faustzahlen fuer der Ic Dienst, November 16, 1944, Roll 562, Frame 1056.

44. FHO, CGR, H 3/123.1, February 2, 1945, Roll 552, Frame 455.

45. FHO, CGR, H 3/380, Faustzahlen, November 16, 1944, Roll 562, Frame 1056.

46. Ibid.

47. FHO, CGR, H 3/118, February 20, 1944, Roll 552, Frame 374.

48. FHO, CGR, H 3/69, Kriegsgliederungen der Roten Armee, 1942, Roll 549, Frame 122.

49. FHO, CGR, H 3/69, Report, October 16, 1943, Roll 549, Frames 223.

50. Konstantin P. Kazakov, *Vsegda s Pekhotoi Vsegda s Tankami* (Moscow: Voenizdat, 1969), p. 127.

51. FHO, CGR, H 3/69, Report, November 12, 1943, Roll 549, Frame 94.

52. FHO, CGR, H 3/69, January 2, 1944, Roll 549, Frame 45.

53. FHO, CGR, H3/69, November 5, 1943, Roll 549, Frame 94.

54. FHO, CGR, H 3/64.1, February 15, 1945, Roll 460, Frame 6438211.

55. FHO, CGR, H 3/73, Kriegsgliederungen der Roten Armee, October 27, 1944, Roll 549, Frame 798.

56. FHO, CGR, H 3/118, January 26, 1945, Roll 552, Frame 372.

57. *VOVE*, p. 39.

11 Utilization of Horses

The Red Army used horses as mounts for cavalry and to pull artillery and wagons. During the 1930s the Soviets had maintained a large cavalry force. At the beginning of the war, additional divisions were mobilized. Many new armies formed in the fall of 1941 had two cavalry divisions assigned. But because the cavalry suffered heavy losses in the winter battles, the Russians disbanded most of the divisions. In 1942 many of the remaining divisions took part in the counterattack at Stalingrad and in offensives in later years.

In the early years of the war the horse was most valuable in transport units. Given the poor state of Russian roads, the horse played a major role on the Eastern Front. The horse could cope with any condition better than wheeled vehicles and sometimes better than tracked vehicles. Poor roads, rough terrain, mud, snow, ice, swamps, forests, and other

obstacles delayed but did not stop horses.[1] However, in rough going the load would have to be reduced, the length of the work day shortened, or the number of horses to pull a wagon increased. In very rough going, two or all three of the restrictions might be required. Horse-drawn transport and cavalry was at its best during the two muddy periods, in the spring and in late fall. In these seasons the ground and unimproved roads became impassable to wheeled vehicles.[2]

Both the Russian Army and the German Army relied heavily on horses for transport. The Germans used 2.75 million horses and mules in World War II, the Russians 3.5 million.[3] German losses of horses were staggering. From November 1, 1941, to January 30, 1942, 119,132 horses died, probably because of exposure or poor feed causing illness.[4] In the German Army, the field artillery was almost completely horse-drawn. The only motor-drawn artillery in the infantry division were the antitank guns. Horse-drawn wagons, not trucks, made up the supply column in the infantry division units. The Germans recognized the value of cavalry and created more cavalry units toward the end of the war.

The Russian Army used horses to pull some artillery in the rifle divisions, but most other artillery regiments were motorized. The small *panje* wagon pulled by a single horse was a mainstay of the rifle formations, but trucks carried most other supplies, especially after the spring of 1943. The horse was not a cheap alternative to the truck. Horses needed much care and food every day.[5] If the horse did not receive care each day, it became sick and had to be sent to the rear. In the morning a horse was watered and fed plus given a minimum amount of grooming. Without grooming, sores would develop around the collar area and other areas where the harness rubbed. The sores would prevent the horse from working at full capacity.

Harnessing even a two-horse team required at least two men and from 15 to 30 minutes. Hitching a six-horse team to a piece of heavy artillery required at least six men and over an hour of tedious work. If not carefully fitted, the harness straps would rub and cause sores. At the end of the day a truck driver parked the truck and walked away, but the wagon driver spent over an hour caring for his horses. The harness was removed and stored carefully so that it would not be tangled the next morning. The horse was fed, watered, and groomed. Good shelter and clean bedding had to be provided or the horse would not sleep well and be in poor condition the following day.

Even if horses remained in the rear while the troops fought as infantry, men had to attend to the horses. Care had to be taken not to burn out the horses by driving them beyond their limits. Horses needed a day off to rest once a week. After 10 days of even moderate work without rest, a horse's condition would deteriorate. Even with light work, if a horse worked more than three weeks without rest, it would need several days to regain its strength. If overworked, the horses needed even more time to regain their strength. Horses required sleep at night, good bedding, and good housing during bad weather to remain well. If neglected, sick horses were sent to the rear to horse hospitals, leaving the cavalrymen without mounts and wagons without teams. Recuperation from most of the diseases took months.[6]

In January 1942 the 2nd Guard Cavalry Corps and the 6th Cavalry Corps were fighting as infantry, and the horses were held in demolished villages where fodder and water was scarce. Many horses became sick or died and could not be replaced quickly.[7]

After combat, horses needed an opportunity to rest and regain strength for the next operation. The period of rest varied depending on the condition of the unit after the operation and the urgency of the next operation. A minimum of 8 to 10 days was needed to bring up replacements of men and horses from the rear, to absorb replacements and returning sick, and to shoe and rest the horses.[8] Replacement horses needed at least a week to accommodate to their teammates in a two-horse team. To train larger teams to work together took even longer.

Adequate stables were essential. A horse could pull a wagon or gun about 30 km per day. At the end of the day stables and fodder had to be available. Thus, these needs severely limited the use of the horse. Artillery units had to find housing for their horses before they could halt for the night. A horse-drawn unit had to send advance scouts forward to search for suitable buildings for the animals. Horses performing routine supply service from the railhead to the troops needed stables at both ends. The usual practice for divisions with a horse-drawn supply column was to move the horses pulling the wagons from stables at the railhead to the stables at the division depot if the distance was less than 40 km. The following day, the horses and wagons returned to the railhead. If the distance were greater than 40 km, a "road

supply sector" of transport units delivered supplies from the railhead to an intermediate point. The divisional supply columns would pick up at the sector point and move the supplies to the troops. If trucks were used instead of horses for the divisional supply column, the distance from railhead to the troops could be extended to 60 km before a road supply sector was needed.[9]

If the distance from railhead to the front exceeded 75 km (two day's travel) and horses were used, the rear area units transported supplies from the railhead to the division depot using supplemental transport. Stables would then be established at convenient points, about 30 km to 40 km apart. The supply system would be strained because the horses would have two long work days each way. The trip back to the depot with empty wagons was not as strenuous as the trip forward with loaded wagons. However, movement 30 km beyond a railhead still created severe problems. Troops more than 80 km beyond the railhead were at a disadvantage because of the shortage of horses and wagons to manage a three-day trip each way. Therefore, although the Red Army made good use of horses at the divisional level, trucks with a much greater radius of movement generally moved supplies from the railhead to divisional depots.[10] The distance from the front to the division depot with motorized resupply was from 40 to 50 km. With horse drawn resupply, the distance was limited to 25 to 30 km." Motorized supply was far more efficient and provided the combat troops with more tactical flexibility.

When not enough trucks were available, horses had to be used. The lack of transport became very severe in the fall of 1941. On December 24, 1941, the Soviet High Command authorized 76 horse-drawn transport battalions, each with 250 wagons or sleighs and 500 horses. The Western Front received 12 of the battalions and 19 remained in the Stavka reserve. The horse-drawn battalions worked very well during the winter and following spring. Reindeer battalions were formed in the north and camel battalions in the Caucasus. In the fall of 1943 the horse-drawn transport battalions helped bring in the harvest.[12] When U.S. trucks began arriving in large numbers, the Red Army relied less on horse-drawn transport battalions.

