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What Made the Strategy Achievable? The Case of the U.S. Strategic Bombing Campaign against Japan during World War II

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This article demonstrates the strong interrelationship between the formulation and implementation of the U.S. strategic bombing campaign against Japan and its economic policies during World War II. Section 1 summarizes previous studies on strategic bombing and wartime economy, presenting the main arguments of this paper. Section 2 explores the connection between the formulation of the U.S. military's air war plan and wartime economic policies. Section 3 clarifies the role of the War Production Board, which was responsible for planning and implementing national production policies. The Board contributed, both directly and indirectly, to the execution of military strategy by helping make production plans more realistic. It adjusted military proposals that were initially seen as unfeasible and worked to ensure they could be implemented effectively. Section 4 illustrates how the situation surrounding B-29 production dictated the planning and initiation of Operation MATTERHORN, an earlier strategic bombing campaign against Japan. While the political and diplomatic considerations accelerated the schedule of MATTERHORN, the economic reality, that is the delay of mass-production of the B-29s, determined the actual day of starting the operation. The discussion emphasizes the necessity of incorporating various factors—economic, scientific, and technological—that enabled strategic bombing operations into the overall narrative.

Introduction

This article illustrates the strong interrelationship between the formulation and implementation of the U.S. strategic bombing campaign against Japan and its economic policies during World War II. It examines how the war strategy defined wartime economic policies and how the wartime economy, particularly the production of essential weapons, influenced the execution of the strategy in terms of timing and methodology.

From the perspective of military history and strategic studies, previous analyses of U.S. (and Allied) strategic bombing have focused on the formulation and execution of the strategy, assessing its success or failure, its impact on the war's outcome, and its moral

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implications. However, most of these studies have overlooked the economic aspects that made bombing the Japanese homeland possible. The planning, feasibility, and implementation of certain strategies or tactics during the war depended on the production situation of the weapons and equipment necessary for their execution. Therefore, to provide a complete picture of U.S. strategic bombing campaigns, it is essential to incorporate the wartime economic system that underpinned them. Although the literature on U.S. wartime economic history details how policies were formulated and executed and how the U.S. business and public sectors achieved overwhelming mass production of munitions, it tends to assume that material superiority contributed to the Allies' victory, thus neglecting how the production situation of certain weapons impacted the execution of the strategy, leading to its success or failure. Thus, this article will focus on the War Production Board (WPB), a governmental agency responsible for the formulation and execution of economic policies, and clarify the importance of it in establishing the mass production system of aircraft and therefore making strategic bombing campaign effective.

This article will consider Operation MATTERHORN to illustrate how the U.S. wartime economy influenced the timing and implementation of the operation. Operation MATTERHORN was the strategic bombing campaign through which the 20th Bomber Command of the U.S. Army Air Forces (AAF) bombed Japan, East Asia, and Southeast Asia from June 1944 to January 1945. While the missions conducted by the 21st Bomber Command, based in the Mariana Islands, were more extensive and well-known, overshadowing MATTERHORN in military history and strategic studies, MATTERHORN was significant as the first operation using B-29s, the latest bombers of the time. Thus, the timing and scale of MATTERHORN depended on the production situation of the B-29s, making it an ideal case for analyzing the influence of the wartime economy on operational planning and execution.

1. Previous Studies and the Main Arguments of This Paper

Historian Paul Kennedy, known for *The Rise and Fall of Great Powers*, focuses on "problem solving and problem solver." He argues that there is often a significant gap between the formulation of strategies and tactics and their implementation, suggesting that attention should be paid to the "problem solver" who made these strategies possible but are often overlooked by scholars. Kennedy emphasizes that "there was then, a truly daunting list of difficulties to be overcome by the Grand Alliance…" during the war, but engineers were able to surmount these difficulties and "the tide turned in the greatest conflict known to history[1]." He poses an important hypothetical question:

> What if the legendary "turnaround" weapons such as the long-range fighter and miniaturized radar—whose arrival on the battlefields in 1943-44 most historians seem to take as a given—had not come into play at the time they did, or had not been developed at all?[2]

For the U.S. strategic bombing of the Japanese homeland, we can similarly ask what if the

[1] Kennedy [2013] pp. xxiii-xxiv.
[2] Kennedy [2013] p. xxiv.

B-29 had not emerged when it did, or had not been developed at all?[3]

Indeed, without the B-29s, which were tested shortly after the U.S. entered World War II, the AAF could not have conducted the campaign at that timing and scale. The AAF faced numerous obstacles that needed to be overcome. First, manufacturers had to produce enough B-29s to make operations possible and effective, as by mid-1944, the B-29 was the only bomber with a combat radius that could reach the Japanese homeland from the bases available to the AAF. Therefore, the production situation of the B-29 directly determined the schedule and scale of the bombing campaign against Japan.