Different types of horses were used for riding than for pulling wagons. Horses were classified as warm bloods or cold bloods, and cross breeding produced mixed bloods. The warm bloods or light cavalry horses were spirited riding horses with endurance and speed similar to the American racehorse. This class of horse was about 60 inches tall and weighed from 880 to 1,100 pounds. The horse carried a weight equal to about 25 to 30% of its own weight (250 to 300 pounds for an average horse weighing 1,000 pounds). The load included the rider, saddle, and 50 to 100 pounds of equipment.[13] The cold bloods or heavy draft horses were 65 to 69 inches high and weighed 1,300 to 1,550 pounds. These horses, although very strong, were not fast. Although docile, they needed much more fodder than the smaller horses.

There were many breeds of saddle and working horses in the Soviet Union. The Akhal-Teke from Turkestan was the oldest breed. It was a small riding horses from 56 to 62 inches high and had little endurance. The Budyonny was bred in the 1920s as a military cavalry mount. It was large (60 to 64 inches high) and very strong. The Don was the Cossack mount dating back to the 18th century. It was accustomed to life on the Steppes and was very hardy and able to care for itself. The Don was also used as a working horse to pull wagons.[14]

The Kabardin was a draft horse native to the Caucasus. It was small (56 to 60 inches) for a draft horse, but very strong and hardy. The Latvian was a 17th century mix of warm blood and cold blood stock from 56 to 60 inches high. It could be used either as a work horse or a saddle mount. It was even tempered and strong. The Russian heavy draft horse was developed in the Ukraine in the 19th century. It was small (56 inches), but had great pulling power and was popular as a work horse on farms. The Vladimir heavy draft was developed in the late 19th century near Moscow. It was a large (64-inch) strong horse used for heavy farm work and hauling.[15]

Asian Steppe ponies were used on the Eastern Front for both riding and pulling wagons. They were smaller than most light cavalry horses, only 53 to 57 inches high, and weighed from 770 to 880 pounds. Strong and hardy with high resistance to disease, the ponies required less food than the western horses and could endure far better the rugged conditions on the Eastern Front.[16] The Kazakh, originally bred in Kazakhstan, was very hardy and able to stand extremes of weather. It ranged from 48 to 52 inches high and was used as a light cavalry horse.[17]

Horses needed large quantities of food every day, depending on their size and the work. A horse performing hard work consumed about 12 pounds of grain and 14 pounds of hay or grass daily. Performing lighter work reduced the amount of grain to 8 pounds but increased the hay to 18 pounds. Doing no work, a horse could graze on grass. The grain portion included oats, barley, corn, peas, beans, or other vegetation preferably high in protein and calories.[18] The horses needed to be fed well to maintain their ability to work.

Although theoretically horses could feed off the country during many months of the year, a grazing horse was not working. To obtain enough food for a day, a horse would have to graze about eight hours per day, leaving little time for work. Troops foraging for fodder on nearby farms reduced the number available for combat. The most efficient way to feed horses was with fodder brought up from the rear.[19] A military unit on the move had no time to graze horses or to send troops out to forage, so all of the fodder was provided, including oats, hay, corn, and straw.[20] Fodder made up a major portion of the supplies required by a division.

The Red Army used more trucks and fewer horses than the German Army because trucks and fuel were available and fewer horses were available in the Soviet Union. A horse did not mature until tt was three or four years old, so the number of horses could not be increased quickly. Usually training would begin when the horse was three years old. About 25% of the horses were lost annually through normal attrition, old age, sickness, or accidents. Therefore, a reserve of colts and young horses equal to 25 % of the working horses had to be maintained to provide replacements. Increasing the total number of working horses required at least three years. The Russians had to rely on the available supply. Removing too many horses from the farms would have crippled agriculture. Horses provided much of the motive power, as the army requisitioned many tractors. Similar to men, horses were drafted for the army in Germany (and presumably in the Soviet Union). Each horse was registered and given a number and could be called up as needed.[21]

After a sharp decline from 36 million horses in 1914 to 24 million in 1924, the number of horses in the Soviet Union began to increase during the 1920s, as shown below:

SOVIET STOCK OF HORSES

(in thousands)

Year	Working Age	2&3 Year Old	Up to 1 Year Old	Total
1925	19,930	3,348	2,869	26,147
1926	21,206	3,992	3,230	28,428
1927	22,827	4,788	3,578	31,193
1928	23,990	5,418	3,797	33,205
1929	24,320	5,499	4,150	33,969

There was a steady increase in the number of working horses from 1925 to 1929 when more than 25% additional working horses became available.[22] The farmers were breeding more horses for work on the farm, and recovery was under way. After 1928 the government drastically reduced the amount of grain left in the rural areas, reducing potential feed for horses. The forced collective farm movement led to a sharp decline in the number of horses, while increasing numbers of tractors filled part of the gap, as shown below:[23]

HORSEPOWER AND MACHINES

(thousands of horsepower)

	Horses in	Machine	Total

Year	Agriculture	Horsepower	Horsepower
1928	28,900	262	29,162
1929	29,200	294	29,494
1930	25,700	428	26,128
1931	21,500	1,082	22,582
1932	18,100	2,056	20,156
1933	15,800	2,636	18,436
1934	14,900	3,866	18,766
1935	14,000	5,483	19,483
1936	13,700	8,092	21,792
1937	14,000	10,390	24,390
1938	14,400	11,410	25,810
1939	15,300	12,800	28,100
1940	15,800	13,870	29,670

The growing number of tractors, combines, and trucks finally compensated for the declining number of horses. In 1940 the combined total of horses and machine horsepower reached 29,700,000 horsepower, compared to 29,162,000 in 1928. Lack of horses, tractors, and other machines prevented the full use of available land that exceeded 118 million hectares. The total number of hectares sown varied within a range of 94 million to 104 million severely hampered by the lack of horsepower available.

The major shift was the ratio of horses to machines that changed from 0.7% machines in 1927 to 46% machines in 1940. The number of total horses was higher than animal horsepower on the farms. From 1928 to 1933 the number of horses in Russia declined from 32 million to 17 million and had increased to only 21 million by 1940.[31] Even in 1940 the Russian farmers depended on horses for more than half their work in the fields.

In 941 many horses remained on the farms to produce crops or were lost to the advancing Germans. The area occupied by the Germans had 11 million horses before the war, over half the total number.[25] Because of the shortage of horses, the Red Army relied more heavily on motor transport than did the Germans.

The Germans were severely handicapped because of their reliance on horses. Because of the many problems associated with the care of the horses and grazing, the 6th German Army at Stalingrad fat the fall of 1942 sent most of its horses far to the rear. When the army was cut off in November, there were few horses to pull the artillery and wagons. That factor had considerable influence on the tactical situation. The Sixth Army did not have enough horses to pull artillery and wagons had it tried to retreat. The rescue force included many trucks loaded with supplies.

The German High Command would have preferred to equip its infantry divisions with more trucks and fewer horses. However, with a limited supply of fuel, German industrial resources would have needed conversion to the manufacture of synthetic fuel and trucks at the expense of weapons. The Russians, on the other hand, had large supplies of oil from the Caucasus and other areas. The 100,000 trucks manufactured annually in U.S.-designed factories in the Soviet Union and over 427,000 trucks provided by lend-lease during the war reduced the Russian reliance on horses. The Red Army supply service and artillery was motorized to a much greater extent than the Germans.[26]

On the other hand, the Russians made far more use of horses in combat than did the Germans. Cavalry units had a long tradition in the Russian Army. Under the czars, cavalry, and especially the Cossacks, played a prominent role in the army. After the revolution in 1917, cavalry played a major part in the battles of the Civil War. Few cavalry formations

survived the demobilization of the Red Army after the Civil War, but they were soon reestablished.

In 1929 there were 14 cavalry divisions and 7 cavalry brigades. By 1938 the number increased to 32 cavalry divisions and 2 brigades formed into 7 cavalry corps.[27] In 1938, only a year before the outbreak of World War II, the Soviets were turning their attention to building their mechanized forces. The experience of the Spanish Civil War did not reveal a major role for cavalry in modern war. Therefore, in the same year, the Soviets disbanded 7 cavalry divisions and 2 brigades. However the Red Army still had a substantial cavalry component including 23 regular and mountain cavalry divisions plus 2 Cossack territorial divisions.[28] The Soviets continued to reduce their cavalry force while the remainder of the army increased. In March 1940 British intelligence assumed the order of battle of the Red Army cavalry as follows, with 21 divisions:[29]

Cavalry Corps	Cavalry Divisions
1st	1st, 9th, 28th
2nd	3rd, 5th
3rd	7th, 11th, 27th
4th	10th, 12th, 13th
5th	25th, 40th, "N"
6th	4th, 6th, 11th
7th	2nd, 32nd, 34th
8th	8th, 31st

German intelligence in 1941 assumed the existence of 16 cavalry divisions, the 1st through 7th, 9th, 13th through 16th, 25th, 29th, 32nd, 34th, and 36th.[30] The Germans omitted the 8th, 10th, 11th, 12th, 27th 28th, 31st, 40th, and "N," and added the 14th, 15th, 16th, and 36th, for a difference of five.

By June 1941 there were only 13 Soviet cavalry divisions, nine in four cavalry corps, one in a rifle corps, and three independent.[31] The cavalry divisions had four regiments, a tank regiment, a horse artillery regiment, an antiaircraft battalion, and other units. The table of organization called for 9,240 men, 64 light tanks, 18 armored cars, 16 antitank guns, 20 antiaircraft guns, 68 guns, and 64 mortars. The cavalry corps had two divisions with 19,000 men and 16,000 horses.[32] Not all of the cavalry divisions were up to strength at the beginning of the war.[33]

The prewar cavalry division was too large, and therefore in July 1941 the light cavalry division was authorized with only 3,447 men. The new division had one cavalry regiment, a tank regiment, and an antiaircraft battalion. The mobilization that followed the outbreak of war included many cavalry units. The newly mobilized divisions were very short of equipment. In July 1941 the 34th Cavalry Division had no heavy weapons. Later it received M1927 76mm guns but no antitank guns until October, when 12 guns arrived.[34] Twenty cavalry divisions were sent to the front by the end of July 1941.[35] By the end of 1941, 82 cavalry divisions had been formed.[36] By December 1941 the Germans had identified 61 cavalry divisions on the front line.[37]

The Soviet cavalry did not carry lances, nor did they charge tanks at full gallop with sabers. The cavalry fought as mounted infantry with heavy firepower that increased during the war. In 1941 cavalry divisions did charge German lines without sufficient support and suffered severe losses. However, for the most part, their main role was to cover retreats as mobile rear guards.

The cavalry relied on its mobility and seldom fought alongside the infantry. In attacks, Soviet cavalry often worked with tanks, providing supporting mobile infantry.[38] The front commander used cavalry to attack at a critical point: to

exploit a breakthrough, to attack open flanks, and to pursue. To carry out these roles, the cavalry had to operate in large units, in a corps of three divisions.[39]

The cavalry was also useful in defense. Held as a reserve, the cavalry counterattacked quickly any enemy penetration of a weakly held line. Cavalry provided screens protecting the intervals between armies and holding rear guard positions, giving the infantry time to escape. Cavalry was especially useful in attacking flanks of advancing troops and then escaping when the enemy reacted.[40]

In 1941 the Russians often made poor use of their cavalry, dividing up the corps and giving the horsemen inappropriate missions. In August 1941 the 2nd Cavalry Corps was divided, one division being held as army reserve and the other as a flank guard. The 26th Army sent the antiaircraft and engineer battalions of the 5th Cavalry Corps on separate missions, leaving the corps without essential elements when called on to fight.[41]

Attaching a motorized division in summer or a ski unit in winter to the cavalry corps gave it staying power to engage enemy strong points while the cavalry moved around the flanks. In December 1941 the 1st Guards Cavalry Corps had the 173rd and 322nd Rifle Divisions attached in the attack on Venev. In January 1942 the 2nd Guard Motorized Division was attached to the 11th Cavalry Corps at Moscow to hold a front of 60 km. The cavalry corps were reinforced in 1942 with tank brigades, mortar regiments, and guard mortar regiments, first attached and then made organic units of the corps and divisions.[42]

In October 1941 the Kamkov Cavalry Group with the 3rd and 14th Cavalry Divisions also had the 3rd and 142nd Tank Brigades, the 34th Motorized Brigade, and the 297th, 81st, and 212th Rifle Divisions. The heavily reinforced corps held a 130 km sector.[43] In December 1941 the 5th Cavalry Corps with the attached 129th Tank Brigade pursued the Germans in their withdrawal from Yelets.[44]

Cavalry units needed extra antiaircraft defense—the moving horsemen were : vulnerable to air attack. So one or two antiaircraft battalions were attached to a cavalry corps during an attack and the air liaison officer could call in air support.[45] In the early months of the war the cavalry had fought under unfavorable conditions imposed by the disasters that struck the Red Army. The Germans had air superiority and the cavalry were vulnerable to air attack. The dry summer weather made the roads passable to wheeled vehicles and deprived the cavalry of their advantage on poor roads. The cavalry did not have sufficient tank support in the early months, and the Germans had more automatic weapons that were effective against cavalry.

In the first winter offensive the severe weather was too much even for the horses to operate in the deep snow. The cavalry became as road bound as the trucks. The severe weather reduced the supply of fodder from the rear and forage was unavailable in the snow-covered fields. Added to these difficulties, army commanders did not know how to use cavalry.[46]

Some army commanders sent cavalry to attack fortified lines without extra supporting artillery. In January 1942 the 6th Army commander sent the 6th Cavalry Corps to attack a fortified position. The cavalry lost 1,800 men, 30% of its combat strength, in 15 days and made no progress. The army commanders seldom assigned a rifle division to the cavalry corps; more often, promised support did not appear at the right time and place.[47]

The winter of 1941-42 was unusually cold, and combined with poor tactics, resulted in the death of thousands of Soviet horses, either from combat or from sickness. The lack of horses was the deciding factor in reducing the number of cavalry formations. Between April 1942 and July 1942, the Soviets disbanded 41 cavalry divisions because of the shortage of horses. The Russian economy could not provide sufficient horses to maintain the large number of divisions.[48] During the summer of 1942, the remaining cavalry units were rebuilt, but the Soviets had difficulty maintaining the cavalry divisions at strength. By November 1942 the 3rd Guards Cavalry Corps, the 8th Cavalry Corps, and the 4th Cavalry Corps at Stalingrad had nearly a full allotment of men but were short about 7,000 horses, about 15%.[49] In January 1943 the 10th Guard Cavalry Division was short 2,000 men and horses and the 9th Guard Cavalry Division was short 2,300. Many of the remaining horses were worn out.[50]

In October 1942 Stalin favored the idea of a cavalry army. The army was to be formed under the headquarters of the 4th Guards Cavalry Corps and include the 9th and 10th Kuban Guards Divisions, the 11th and 12th Don Guards Divisions, and the 30th, 63rd, and 110th Cavalry Divisions.[51] However, the General Staff opposed the idea, believing that an independent cavalry army could not operate against machine guns and tanks. The supporting units would slow the cavalry, eliminating any possible gain in mobility. They saw the large force as unwieldy. The concentration of so many horses would create problems in supplying sufficient quantities of fodder. Thus, the General Staff recommended the formation of horse mechanized groups instead.[52]

The Soviet cavalry became a major offensive force with the formation of the horse mechanized groups (KMG) in November 1942, consisting of a cavalry corps, a tank corps, and supporting artillery, tank destroyer, antiaircraft, and engineer units. It was a reduced-scale tank army with the mechanized corps replaced by cavalry.[53] While the mechanized corps had 191 tanks and 50 armored cars, the cavalry corps had 123 tanks and 12 armored cars. Each had one or two regiments of mechanized artillery.[54] The horse mechanized groups functioned the same as the tank armies except that the accompanying troops were mounted on horses instead of riding in trucks. The horse mechanized groups were a major part of the Soviet offensive capability from early 1943 until the end of the war.