The strategic bombing campaign against the Japanese homeland spanned from June 15, 1944, to August 14, 1945, when the Japanese government decided to accept the Potsdam Declaration. Operation MATTERHORN, conducted by the 20th Bomber Command, engaged in 49 missions, of which 10 targeted the Japanese homeland. In contrast, the missions conducted by the 21st Bomber Command based in the Mariana Islands totaled 332, including training missions, dropping approximately 160,000 tons of bombs on the Japanese homeland. By May 1945, the number of daily sorties regularly exceeded 500[4]. Ultimately, over 60 cities were devastated, Japanese aircraft industry was nearly destroyed, and numerous mines were scattered in the waters surrounding Japan. Although accurately counting the number of victims is challenging, estimates suggest that more than 100,000 people died in Tokyo alone, with over 200,000 casualties for the entire bombing campaign[5]. There are varying opinions on how the bombing campaign influenced the war's outcome, specifically whether it accelerated the war's end. Nevertheless, given the significant sacrifices made and the continuation of similar military activities after the war, it is vital to question why such contentious military operations were conducted and what enabled their realization, thus providing a clearer overall picture of strategic bombing.

In military history and strategic studies, authors examining the U.S. strategic bombing campaign during World War II often overlook—or assume as a given—the factors that enabled the implementation of strategic bombing. They focus on issues such as the establishment of precision bombing as the U.S. bombing doctrine during the interwar years, the overall unsuccessful attempts at precision bombing against both Germany and Japan, and the resulting inclination of the U.S. military toward area bombing campaigns targeting cities[6]. Some researchers have addressed the ethical implications of area bombing due to its indiscriminateness[7], while others have assessed the extent to which the strategic bombing campaign affected the war's outcome[8]. However, the critical factor of building a system for

[3] Regarding the strategic bombing against Germany by the U.S., Kennedy emphasizes that the development and mass production of the long-range escort fighter, the P-51 Mustang, were critically important to its success, specifically focusing on the development of the Rolls-Royce Merlin engine used in P-51. Although he discusses the strategic bombing of Japan only briefly, he notes the development and technological improvement of the B-29 bomber and its R-3350 engine. Kennedy [2013] pp. 99-135; 323-328.

[4] Fujita [2020] pp. 69-70, 76.

[5] See the following websites: The Center of the Tokyo Raids and War Damage (https://tokyo-sensai.net/; March 24, 2025); Air Raids 1945 (Kūshū 1945) by *Asahi Shinbun* (https://www.asahi.com/special/kushu1945/; March 24, 2025). The victims of the atomic bombings are excluded from the latter figure.

[6] Schaffer [1985]; Biddle [2002]; Crane [2016].

[7] Schaffer [1985]; Grayling [2006]; Dower [2010] pp. 162-196.

[8] Shortly after the war, the United States Strategic Bombing Survey (USSBS) conducted official research on the effects of the strategic bombing campaign against Japan. The USSBS emphasized the effectiveness of strategic bombing in accelerating the end of the war and even argued that, without the atomic bombings, the war against Japan could possibly have ended by November 1, 1944, the scheduled start date of Operation OLYMPIC, the planned invasion of Japan. Records of the USSBS are available in the digital collection of the National Diet Library of Japan (see the research navigation: https://ndlsearch.ndl.go.jp/rnavi/occupation/USB; accessed March 24, 2025). From a moral perspective, some authors did not acknowledge the usefulness of strategic bombing. Gian P. Gentile, a former professor at West Point, argues that the USSBS's conclusions lacked objectivity because

increasing aircraft and bomber production within the wartime economy has either been ignored or considered a given in discussions of large-scale bombing campaign[9].

However, the production situation of the B-29 has not been entirely overlooked. In historical studies and narratives about the bombing of Japan or the development of the B-29, the well-known "Battle of Kansas" is almost invariably referenced. This story centers on Boeing's Wichita (Kansas) B-29 plant, where Henry H. Arnold, a commanding general of the AAF, visited in March 1944 and expressed disappointment with the production situation. Arnold then strongly encouraged managers and employees to work harder. As noted in an essay about MATTERHORN, the commander of the 20th Bomber Command had about 150 B-29s ready by May 1944, thanks to the dedicated efforts of the personnel in Wichita[10]. However, these discussions often remain anecdotal and tend to overlook the policy discussions surrounding the U.S. wartime economy that underpinned the "Battle of Kansas[11]." (In fact, as shown in Table 4 below, the B-29 production numbers at the Wichita plant in March and April 1944 were not significantly different from those in January and February.)

In the fields of economic history and the history of the aircraft industry, the essential focus has been on how successfully the United States achieved "the miracle of production." However, these studies generally overlook that military policy guided wartime economic policy and dismiss how the success or failure of wartime economic policy affected the planning and execution of individual strategies. Economist Raymond Goldsmith noted as early as 1946 that "what won the war for them [the Allies] in the end, was their ability—and particularly that of the United States—to produce more, and vastly more, munitions than the Axis[12]." Several points have been discussed, including what contributed to achieving this "miracle," the impact of the wartime economy on the postwar economy[13], and how the wartime economy expanded the aircraft industry.

Regarding the first point, there is a narrative that emphasizes the role of business and industrial leaders or the industry as a whole in achieving the "miracle[14]." In contrast, several studies have emphasized economic policy and the role of the public sector. For instance, economic historian Kawamura Tetsuji details the development of the wartime economic system in which the United States emerged from the Great Depression and achieved significant economic expansion[15]. Mark Wilson credits "the role of public sector, including the work of the men and women who staffed powerful military and civilian governmental agencies" for the success of U.S. industrial mobilization, rather than attributing it solely to business leaders. He also emphasizes the friction between

its members were motivated by a desire to make the Army Air Forces (then one of the three branches of the Army) independent. According to Gentile [2001], this intent influenced them to present the results of the strategic bombing campaign in a more favorable light. From a strategic perspective, Robert A. Pape emphasizes the overall critical role of air power but argues that "no strategic bombing campaign has ever yielded decisive results." Pape [1996] p. 316. Regardless of whether strategic bombing was or is considered decisive, many authors have recognized that it contributed to reducing the capacity of Japan (and Germany) to continue the war. See also Overy [1997:1995] pp. 101-133; Frank [2001:1999] pp. 350, 354; Biddle [2019] p. 31.

9 Responding to this trend, Fujita [2021] notes that the establishment of a mass production system for the B-29 around late 1944 was a determining factor in the shift from a precision bombing policy to area bombing.

10 Correll [2009].

11 Berger [1970] pp 22-35, 48-59; LeMay and Yenne [2007:1988] pp. 58-77.

12 Goldsmith [1946] p. 69.

13 Some studies argue that the wartime economic system laid the foundation for the military–industrial complex that emerged during the Cold War era. Fujita [2019] reviews this research line.

14 As a typical example, see Herman [2012].

15 As the U.S. wartime economy was driven and supported by enormous military demand and massive government spending to meet that demand, Kawamura [1995] argues that this system became the foundation for postwar "sustained growth." He also highlights the importance of the economic policies implemented before the U.S. entered the war, a period he terms the "Defense Period." Kawamura [1998].

government and business rather than their cooperation[16]. In discussing the aircraft industry, John B. Rae portrays its growth while assuming its public nature. In her book, Nishikawa Junko credits the establishment of a subcontracting system for the expansion of aircraft production and details the role of government civilian agencies in introducing the system[17]. In response to these research trends, this paper focuses on a government agency, the War Production Board (WPB), shedding light on the influence the WPB exerted—both directly and indirectly—on aircraft production policies and therefore the military strategy.

Focusing on the government does not diminish the importance of the industrial sector. In terms of mass aircraft production, the automobile industry played a crucial role. Represented by "Fordism," this industry established an assembly-line operation system in the early 20th century, paving the way for mass production and consumption in the United States. In contrast, the aircraft industry had not adapted to mass production and relied heavily on skilled labor before World War II[18], which hindered its ability to meet the high demand for aircraft, especially bombers, on its own. Consequently, U.S. government agencies responsible for industrial mobilization arranged for automobile firms to operate factories for airframes and engines. Among these, the most notable was the Willow Run factory in Michigan, operated by Ford Motor[19].

Moreover, the war compelled the aircraft industry to transform itself, leading it to adopt mass production methods. This development occurred in two ways. First, as Nishikawa asserts, the aircraft industry introduced a subcontracting system during wartime. This system involved various industries, including automobile manufacturers, primarily producing parts and engaging in sub-assembly, while aircraft firms handled the final assembly. Additionally, small-scale factories known as "feeder plants" were effectively utilized, especially on the West Coast, to manufacture various parts and supply them to airplane companies. Importantly, the subcontracting system persisted after World War II, supporting the industry's prosperity[20]. Second, aircraft companies began adopting mass production techniques similar to those of the automobile industry. They simplified and segmented their manufacturing processes, standardizing parts and finished products so that unskilled labor, including women, could play a significant role[21]. Given the importance of quantity for executing strategic bombing campaigns effectively [22], the earlier establishment of mass production in the automobile industry and its collaboration with the aircraft industry to meet high demand for airplanes were critical for these campaigns. Thus, the large-scale strategic bombing campaign during World War II can be contextualized within

16 Wilson [2016], p. 3. Alexader J. Field agrees with Wilson on this point. Field argues that the levels of wartime production (what he calls "sheer quantity production") were achieved through government or public sector efforts rather than private business. He challenges the narrative that World War II had a great and positive impact on the U.S. economy and that productivity (as opposed to output) grew during the war and had a lasting positive effect on the U.S. economy after the war. He concludes that "The economy's postwar capabilities are almost entirely attributable to conditions already in place in 1941." Field [2022] p. 372. Paul Koistinen similarly argues that "when placed in the proper context, the American production record does not appear exceptional." He criticizes the close wartime relationship between the military and industry, arguing that it hindered effective war mobilization. Koistinen [2004] p. 498.

17 Rae [1968] pp. 119-172; Nishikawa [2008], pp. 49-102.

18 Sato [2003] pp. 88-91.

19 Willow Run was engaged in the production of the B-24, a long-range bomber that served as one of the main weapons in the bombing campaign in Europe. In summary, the U.S. military accepted 18,190 B-24s, of which 6,792 were manufactured at the Willow Run factory. Office of Statistical Control [1945], *Army Air Forces Statistical Digest: World War II*, pp. 115, 118.