The cavalry was reorganized for its new role. The number of units was sharply reduced. The number of cavalry corps dropped from 17 in February 1942 to 8 in September 1943.[55] By December 1943 there were only 26 cavalry divisions remaining; the others were disbanded because of the shortage of horses.[56] The table of organization was also changed in 1942. The new cavalry division had 5,700 men, three cavalry regiments, a tank regiment, a mortar artillery regiment, and other units. The division was more heavily armed with 41 light tanks, 24 76mm guns, 12 45mm antitank guns, 6 37mm antiaircraft guns, 12 120mm mortars, and 36 82mm mortars.[57] By 1943 the cavalry corps consisted of three cavalry divisions, a mechanized artillery regiment, a tank destroyer regiment, an artillery regiment, an antiaircraft artillery regiment, a Guard mortar regiment, a mortar regiment, an independent mortar battalion, and service units. The corps had in addition to divisional weapons, 21 SU76s, 20 76mm antitank guns, and other mortars, rocket launchers, and antiaircraft guns.[58]

After November 1942, the cavalry played an important role, providing the tanks with supporting infantry that could match speed with the tracked vehicles over the roughest terrain. The horse mechanized groups were especially effective in exploiting the breakthroughs, driving hard into the German rear before the retreating enemy counterattacked or created new lines of defense. The Soviets adopted new tactics for these groups. Although cavalry was very vulnerable to machine gun fire and tanks, it could maintain the speed of advancing tanks. Employment of a horse mechanized group began first with the concentration of the group far behind the front. The group moved to a concealed marshaling area located a night's march from the jumping-off position. The approach march took the group to the jumping-off position 12 to 15 km behind the front line on the night before the operation began. When the infantry and tanks broke through the front, the cavalry and tanks would pass through to exploit.[59]

The horse mechanized group also broke through the German lines. In the attack, two of the tank brigades would pierce the enemy front followed closely by the cavalry corps. With the cavalry was the third brigade of the tank corps. The cavalry would attack the enemy infantry while the tanks dealt with any remaining heavy weapons. Rifle divisions then advanced and cleared away any remaining infantry. The advantage was that the advancing tanks had the support of the cavalry immediately behind them to hold the captured ground. If the German strong points with automatic weapons withstood the cavalry, the advancing infantry was soon available.[60] While only part of the infantry in the mechanized corps could ride either in the half-tracks or on the tanks, all of the cavalrymen could keep up with the tanks moving across broken ground in a situation of exploiting a breakthrough.

The cavalry came into its own with the formation of horse mechanized groups. The groups were held under front control and took their designation from the front. In August 1944 there were six horse mechanized groups, one each with the 1st and 2nd Baltic fronts; the 1st, 2nd, and 3rd Ukrainian fronts; and the 1st White Russian front. Later horse mechanized groups included additional tank and mechanized corps making them larger than some tank armies. The 1st Ukrainian horse mechanized group (later divided into two groups) included the 1st and 6th Guard Cavalry Corps, the

25th and 31st Tank Corps, and the 4th Guard Tank Corps. The 1st White Russian group had the 2nd, 4th, and 7th Guard Cavalry Corps and the 9th Tank Corps. The groups were used only after meticulous preparation for exploiting a breakthrough or covering a gap between advancing forces.[61]

By early 1943 the Red Army had eight cavalry corps that could be joined with a tank corps to create a powerful exploitation force superior in firepower to a contemporary German panzer corps. The horse mechanized groups were equal to tank armies in their ability to exploit a breakthrough. Added to the six tank armies and independent tank corps, the Soviets had a plentiful supply of offensive units that could strike randomly anywhere along the front. The Germans were forced to abandon a flexible defense and resort to heavily fortified lines. Despite the German defenses, the Russians retained the ability to break through the German lines at will.

The horse played a significant role both in the offensive capability of the Red Army and in supply. However, the Germans relied far more heavily on the horse in its logistical system because of the shortage of trucks and fuel. Because of the difficulty in caring for horses compared to motor vehicles and the greater speed and flexibility of the trucks, the Soviets had a decided advantage over the Germans in logistics. While German campaigns were lost because of supply failures, after the spring of 1943 supply problems merely limited Soviet offensives and delayed their operations. As the Germans were continually retreating into a denser rail network, the dependence of the Germans on the railroad and the horse-drawn wagons was not a crucial factor to them in the last two years of the war, although it did limit their capability to move divisions from one sector to another. The Russians, on the other hand, steadily reduced their reliance on horses for supply with increasing numbers of trucks, making it possible to sustain offensives despite skillful German defense. Toward the end of the war, the Red Army made increasing use of the horse in combat to provide heavily armed mobile infantry support for their tanks. While the role of the horse shrank in supply, it increased in combat, a fitting situation for the horse and its long tradition in battle.

NOTES

1. Parrish, p. 88.

2. A. Niessel, "Cavalry," in Liddell-Hart, p. 337.

3. Janus Piekalkiewicz, *The Cavalry of World War II* (New York: Stein and Day, 1980), p. 4.

4. Klaus Reinhardt, *Die Wende vor Moskau* (Stuttgart: Deutsche Verlag-Anstalt), p. 316.

5. Piekalkiewicz, p. 5.

6. Niessel, p. 340; Parrish, p. 78.

7. Parrish, p. 78.

8. Parrish, *p.* 78.

9. *U.S.S.R. Report: Military Affairs, June 12, 1986, Provisional Field Regulations for the Red Army (PU 36),* trans. Foreign Broadcast Information Service (Washington, DC: Government Printing Office, 1986), p. 25.

10. *PU 36,* p. 25.

11. *PU 36,* p. 25.

12. Khrulev, p. 375.

13. Grbasic, p. 274; Dinardo, pp. 10-11.

14. Elwyn H. Edwards, ed., *Encyclopedia of the Horse* (London: Octopus Books Limited, 1977), p. 67; Peter Churchill, ed., *The World Atlas of Horses and Ponies* (New York: Crescent Books, 1980), pp. 124-27.

15. Churchill, pp. 128-30; Edwards, pp. 69-71.

16. Grbasic, pp. 275, 277; DiNardo, pp. 10-11.

17. Edwards, p. 87.

18. Edwards, p. 181-82.

19. Parrish, pp. 77-78; Niessel, p. 338.

20. DiNardo, p. 11.

21. DiNardo, p. 12; Hunter and Seymour, p. 109.

22. Hunter and Seymour, p. 103.

23. Hunter and Seymour, pp. 107-09.

24. Hunter and Seymour, pp. 107, 111; DiNardo, pp. 39, 51.

25. DiNardo, p. 46.

26. DiNardo, p. 98.

27. Louis C. Rotundo, "The Creation of Soviet Reserves and the 1941 Campaign," *Military Affairs* 50:1 (January 1986), p. 23; Tiushkevich, p. 198.

28. M. V. Zakharov, "On the Eve of World War II (May 1938-September 1939)," *Soviet Studies in History* 23:3 (Winter 1984-85), p. 95.

29. PRO, WO 33 1684, Order of Battle, March 15, 1940, The 11th Division appears twice.

30. FHO, CGR, H 3/1725, 1941, Roll 558, Frame 721.

31. Rotundo, "Soviet Reserves," p. 23; *VOVE,* p. 311.

32. *VOVE,* p. 511; Viktor A. Anfilov, *Proval Blitskriga* (Moscow: Nauka, 1974), p. 126; Malanin, p. 31.