20 Nishikawa [2000].

21 Sato [2003].

22 In early 1945, the AAF shifted the emphasis of its strategic bombing campaign from precision bombing to area bombing. Fujita [2021] argues that this shift was made possible by the increased number of B-29s deployed.

the U.S. history of mass production and consumption.

Indeed, strategy and economy were interrelated. For example, during the interwar period, U.S. Army leadership generally dismissed the idea of strategic bombing, while proponents formulated "precision bombing" as the doctrine of the U.S. Army Air Corps (AAC), constrained by tight economic limits; in other words, bombers—especially long-range bombers—were too expensive to acquire in large numbers[23]. However, as will be discussed, the military freed itself from these constraints with an enormous budget after entering the war, leading to the formulation of air war plans focused on strategic bombing. Consequently, aircraft production was prioritized in America's munitions policy, reflecting the wartime strategies using it, particularly long-range bombers.

More comprehensive discussions integrate military history with economic history. In his extensive work, *Why the Allies Won*, Richard Overy examines several factors that contributed to the Allies' victory. He identifies strategic bombing as one of these factors, alongside the overwhelming superiority of the Allies' mass production capabilities and technological competence[24]. However, due to the book's broad scope, it does not delve deeply into the individual cases of the factors that made strategic bombing feasible. Meanwhile, military historian Kenneth P. Werrell published one of the most detailed studies on strategic bombing against Japan, analyzing the development and production of the B-29 and other equipment such as engines and radar, which facilitated bombing missions and diversified bombing methods. However, as his focus was primarily on technological feasibility, his analysis lacked an economic perspective[25]. As for strategic bombing against Japan, an economic viewpoint is crucial since the number of bombers often dictated the nature of the campaign. Nevertheless, these studies explore what made strategies possible, even if that is not the core question of each study, and attempt to provide some answers.

This paper is situated within the context of this series of studies and examines how the planning and implementation of military strategy interacted with the formulation and execution of economic policy. It argues that the production situation of specific weapons necessary for executing particular strategies critically impacted their implementation. First, this article demonstrates the interactions between the U.S. air war strategy and the formulation of production targets for aircraft before and during the early stages of the war. Next, it explores how the WPB influenced the military strategy by intervening in munitions programs. It shows that the WPB directly or indirectly facilitated strategic bombing campaigns by successfully urging the military to downsize its munitions program based on feasibility, thereby establishing an effective production situation. The final section focuses on Operation MATTERHORN, an early strategic bombing campaign against the Japanese homeland, asserting that the production situation of the B-29 significantly affected how and when the operation was executed. This paper references primary sources, including minutes from WPB regular meetings, monthly reports on the production situation from the U.S. National Archives and Records Administration, and records from the Joint Chiefs of Staff (Microfilm, Meiji University).

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23 Morris [2017] pp. 135-190.

24 Overy [1997:1995] pp. 101-133, 180-244. Still, Overy concludes that "The Allies won the Second World War because they turned their economic strength into effective fighting power, and turned the moral energies of their people into an effective will to win." He places greater importance on "will" and "courage," although he concedes that these qualities are "difficult for historians to use as instruments of cold analysis." Overy [1997:1995] pp. 324-325.

25 Werrell [1996] pp. 55-83. Conrad Crane also devotes one chapter each to the development of radar and sights, as well as better bombs. Crane [2016] pp. 101-132.

2. Formulation of Air War Planning and the Establishment of a Mass Production System for Aircraft

Throughout World War II, the U.S. aircraft industry expanded significantly. In 1939, the year war erupted in Europe, this industry produced approximately 5,000 airplanes, most of which were small and private. However, when the situation in Europe shifted in mid-1940, the United States began to establish the foundation for national defense, resulting in a production record of approximately 3,800 military planes that year. By the end of the war, the aircraft industry had manufactured an enormous total of 300,000 planes, with a peak production year of less than 100,000 in 1944. Approximately 98,000 of the 300,000 produced were bombers, with 35,000 being long-range (LR) or very long-range (VLR) bombers, such as the B-17, B-24, B-29, and B-32, each with four engines. Comparing production in 1940 to that in 1944, the number of manufactured planes increased by 25 times, while airframe weight increased by 81 times. During the same period, floor space increased by 12 times, the workforce grew by 16 times, and sales rose by 30 times[26]. These results indicate that the U.S. aircraft industry achieved remarkable success during the war and played a crucial role in securing victory.

A significant portion of aircraft production consisted of LR and VLR bombers (12% by number but 35% by airframe weight), which were primarily used for strategic bombing, although they served other purposes as well[27]. This underscored their importance during World War II. However, during the interwar period, the U.S. Army, which controlled the AAF and its predecessor (the AAC), did not regard strategic bombing as valuable. This was evidenced by the fact that the AAC had only 13 B-17s in the autumn of 1938, the latest bomber at the time[28]. Even advocates of strategic bombing justified the procurement of bombers primarily for hemispheric defense due to budgetary constraints. With the onset of World War II, long-range bombing became the only means to directly attack Nazi Germany and Italy on the European continent, especially after Nazi forces launched westward offensives and defeated France in mid-1940. In this context, President Franklin D. Roosevelt (FDR) strongly promoted the expansion of aircraft production, particularly for LR and VLR bombers.

The initial production target was 50,000 aircraft, announced by FDR in May 1940[29]. This was a lofty objective, considering that the production record in 1939 was only 5,000. By September 1940, the 8-A schedule[30] was developed based on FDR's target, requiring the production of 47,495 airplanes, including spares, from August 1940 to July 1942. This target was revised on October 23 to demand 41,341 aircraft in the same period. These reports were more moderate than FDR's target, as they were based on economic feasibility assessments by experts. However, further demands from military services and the British necessitated upward revisions to the schedule. The 8-C schedule (March 1941) requested the manufacture of 78,961 aircraft by June 1943, including VLR bombers such as the B-29 and B-32. The latest version before Pearl Harbor, the 8-G schedule, presented targets similar to 8-C (75,637 by June 1943). Prior to that, the 8-E schedule (May 5, 1941) included a goal of

26 Craven and Cate [1983c:1955] p. 331.
27 Craven and Cate [1983c:1955] pp. 352-353.
28 Craven and Cate [1983c:1955] pp. 202-204; Rae [1968] p. 96.
29 Holley [1989:1964] pp. 226-228.
30 Report no. 8 series referred to aircraft production schedules designated by the aircraft section or branch in advisory agencies involved in the munitions program, such as the National Defense Advisory Committee, the Office of Production Management, and the War Production Board.

producing 500 long-range bombers per month by June 1943[31].

These production figures also accounted for supplies intended for Allied nations, primarily Britain. Even before the war broke out, there were foreign orders for aircraft from Britain and France due to the threat posed by Nazi Germany. However, when the war began in September 1939, the U.S. Congress debated whether to invoke the Neutrality Act, which negatively impacted aircraft production[32]. The Act was revised in November 1939, allowing U.S. firms to export munitions to belligerent nations on a "cash-and-carry" basis, leading to increased foreign orders and facility expansions[33]. Subsequently, the supply of aircraft to Britain and France (and after France's surrender, exclusively to Britain) grew, especially after the Lend-Lease Act was passed in March 1941. While the 8-A schedule (September 1940) called for the production of 47,495 aircraft, 13,694 were planned for delivery to Britain[34]. The 8-C schedule, drawn up just before the passage of the Lend-Lease Act, planned to deliver about 25,000 airplanes to Britain (approximately 20,000 of the total 50,000 for tactical purposes)[35]. In summary, foreign orders and aid to Britain under the Lend-Lease Act helped spur facility expansions, as noted in the official history of the AAF, which stated, "The adoption of lend-lease in March and the President's acceptance in May of a program for the production of 500 four-engine bombers per month removed the question of a further expansion of plant from the area of debate[36]."

After the United States joined the United Nations, production targets soared, largely driven by FDR. In January 1942, he set the aircraft production target at 60,000 for 1942 and 125,000 for 1943. These figures were so ambitious that they could not be met, at least not in sheer numbers. FDR's commitment to expanding aircraft production strongly constrained discussions between the military and the WPB, which was responsible for the wartime economy; the military insisted on maintaining these targets, while the WPB sought to revise them downward. As mentioned earlier, the 8 series prepared by economic experts tended to present more realistic targets than those set by FDR and the military. For instance, the 8-I schedule, announced at the end of January 1942, set "ultimate" objectives at 56,810 for that year and 105,133 for the following year[37]. As we will see, the WPB attempt-

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31 Craven and Cate [1983c:1955] p. 289; J. Carlyle Sitterson [1946] "Aircraft Production Policies under the National Defense Advisory Commission and Office of Production Management, May 1940 to December 1941," *Historical Reports on War Administration: War Production Board*, no. 21, p. 97.

32 Holley [1989:1964] p. 201.

33 Craven and Cate [1983c:1955] p. 191. I. B. Holley Jr. points out that "the greatest contribution of the foreign orders lay in their psychological value to the aircraft industry. The prospects of a sharply rising curve of export sales seem to have put manufacturers in a mood to take bigger risks, to sink more capital in plant expansions…" Holley [1989:1964] p. 200. For discussions on the importance of exports to the aircraft industry, see also Nishikawa [1993] pp. 14-18.

34 Sitterson, "Aircraft Production Policies," p. 50.

35 In September 1940, it was authorized that British procurement officials would join the joint committee of the U.S. Army and Navy to discuss the aircraft production program. Nishikawa [2008] pp. 50-53.

36 Craven and Cate [1983c:1955] pp. 311-314, quotation from p. 313. It must be noted that the U.S. aid to Great Britain was not a one-way street. For its sub-contracting system, the U.S. aircraft industry referred the British aircraft industry, which had already established a system of "wholesale sub-contracting" (see Nishikawa [2000] p. 59). In addition, the exchange of scientific and technological information, including in the field of nuclear science, greatly contributed to the research and development efforts of both nations. For aircraft production, the British Rolls-Royce Merlin engine (denoted as V-1650 in the U.S.) played a significant role. Paul Kennedy argues that the U.S. fighter plane P-51, when equipped with the Merlin engine, helped overcome the obstacle faced by the Eighth Air Force in conducting its strategic bombing campaign against Germany. Kennedy [2013] pp. 116-126. U.S. firms, including the Packard Motor Car Company, manufactured the Merlin engine. Craven and Cate [1983c:1955] pp. 309-310; Sitterson, "Aircraft Production Policies," pp. 65-66. Packard produced 54,714 Merlin engines during the war. Holley [1989:1963] p. 581.