33. Salisbury, p. 98.

34. Salisbury, p. 98.

35. Anfilov, *Blitskriga,* p. 475.

36. Tiushkevich, p. 270; *VOVE,* p. 311; Malanin, p. 31.

37. FHO, CGR H 3/83.2, December 1, 1941, Roll 550, Frame 637.

38. Ely, pp. 87-88; Piekalkiewicz, p. 48.

39. Parrish, p. 75.

40. Parrish, pp. 90-94.

41. Parrish, p. 80.

42. Parrish, p. 76; Niessel, pp. 337-38.

43. Parrish, p. 76.

44. Parrish, p. 76.

45. Parrish, pp. 77-78; Niessel, p. 338.

46. Parrish, pp. 79.

47. Parrish, pp.. 80.

48. Tiushkevich, p. 280; *VOVE,* p. 311.

49. Louis C. Rotundo, ed., *Battle for Stalingrad: The Soviet General Staff Study* (Washington, DC: Pergamon-Brassey's, 1989), p. 160; Tiushkevich, p. 280; Malanin, p. 32.

50. Shtemenko, *General Staff,* pp. 80-90.

51. Shtemenko, *General Staff,* p. 68.

52. Shtemenko, *General Staff,* pp. 116-17.

53. *VOVE,* pp. 311, 365.

54. FHO, CGR, H 3/123.2, August 1, 1944, Roll 552, Frame 764.

55. Tiushkevich, p. 280; *VOVE,* p. 311. 56. Tiushkevich, p. 316.

57. FHO, CGR, H 3/63, August 1944, Roll 459, Frame 6438037.

58. *VOVE,* p. 311; FHO, CGR, H 3/63, August 1944, Roll 459, Frame 6438036.

59. Niessel, p. 340.

60. Piekalkiewicz, p. 222.

61. Niessel, p. 339.

12 Conclusion

This book is a logical sequel to *Second Front Now 1943* (published in 1981) and *Hitler's Nemesis: The Red Army, 1930-1945* (published to 1994), which present the thesis that a second front was not only possible in 1943 but advisable from the Western point of view. However, the second front was not essential to the Soviets after early 1943. According to one Soviet historian, "After this [the battle of Stalingrad] nobody could any longer doubt the ability of the Soviet Army to crush Nazi Germany singlehandedly."[1] Stalin probably did not want a second front in 1943, at least in France. Politically, he needed additional time to position the Red Army in the heartland of Germany to prevent a second *Cordon Sanitaire* similar to the one created by the Treaty of Versailles in 1919. He had to drive the Germans across Poland, therefore timing was a political rather than a military decision. The Western Allies could have hastened the end of the war but chose not to do so.

The Red Army defeated the Wermacht because it had been preparing to do so for 10 years. Germany was its primary foe from 1933 on. The Red Army was organized and trained, as described in detail in *Hitler's Nemesis: The Red Army, 1930-1945,* and the weapons and supply system were provided, as described in this work.

A doctrine for the general Russian strategy on the conduct of war had to be devised first. Then considerable debate

followed on tactics sharpened by the experiences in Spain, Mongolia, and Finland. Next was the need to design weapons to implement the tactics and to organize a system to utilize those weapons. The final essential, and equally crucial, step was to provide manpower to produce the weapons, munitions, and other material to supply units and replace losses.

To provide the weapons and supplies, the entire Soviet economy was overhauled to develop heavy industry in the 1930s under the fife-year plans. Foreign technical assistance reshaped the steel, coal, chemical, tractor, automobile, farm machinery, oil, textile, and other industries. Weapons designs were selected from the best offered on the market in the 1930s, including artillery from Germany and Czechoslovakia, the tank designed by Walter Christie of the United States, and machine pistols from Finland. Other weapons were improvements of Russian designs. All were upgraded during the 1930s, making them more efficient to use and to manufacture. The designers never lost touch with the need for mass production. Factories were built or rehabilitated to manufacture the entire range of weapons.

As part of the reorganization of the army, a logistical system was created more suitable to the geography of the Soviet Union and its transportation infrastructure. Germany, Great Britain, and the United States continued to create divisions of the Napoleonic mode with sufficient administrative and service units to supply themselves from rear depots. The Soviets reversed the order and provided the army depots with the transport to deliver the supplies to the divisions. The result was enormous reductions in the service elements of all combat units and more efficient use of available transport.

The inflexible system used by the other armies resulted in divisions being held in the rear while their organic transport was transferred temporarily to extemporized supply organizations that lacked unit cohesion and solid command relationships. One seldom received a promotion for good performance while attached to another unit. A Soviet army could supply several leading divisions well, while leaving the rest of its divisions guarding the flanks with very few supplies. Divisions needing additional supplies or located farther from the depots were provided a larger share of transport from the army pool. On occasion the army trucks brought shells direct to artillery batteries to ensure prompt delivery. A major Soviet advantage was that they delivered supplies with trucks, while the German division fetched its supplies from depots with horse-drawn wagons.

The entire Soviet supply system had to be cost-effective. The Soviet economy was but a fraction of the potential industrial base of the combined nations of Europe under Hitler's sway. In 1942 the Soviet Union produced 12.5 million tons of steel while Germany alone produced 30 millions tons. In addition, Germany had access to the steel production of the captured nations.[2]

Both countries had copious manpower for industrial development and military service. In 1941 there were 80 million German citizens versus 200 million Soviets. However, the Germans also had the manpower of Allied European nations and the population of the occupied zone of Russia. In contrast, Russia lost 40 to 60 million people in the first six months of the war, reducing its favorable ratio of manpower. Although Russia's allies made a substantial contribution to defeating the Germans with the air war and lend-lease supplies, until June 1944 the Western Allies did not tie up considerable numbers of German troops.

The equation was balanced by Germany's extremely wasteful and inefficient management of both industrial and human resources. In 1942 only 8 million tons of steel out of 30 million went to German military production.[3] While the Russians extracted the last drop from their potential, the Germans only talked of total war until late in 1943. Russia from the very beginning demanded incredible sacrifices from its people. Fourteen-year-old boys, women, and invalids worked 12-hour shifts six or seven days a week to replace men in the army. Every possible ounce of human and industrial capacity was devoted to winning the war, stripping the civilian economy of all but the barest essentials. On the other hand, German women were not employed in industry to any appreciable extent and factories worked only one shift. Some teenagers served part time in antiaircraft units, but the high schools remained open. The Germans continued to manufacture luxuries such as furniture and other civilian goods, in addition to receiving civilian goods made in occupied countries. Even in the captive nations, life was probably more palatable than for a Russian transferred to one of the new industrial centers in the Ural Mountains.

Perhaps the most outstanding aspect of the productive effort was the Russian ability to reduce every weapon and

organization to a required minimum standard. The Soviet government had learned the value of utter simplicity through necessity during the period following the Revolution of 1917 and the Civil War. The need was to reconstitute the country under three five-year plans after devastation had taught the lessons of maximum return for investment; the resources used to accomplish an objective were reduced to the bare minimum.

Russian weapons were simple, not because the soldiers were too stupid to operate complex weapons but because any feature was eliminated that did not offer enough advantages to compensate for its cost. An example of minimum quality to accomplish the task was the T34 tank, which was extremely uncomfortable for the crew. Nevertheless, the gun and armor were excellent, and the tank was considered the best used during World War II.

Throughout the war the number of man-hours and material to produce a T34 were steadily reduced by simplifying the design. Few changes were made to improve the performance at the cost of production. In contrast, German weapons became increasingly complex. Six months passed from the time the Tiger was first used in battle until it was comparatively free of technical flaws. The Panther was still not free of problems at the Battle of Kursk, yet both tanks were marvels of German technical innovation.

German commanders, with large service organizations, continually complained about the lack of engines and other spare parts to continue operating their tanks and motor vehicles. Hitler was castigated for being more concerned about making large numbers of new tanks than for maintaining existing ones.

The Russians, on the other hand, concentrated on making simple, easy-to-maintain tanks with a limited service life. Cripples were stripped of usable parts and scrapped or sent to the rear to be remanufactured in repair plants. Rarely if ever did a prisoner mention the lack of spare parts as a factor in the shortage of equipment for the front.

The root of the matter was cost-effectiveness: what manner could human and physical resources be used to the greatest advantage? The choice was either a single beautiful tank with excellent optics and comfortable crew facilities or the cost equivalent of four ugly hulks. The Germans opted for the former and lost the production battle.

The question remains, though: How did a country that could not provide even rifles for its army in World War I outproduce most of Europe only 25 years later? Russia had been devastated by heavy losses in World War I, as well as by foreign intervention from 1917 until 1919 and a Civil War that lasted until 1921. The Communist regime eliminated the professional class, including army officers, engineers, government officials, transportation specialists, and practically every other person with skills necessary for a smoothly operating economy. The Soviet Union was in chaos by the late 1920s, with millions dying of starvation and industry at a standstill.

During the 1920s the Communist leadership swallowed its pride and invited foreign concessions under the New Economic Policy (NEP). ft encouraged foreign companies to enter the country and operate coal mines, gold mines, factories» the telegraph system, and other businesses, taking the profits out of the country. Although this system provided economic activity, the concept of allowing foreign capitalists to exploit the country was disagreeable, plus profits flowed out of the Soviet Union. The concessions were practically canceled by the early 1930s.

Replacing the concessions, the five-year plans were designed to modernize the Soviet economy. Coincidental with the First Five-Year Plan, the Russians began signing technical assistance agreements with Western companies, primarily American, some German, and a few British, French, Swiss, and others.

Fundamental to the overall development of the Soviet economy from 1929 to 1941, and the phenomenal wartime industrial production, was the technical assistance of the United States in the 1930s. The agreements generally called for the U.S. companies to design, build, and equip plants and train Russians in their operations. These plants were then copied by Russians with limited foreign help. Under such agreements the entire Soviet auto, tractor, and steel industries were expanded and modernized. And Russia's armaments industry benefited from German contracts. Other industries also profited from foreign expertise. However, by 1936 most of the foreigners had left, though the Soviets continued to import machinery for their factories.

The U.S. technical assistance enabled the Soviet Union to advance technologically a half-century's worth in only about eight years. This rapid advance was possible because copying Western technology eliminated the need for research and

development. Standardizing almost everything from blast furnaces to lathes avoided the cost of customizing machinery for each plant. And multiple-unit construction reduced manufacturing time and cost. By the late 1930s, the Soviet Union had the latest designs and the largest factories, primarily copied from the best available in the United States. After the foreigners left, young Soviet engineers with little experience operated the existing plants and produced copies, not only of machines but of entire plants. Although plagued by inefficient operation in the late 1930s, these factories formed the basis for Soviet war industry in World War II. Such factories—far more efficient than their German counterparts—made the tanks and other weapons that defeated the Germans.

In addition to production, Russia's allies made a substantial contribution to defeating the Germans with their air war and lend-lease supplies, although the major share of lend-lease arrived after early 1943 when the battle largely had been won. During the crucial period from June 1942 to November 1943, only four convoys had arrived in the north because German attacks prevented deliveries. The Far Eastern route and the Persian Gulf route had to be developed and experienced slow starts. Nevertheless, during the war lend-lease provided the Russians with trucks, locomotives, rails, and other goods that otherwise would have absorbed much Soviet productive capacity, while the weapons were made by Russians.

Many Western writers believe that the Germans were beaten with massed attacks of poorly equipped Russian riflemen. But how could subhuman masses defeat what was undoubtedly the best tactically trained army of the war, the German Army? In 1941 and to a lesser degree in 1942, the Red Army relied on superior manpower to counter German skill and equipment. The Red Army seldom had more than 6.5 million troops on the Eastern Front and more often it had less. The total in the armed forces was usually about 10 million. The German and satellite armies facing the Russians varied from period to period, but seldom were below and sometimes exceeded 3 million. The Russians did enjoy a two-to-one margin and more in select areas, but it was not enough to overwhelm the Germans with manpower alone. The Russians sustained 11.3 million killed and captured, compared to over 3 million Germans plus their Allies killed on the Eastern Front. Most of the Russian losses (6 million) were sustained in the first 15 months of the war, while German losses in that period were low. For the remainder of the war, losses of two-to-one were the price of attacking a highly proficient defender.[4]

Given Russia's lack of overwhelming manpower, the Soviets countered the highly skilled German Army with masses of weapons. The primary reason for Soviet success was production. The industrial base of the Soviet Union was but a fraction of the potential industrial base of the combined industrial nations of Europe under Hitler's sway. With less than half the steel capacity of Germany and its satellites, the Soviet Union won the battle of production through sacrifice and by relying on the strength of its economy, created in large measure by American technical assistance in the 1930s. And the Russian military economy continued to grow during the war. The railroads and trucks efficiently moved supplies and equipment to the front. Together these elements provided the Red Army with a logistical base that made possible the continuous drive from Kursk to Berlin. In time the Soviet Union outproduced the Germans and overwhelmed them with equipment. This productive capacity and the logistical system were in place by early 1943.

Although the Russians still needed lend-lease assistance in early 1943, the military position had shifted in favor of Russia. Incompetent military leaders had been replaced with dynamic young men. The commissars no longer had dual command; their role was mainly political indoctrination of the troops. The Red Army had developed effective tactics and was by then superior in numbers to the Germany Army in both weapons and men. The Germans still retained an edge in technical skill and mobility, as demonstrated by Manstein's victories in February 1943, but their effort was no longer enough to sustain the German initiative.[5]

The threat of a second front was significant in 1942 because intimidation had tied down many German divisions in France while the debate went on among Allied leaders. The Dieppe raid motivated Hitler to order a strengthening of seaport defenses. After the defeat at Stalingrad and the withdrawal from the Caucasus, Hitler was able to summon the divisions in France, his last strategic reserve, to restore the favorable German balance. When Hitler learned of the decision at Casablanca in January 1943 not to land that year, he immediately began to transfer dozens of divisions from France to Russia, giving Manstein the troops needed to repulse the Soviet offensives in February and March. Although Manstein used these divisions to drive back the Soviet spearheads, by early 1943 the Soviets had achieved a degree of superiority so that a successful conclusion for the Russians was no longer in doubt. By July 1943 there was no hope for a German victory, even though the Allied invasion was a year away.

In 1943 Stalin feared that American and British forces would sweep aside the weak German forces and occupy most of Germany, and perhaps even parts of Poland, while the Russians were still fighting east of the Dnieper River. Stalin was aware of the danger of an early German collapse in the west in 1943, and therefore supported the Allied diversions to Sicily and Italy. Stalin did not want an earlier invasion in France and subsequent movement of the meeting point of the two armies farther east, even at the expense of more Russian casualties. Soviet historians believed that the Allies launched the second front only after "it became quite obvious that the Soviet troops would crush Germany without a second front being opened. "[6]

The average Russian would have welcomed the assistance rendered by a second front at any time to reduce casualties. His view was that the second front coming "belatedly" contributed only to "hastening the final defeat of the fascist bloc."[7] Lend-lease, considered a very valuable support during the war, was sorely missed in the crucial phase from June 1942 to mid-1943. After the war, however, the Soviet interpretation changed. In denigrating the value of lend-lease, one author stated that it "did not contribute substantially to the growth of the USSR's military and economic potential during the war."[8]

Supply and organization were the keys to victory. The Russians not only won the battle of production but also developed an efficient military organization that placed the fruits of production in the right place at the right time. The production methods were assimilated from the Americans, but the organization was home grown. Faced with competing needs for resources in building the economy in the 1930s, the Russians at the same time developed a powerful army. Untrained and equipped with obsolete weapons, the Red Army suffered heavy defeats in 1941 and 1942, but by early 1943 was well trained and organized as well as equipped with modern weapons.