37 The "ultimate" (and "initial") objectives were applied in the 8-I schedule (and continued through 8-J and 8-K) to reflect the President's declared objectives. Although many concerned people considered the objective un-

ed to further decrease these still ambitious figures.

Why were such unrealistic numbers established as targets? The military services often grossly overestimated munitions requirements, though their estimates were not without basis. In July 1941, FDR ordered the secretaries of War and the Navy to prepare "the over-all production requirements required to defeat our potential enemies[38]." The newly established Air War Plans Division (AWPD) of the AAF completed a comprehensive air offensive plan, AWPD-1, on August 12. The ultimate goal was the defeat of the Axis powers rather than merely hemispheric defense, and it estimated the forces necessary to achieve that end. AWPD-1 focused on strategic bombing targeting the German economy, identifying 154 critical targets, including the electrical power system, oil, and aircraft industries.

To completely defeat the Axis, planners estimated that the ultimate forces required for bombers included 98 groups: 10 medium bomber groups (1,062 airplanes), 20 long-range groups (1,700 airplanes), and 68 very long-range groups (5,740 airplanes). Due to the limited availability of airfields in the United Kingdom and the Middle East, only 54 of the 98 groups could be based there. Consequently, the planners determined that 44 groups of bombers, capable of operating from bases in Newfoundland, Greenland, etc., with a 4,000-mile (6,400 km, significantly longer than the B-29) operating radius, were necessary. The monthly replacement numbers for bombers totaled 1,334. Additionally, 25 long-range bomber groups (2,125 airplanes and 81 monthly replacements) were required to defend U.S. possessions and the Western Hemisphere, along with two groups (170 airplanes and 34 replacements) for strategic defense in Asia (Table 1). These calculations were incorporated into the "Estimate of United States Over-All Production Requirements," issued on September 11 by the Joint Army-Navy Board.The grand total amounted to 63,467, comprising 239 groups and 108 separate squadrons by 1945[39]. Despite the high demand for VLR bombers, military historian Robert F. Futrell notes that this figure "was remarkably similar to the 269 tactical groups that the Army Air Forces would possess at its maximum strength during World War II[40]," reflecting the presidential objective of those higher numbers[41]. The presidential objective reflected those higher numbers.

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realistic, the military viewed it as imperative. Therefore, the initial objective was set a more practicable target, "assigned to manufacturers" and used as "the basis for planning immediate plant expansion and allocation of materials and equipment." As Craven and Cate explains, "the production scheduled under the ultimate objective was never attained," indicating that the "ultimate" objective was to demonstrate for planners to work toward the goal the President had declared. Craven and Cate [1983c:1955] pp. 289-290. The figures from the 8-I schedule are quoted from the Planning Committee, meetings, nos. 13 and 14, held on March 23 and 25, 1942, Box 1, Minutes and Transcripts of Proceedings of Meetings, WPB Planning Committee, RG 179 (Records of the War Production Board), NARA.

38 Futrell [1989] p. 109.

39 Futrell [1989] pp. 108-112; Craven and Cate [1983a] pp. 131-132.

40 Futrell [1989] p. 113.

41 AWPD-4 presented on December 15, 1941, enlarged the requirement: 13 medium bomber groups, 64 long-range bomber groups, 32 very long-range bomber (B-29 and B-32) groups, and 59 4,000-mile bomber groups. The total aircrafts were 90,000, which demanded a production rate of 3,000 aircrafts a month. Furthermore, the plan recommended "NATIONAL FIRST PRIORITY TO THE PRODUCTION OF AIRCRAFT," though not accepted. Futrell [1989] pp. 127-128; Craven and Cate [1983a:1948] p. 236.

Table 1: Requirement of AAF in AWPD-1

Missions	Type	Groups	Airplanes	Replacement/ month
Air Offensive against Germany	M Bomber	10	1,062	143
	LR Bomber	20	1,700	228
	VLR Bomber	24	2,040	273
	4,000-mile Bomber	44	3,740	501
	Day Pursuit	21	2,756	334
	Night Pursuit	--	656	80
Defend U.S. possessions and Hemisphere	LR Bomber	25	2,125	81
	Day Pursuit	32	4,200	90
	Night Pursuit	--	1,000	27
Strategic Defensive in Asia	LR Bomber	2	170	34
	Day Pursuit	1	132	17
	Night Pursuit	--	31	4
Air Support for Ground Forces	Light bomber	13	946	42
	Dive bomber	13	1,255	56
	Observation	108 Squadrons	1,901	98
	Photo	2	142	23
	Transport	19	1,520	77
	Gliders	--	(3,000)*	(153)*
Maintenance	Transport	13	1,040	25
Training	All Types	--	37,051	--
Grand Total		239 108 Squadrons	63,467	2,133

Source: Haun [2019] pp. 237-238.