The objective of Red Army organization was to obtain the most cost-effective method of employing men and weapons under prevailing conditions. During the 1930s the Russian military organization was in a constant state of flux, reflecting radical changes in strategic and tactical thinking. Changes still under way in mid-1941 contributed to the early defeats. However, a steady stream of new organizations were developed, tried, discarded if faulty, and replicated endlessly if successful. Organizations were drastically altered to reflect the increasing number of weapons and the means to deploy them versus the limited manpower position. While the number of riflemen steadily dropped mathematically, the number of weapons multiplied geometrically. Thus, the Red Army of April 1945, a far stronger instrument than in June 1941, emerged as a powerful machine devoted to the defeat of Hitler. In the end, success was achieved by overpowering numbers of weapons efficiently deployed, but paid for in part by the tragic loss of millions of men.[9]

Although planning, preparation, and leadership were important, the people of the Soviet Union defeated Hitler by working, fighting, and dying to defend their country. Despite the burdens of the Communist regime, memories of the repressions of the czars fresh in the minds of farmers and workers encouraged them to support Stalin and oppose the Germans. In defiance of German concentration in the east, the Red Army was clearly in control by early 1943. A second front in 1943, though not essential to Soviet success, would have been advantageous to the West in the postwar period. The arrangements made at Teheran would have been far different and the iron curtain would have been established many miles to the east.

NOTES

1. Andrei Grechko, "An Historic Victory," in *Soviet Studies on the Second-World War* (Moscow: USSR Academy of Sciences, 1976), p. 12.

2. FHO, CGR, H 3/340, Analysis, August 2, 1943, Roll 562, Frame 261.

3. Ibid.

4. James F. Dunnigan, ed., *The Russian Front* (London: Arms and Armour Press, 1978), p. 83.

5. Beaumont, p. 144.

6. Semyon Khromov and Nikolai Shishov, "Military Alliance of the Peoples Against Fascism," in Grechko, *Soviet Studies,* p. 125.

7. Pyotr Fedoseyev, "The Soviet Union's Victory in the Great Patriotic War and the Course of World History," in Grechko, *Soviet Studies,* p. 38.

8. Fedoseyev, in Grechko, *Soviet Studies,* p. 50.

9. Albert Seaton and Joan Seaton, *The Soviet Army 1918 to the Present* (New York: New American Library, 1986), pp. 114-115, 136-37; Van Tuyll, pp. 33, 130-31; Liddell-Hart, pp. 1-6; Harrison, pp. 116-17; Glantz, *Don,* pp. 8-9; Trevor N. Dupuy, *Understanding War* (New York: Paragon House, 1987), pp. 40-50; Beaumont, p. 162; Voronov in Bialer, pp. 182-83.

Select Bibliography

Anan'ev, I. M. *Tankovie Armii v Nastuplenii.* Moscow: Voenizdat, 1988.

Anaymanovich, M. A. *Voiska Protivovozdushnoi Oboroni Strani Istoricheskiy Ocherk.* (P. Batitskiy, ed.) Moscow: Izdatelistvo, 1968.

Andronikov, Nikolaii, and W. D. Mostowenko. *Die Roten Panzer: Geschichte der Sowjetischen Panzertruppen 1920-1960.* Munich: J. F. Lehmann, 1963.

Anfilov, Viktor A. *Bessmertnii Podvig Issledovanie Kanuna i Pervogo Etapa Velikoi Otechestvennoi Voini.* Moscow: Nauka, 1971.

_____. *Krushenie Pokhoda Gitlera na Moskvu, 1941.* Moscow: Nauka, 1989.

_____. *Proval Blitskriga.* Moscow: Nauka, 1974.

Antipenko, N. A. *Na Glavnom Napravlenii.* Moscow: Nauka, 1967.

Beaumont, Joan. *Comrades in Arms: British Aid to Russia 1941-1945.* London: Davis-Poynter, 1980.

Bellamy, Chris. *Red God of War.* London: Brassey's Defence Publishers, 1986.

Bialer, Seweryn, ed. *Stalin and His Generals: Soviet Military Memoirs of World War II.* New York: Pegasus, 1969.

Biryukov, G. F., and G. Melnikov. *Antitank Warfare.* Moscow: Progress Publishers, 1972.

Blunt, Brian, and Tolley Taylor. *Brassey's Artillery of the World.* New York: Bonanza Books, 1979.

Bolotin, D. N. *Sovetskoe Strelkovoe Oruzie.* Moscow: Izdatelistvo, 1990.

Clark, Alan. *Barbarossa The Russian-German Conflict, 1941-45.* New York: New American Library, 1966.

Cole, John P., and F. C. German. *A Geography of the U.S.S.R. The Background of a Planned Economy.* London: Butterworths, 1984.

Conquest, Robert. *The Great Terror: A Reassessment.* New York: Oxford University Press, 1990.

Dinardo, R. L. *Mechanized Juggernaut or Military Anachronism? Horses and the German Army in World War II.* New York: Greenwood Press, 1991.

Dunn, Walter S., Jr.. *Second Front Now 1943.* University, AL: University of Alabama Press, 1981.

Dunnigan, James F. *How to Make War.* New York: Morrow, 1988.

_____ ed. *The Russian Front.* London: Arms and Armour Press, 1978.

Dupuy, Trevor N. *Understanding War.* New York: Paragon House, 1987.

Dupuy, Trevor N. and Paul Martell. *Great Battles on the Eastern Front: The Soviet-German War 1941-1945.* Indianapolis, IN: Bobbs-Merrill, 1982.

Ely, Louis B. *The Red Army Today.* Harrisburg: Military Services Publishing Co., 1953.

Eremenko, Andrei I. *Stalingrad, zapiski komanduyushchego Frontom.* Moscow: Voenizdat, 1961.

Erickson, John. *The Road to Berlin.* Boulder, CO: Westview Press, 1983.

_____. *The Road to Stalingrad: Stalin's War with Germany.* New York: Harper & Row, 1975.

Fremde Heer Ost. *Truppen-Upersicht und Kriegsliederungen Rote Armee Stand August 1944.* Captured German Records. National Archives.

Fugate, Bryan I. *Operation Barbarossa.* Novato, CA: Presidio Press, 1984.

Glantz, David M. *August Storm: Soviet Tactical and Operational Combat in Manchuria 1945.* Combat Studies Institute. Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1983.

_____. *From the Don to the Dnepr: Soviet Offensive Operations, December 1942-August 1943.* London: F.Cass, 1991.

Golikov, Arseni, *With the Red Fleet.* London: Putnam & Co., Ltd., 1965.

Grabin, V. G. *Oruzie Pobedi.* Moscow: Izdatelistvo, 1989.

Grbasic, Z., and V. Vuksic. *The History of Cavalry.* New York: Facts on File, 1989.

Grechko, A. A, *Liberation Mission.* Moscow: Progress Publishers, 1975.

Grechko, A., et al. *Soviet Studies on the Second World War.* Moscow: USSR Academy of Sciences, 1976.

_____. *Soviet Studies on the Second World War.* Moscow: USSR Academy of Sciences, 1976.

Grove, Eric. *Russian Armor 1941-1943.* London: Almark Publishing Co., Ltd., 1977.

Harrison, Mark. *Soviet Planning in Peace and War 1938-1945*, Cambridge: Cambridge University Press, 1985.

Hogg, Ian, and John Weeks. *Military Small Arms of the Twentieth Century.* Northfield, IL: Digest Books, 1973.

Hunter, Holland. *Soviet Transport Experience: Its Lessons for Other Countries.* Washington, DC: The Brookings Institution, 1968.

Hunter, Holland, and Janusz M. Seymour. *Faulty Foundations: Soviet Economic Policies 1928-1940.* Princeton, NJ: Princeton University Press, 1992.

Istoriya Velikoy Otechestvennoy Voyny Sovetskogo Soyuza 1941-1945. 6 vols. Moscow: Voyennoye Izdatelistvo, 1960-63.

Istoriya Vtoroi Mirovoi Voyny 1939-1945. 12 vols. Moscow: Voyennoye Izdatelistvo, 1973-82.

Ivanov, S. P. *The Initial Period of the War: A Soviet View.* Soviet Military Thought Series, no. 20. Washington, DC: U.S. Government Printing Office, 1986.

Kazakov, Konstantin P., ed. *Artilleriia i Raketi.* Moscow: Voenizdat, 1968.

_____. *Vsegda s Pekhotoi Vsegda s Tankami.* Moscow: Voenizdat, 1969.

Kazakov, Vasiliki I. *Artilleriia Ogono.* Moscow: Izd-vo, 1972.