* Not included in totals.

3. War Production Board's engagement with the miliary services

For the WPB[42], responsible for planning and implementing production policy, the military's requirements and FDR's objectives were entirely unrealistic. The WPB believed that an unfeasible objective hindered actual production, and since it could not directly intervene in military procurement, it struggled with the military to reduce targets to a realistic level. From early 1942 to 1943, a "feasibility controversy" emerged between the WPB and the

42 The WPB was established by Executive Order 9024 in January 1942 as the successor to the Supply Priorities and Allocations Board and the Office of Production Management . The WPB members were a chairman appointed by the President, the Secretaries of War and the Navy, and several of directors or administrators of civilian agencies. Executive Order 9024, in *The War Production Board and Management of the Wartime Economy*, vol. 31 of *Documentary History of Franklin D. Roosevelt Presidency*, McJimsey, George T. [2012:2006] ed., Bethesda, MD: University Publications of America, Reprint edition, pp. 7-9.For a detailed history, see United States Civilian Production Administration (USCPA) [1969:1947] *Industrial Mobilization for War: History of the War Production Board and Predecessor Agencies, 1940-1945*, vol. 1, *Program and Administration*, New York: Greenwood Press. See also Koistinen [2004] pp. 195-217.

military, particularly the Army Service Forces (ASF), which was responsible for nearly all Army procurement [43]. For example, at a meeting on March 31, 1942, the WPB estimated a realistic military expenditure of $40 billion in 1942 and $60 billion in 1943, in contrast to the $60 billion and $110 billion projected by the military services for the same years[44].

In this situation, the WPB decided that Chairman Donald Nelson would consult with the Joint Chiefs of Staff (JCS), the top policymaking body of the military, to revise the target numbers downward. As early as March 1942, Nelson informed Secretary of the Navy Frank Knox that the military's estimate (60 billion in 1942 and 110 billion in 1943) "must be carefully reviewed in the light of available resources—raw materials, manpower, and industrial facilities[45]." While the military services revised their estimate downward to 92.9 billion, the WPB set its estimate at 75 billion, reflecting the growing U.S. production capacity[46], despite the significant gap between their estimates. Consequently, in a memorandum to the JCS dated October 19, Nelson urged the JCS to reduce its objectives[47]. As a result, the JCS decided to lower the objectives to 80 billion dollars. "Although this figure exceeds the War Production Board's estimate of the productive capacity of the nation by approximately $5.0 billion," the JCS concluded, "the program is considered to be within the productive capacity of the nation[48]."

The reduction in overall military spending for the munitions program led to a revision of priorities, particularly regarding aircraft production. In discussions about the issue, the WPB exerted influence to maintain a priority on aircraft production. Along with revising the overall production objectives, the priorities for military production were also considered by the JCS. JCS 146/1, a document titled "Priorities in Production of Munitions Based on Strategic Considerations" dated November 1942, outlined that "five parts of the U.S. Military program are of equal importance[49]": The Army Supply Program (including the aircraft program); The Navy War Program; The Marine Corps Supply Program; The Maritime Commission Program; and The International Aid Program. Effectively, this policy lowered the priority assigned to aircraft production. Until then, under President Roosevelt's instructions, aircraft production had been given a higher priority. For example, during the 11th meeting of the WPB, it was noted that "the War and Navy Departments have been requested to let no contracts for new facilities, other than those essential to attainment of the aircraft objectives[50]."

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43 In the United States, the military services were almost exclusively responsible for estimating requirements, procuring munitions, and contracting with firms, unlike the United Kingdom, which established the Ministry of Supply. For discussions on the disputes over the authority for overall wartime production and procurement, see Ohl [1994] pp. 72-97; Eiler [1997] pp. 326-368.

44 The minutes of regular meetings of WPB and the Monthly Reports to the War Production Board are stored in the following collection: Office of the Undersecretary of War, Administrative Office, Subject-Numerical, 1941–1945, Boxes 735–747, Record Group 107 (Records of the Office of the Secretary of War), National Archives and Records Administration (NARA). Hereafter, references to these documents will include only the box numbers, as in the following examples: WPB meeting, No. 11, March 31, 1942, Box 737.

45 Donald Nelson to Frank Knox, March 16, 1942, attached to J.C.S. 134, U.S. War Production Objectives, 1943, October 19, 1942, Reel 1 (R1), Strategic Issues (SI), Records of the Joint Chiefs of Staff, part 1: 1942-1945 (RJCS pt. 1), microfilm, Meiji University.

46 WPB meeting, no. 35, October 13, 1942, Box 739.

47 War Production Objectives for 1943, October 15, 1942, and Nelson to JCS, October 19, attached to J.C.S. 134.

48 J.C.S. 134/2, U.S. War Production Objectives, 1943, November 23, 1942, R1, SI, RJCS pt. 1. The actual figure for war production totaled to approximately 70 billion dollars. Monthly Report to the War Production Board, December 1943, 1, Box 744.

49 J.C.S. 146/ 1 (J.C.S. 146 series title is "Priorities in Production of Munitions Based Strategic Considerations), November 17, 1942, R1, SI, RJCS pt. 1.