Kehrig, Manfred. *Stalingrad: Analyse und Dokumentation Einer Schlacht.*

Stuttgart: Deutsche Verlags-Anstalt, 1974.

Kennan, George F. *Russia and the West under Lenin and Stalin.* Boston: Little, Brown and Company, 1961.

Kerr, Walter. *The Secret of Stalingrad.* New York: Playboy Press, 1979.

Kotelnikov, Vladimir. "The Role of Soviet Science in the Great Patriotic War. " In *Soviet Studies on the Second World War,* A. Grechko et al. Moscow: USSR Academy of Sciences, 1976.

Krivosheev, G. F. *Poteri Vooruzhenikh sil SSSR v Voinakh Voevikh Deistviiakh i Voennikh Konflitakh Grif Sekretnosti Snyat.* Moscow: Izdatelistvo, 1993.

Kumanev, G. A. *Na Sluzhie Fronta i Tila 1938-194S»* Moscow: Izdatelistvo Nauka, 1976.

Liddell-Hart, Basil H. *The Red Army.* New York: Harcourt Brace, 1956.

Losik, O. A. *Stroitelistvo i Boyevoye Primeneniye Sovetskikh Tankovykh Voysk v Gody Velikoy Otechestvennoy Voyne.* Moscow: Voyenizdat, 1979.

Lucas, James, *War on the Eastern Front 1941-1945: The German Soldier in Russia.* New York: Bonanza Books, 1979.

Makhine, Theodore H. *L'Armée Rouge.* Paris: Payout, 1938.

Malanin, K. "Razvitie Organizatsionnik Form Sukoputhik Voisk v Velikoi Otechestvennoi Voine." *VIZh* 8 (August 1967), pp. 28-39.

Milward, Alan S. *War Economy and Society 1939-1945.* London: Lane, 1977.

Niepold, Gerd. *Battle for White Russia The Destruction of Army Group Centre June 1944.* London: Brassey's Defence Publishers, 1987.

Nove, Alec. *An Economic History of the USSR.* New York: Penguin Books, 1982.

Parotkin, Ivan, ed. *The Battle of Kursk.* Moscow: Progress Publishers, 1974.

Parrish, Michael, ed. *Battle for Moscow: The 1942 Soviet General Staff Study.* Washington, DC: Pergamon-Brassey's, 1989.

Pavlovskii, I. G. *Sukhoputniye Voyska SSSR.* Moscow: Voyenizdat, 1985.

Poirier, Robert G., and Albert C. Conner. *Red Army Order of Battle in the Great Patriotic War.* Novato, CA: Presidio Press, 1985.

Reinhardt, Klaus. *Die Wende vor Moskau.* Stuttgart: Deutsche Verlag-Anstalt, 1972.

Rokossovsky, Konstantin K. *Velikaia Pobdea Na Volga.* Moscow: Voennoe Izdatelistvo, 1965.

Rotundo, Louis C., ed. *Battle for Stalingrad: The Soviet General Staff Study*. Washington, DC: Pergamon-Brassey's, 1989.

Salisbury, Harrison E. *The 900 Days The Siege of Leningrad.* New York: Avon Books, 1970.

Savushkin, R. A. *Razvitye Sovetskikh Vooruzhennykhj Sil i Voennogo Iskusstva y Mezhvoennyi Period 1921-1941*. Moscow: Lenin Military-Political Academy, 1989.

Schmidt, Paul K. *Hitler Moves East 1941-45*. New York: Bantam Books, 1966.

Schofield, Brian B. *The Russian Convoys.* London: B. T. Batsford, 1964.

_____. *The Arctic Convoys.* London: MacDonald and James, 1977.

Seaton, Albert. *The Russo-German War, 1941-45*. New York: Praeger, 1970.

Seaton, Albert and Joan Seaton. *The Soviet Army 1918 to the Present.* New York: New American Library, 1986.

Shtemenko, S. M. *The Last Six Months.* Garden City, NY: Doubleday & Co., 1977.

_____. *The Soviet General Staff at War 1941-1945*. Moscow: Progress Publishers, 1970.

Skorobogatkin, K. F., et al. *50 Let Voorezhennykh sil SSSR*. Moscow: Voyenizdat, 1968.

Stoler, Mark A. *The Politics of the Second Front.* Westport, CN: Greenwood Press, 1977.

Stolfi, Rüssel H. S. *Hitler's Panzers East: World War II Reinterpreted.* Norman: University of Oklahoma Press, 1992.

Strana Sovetov za 50 let Sbornik Statisticheskikh Materialov. Moscow: Statistita, 1967.

Sutton, Antony C. *Western Technology and Soviet Economic Development*, 3 vols. Stanford: Hoover Institution Press, 1968-73.

Tiushkevich, Stepan A., ed. *Sovetskie Vooruzhennye Sily*. Moscow: Voenizdat, 1978.

_____ed. *The Soviet Armed Forces.* Washington, DC: Superintendent of Documents, GPO, 1985.

United States War Department, Military Intelligence Division. *German Military Intelligence 1939-1945*. Frederick, MD: University Publications of America, 1984.

_____. *Handbook on USSR Military Forces. November 1945 Technical Manual 30-430.* Washington, DC: GPO, 1946.

U.S.S.R. Central Statistical Board of the USSR Council of Ministers. *National Economy of the U.S.S.R. Statistical Returns.* Moscow: Foreign Languages Publishing House, 1957.

U.S.S.R. Report: Military Affairs, June 12, 1986. Provisional Field Regulations for the Red Army (PU-36). Foreign Broadcast Information Service, trans. Washington, DC: GPO, 1986.

Van Creveld, Martin. *Supplying War*. Cambridge: Cambridge University Press, 1977.

_____. *Technology and War From 2000 BC to the Present.* New York: Free Press, 1989.

Van Tuyll, Hubert P. *Feeding the Bear: American Aid to the Soviet Union, 1941-1945*. New York: Greenwood Press,

1989.

Vassilevsky, A., et al. *Moscow Stalingrad 1941-1942: Recollections Stories Reports.* Moscow: Progress Publishers, 1974.

Velikai Otechestvennia Voina 1941-1945 Entsiklopediya. Moscow: Sovetskia Entsiklopediya, 1985.

Voenno Istoricheskii Zhurnal. Moscow: Isdatelistvo "Kracnaia Zvezda." JPRS Report, Foreign Military Review, Microfiche #5059.

Volz, Arthur G. "Soviet Artillery Weapons: I, The Imperial Heritage." *Soviet Armed Forces Review Annual* 10 (1985-1986), pp. 209-32.

_____. "Soviet Artillery Weapons: II, 1918-1941." *Soviet Armed Forces Review Annual* 11 (1987-1988), pp. 301-23.

_____. "Soviet Artillery Weapons: III, 1941-1945." *Soviet Armed Forces Review Annual* 12 (1988), pp. 209-32.

Voronov, Nikolai N. *Na Sluzhbe Voyennoy.* Moscow: Voyenizdat, 1963.

Voznesenskii, Nikola A. *Soviet Economy During the Second World War.* New York: International Publishers, 1949.

Werth, Alexander. *Russia at War.* New York: Discus Books, 1970.

Westwood, J. N. *A History of Russian Railways.* London: George Allen and Unwin Ltd., 1964.

Wray, Timothy. *Standing Fast: German Defensive Doctrine on the Russian Front During World War II, Prewar to March 1943.* Combat Studies Institute Research Survey, no. 5. U. S. Army Command and General Staff College. Washington, DC: GPO, 1987.

Zaloga, Steven J., and James Grandsen. *Soviet Tanks and Combat Vehicles of World War Two.* London: Arms and Armour Press, 1984.

Ziemke, Earl F. *The Soviet Juggernaut.* Morristown, NJ: Silver Burdett, 1988.

Ziemke, Earl F., and Magna E. Bauer. *Moscow to Stalingrad: Decision in the East.* New York: Military Heritage Press, 1988.