50 WPB meeting, no. 11, March 31, 1942.

Henry Arnold, the commanding general of the AAF, objected to that policy. Initially, he had agreed to it because he was informed that the priorities of each sector "could be parallel each other but there would be no interference with the production of the 107,000 airplanes as laid out for 1943." However, he later learned that the new arrangement would lower the priority of aircraft production, leading him to withdraw his concurrence[51]. Furthermore, Donald Nelson also opposed the priorities outlined by the JCS, stating,

> I have in mind the President's recent instructions that the aircraft program be carried out regardless of its effect on other programs. I have received somewhat similar instructions from him with respect to escort vessels and merchant shipping. I cannot reconcile these instructions from the President with the suggested priorities set forth on Tab "A[52]."

Taking Nelson's opinion and the president's instruction into account, William Leahy, a Navy admiral and chairman of the JCS, established the highest priority group as "No. 1 Group," which separated the aircraft production program from the entire Army supply program. The JCS then presented four sectors in No. 1 Group, including 107,000 airplanes, other Army munitions and supplies, Navy warships and equipment, and vessels constructed by the Maritime Commission[53]. Nelson, however, argued that it would be difficult to complete the production of 107,000 aircraft based on the plan Leahy proposed[54]. In contrast, Navy members criticized Nelson and Arnold, insisting on maintaining JCS 146/1 [55]. Arnold argued that the highest priority should be given to the aircraft production program, citing Nelson's perspective[56]. In February 1943, the chairman of WPB requested that the JCS clarify what constituted the "must program[57]." After these discussions, the JCS divided the entire munitions program into four sectors (Army and Navy aircraft, Army, Navy, and Maritime Commission) and then segmented each sector into Groups 1 to 3. In this framework, Group 1 of each sector was defined as the "must program," with each item in Group 1 given equal preference[58]. Through these correspondences between WPB and JCS, the priorities for the munitions program were refined based on considerations of economic feasibility in WPB. By doing so, WPB contributed to greater efficiency in military production.

WPB prompted a reduction in the overall munitions program and addressed the prioritization issue. At the same time, it sought to decrease the scale of the aircraft production program, as WPB economists considered the production of 125,000 aircraft, as proposed by

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51 J.C.S. 146/2, November 24, 1942, R1, SI, RJCS pt. 1.

52 Donald Nelson to William D. Leahy, November 18, 1942, attached to J.C.S. 146/4, November 24, 1942, R1, SI, RJCS pt. 1.

53 William D. Leahy to Donald Nelson, November 26, 1942, attached to J.C..S. 146/5, November 30, 1942, R1, SI, RJCS pt. 1.

54 Donald Nelson to William D. Leahy, December 3, 1942, attached to JCS 146/ 6, December 5, 1942, R1, SI, RJCS pt. 1.

55 Memorandum for Admiral [Earnest J.] King, December 7, 1942, attached to J.C.S. 146/8, December 7, 1942, R1, SI, RJCS pt. 1.

56 J.C.S. 146/7, December 7, 1942, R1, SI, RJCS pt. 1.

57 Donald Nelson to William D. Leahy, February 11, 1943, attached to J.C.S. 146/10 (revised), February 27, 1943.

58 J.C.S. 146/12, March 15, 1943, and William D. Leahy to Donald Nelson, March 16, 1943, attached to J.C.S. 146/13, March 18, 1943, R1, SI, RJCS pt. 1.

Table 2: Aircraft production estimates and record for June to December 1942.

type	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
All	52,235	53,551	51,485	50,835	49,412	47,510	47,694
Combat	29,050	28,950	27,589	27,058	26,169	24,933	24,918
Bomber	15,458	15,165	14,519	14,121	13,531	12,767	12,679
LR	2,879	2,901	2,645	2,631	2,610	2,540	2,579

Source: Monthly Reports to the War Production Board.

FDR, was deemed too ambitious and unrealistic. It was believed that setting such exceedingly high objectives for the program, categorized as one of the "must programs," would disrupt other equally important initiatives and negatively impact the overall economy[59]. Consequently, Donald Nelson recommended that William Leahy reduce the aircraft production target for 1943 from 107,000 to a maximum of 95,000. Ultimately, the actual number manufactured in 1943 was around 85,000, indicating that even 95,000 was an overestimation[60].

Indeed, the WPB continued to revise the aircraft production objectives downward. This is evident from the "Monthly Reports to the War Production Board," which the Office of Progress Report compiled each month during the war. Table 2 illustrates the aircraft production estimates or objectives for 1942 at the end of each month (with December reflecting the actual production record). By June, it was clear that the President's objective for 1942—60,000 aircraft, of which 45,000 were tactical and the remainder trainers[61])—was unattainable. Comparing the figures from June to December, the achievement rate for all types was 91%, while the rate for combat types was only 85%. This indicates that, to approach the target, greater emphasis was placed on producing trainers, which were relatively easier to manufacture. The Planning Committee, "an advisory body to the Chairman of the War Production Board" established by General Administrative Order No. 22 on March 3, 1942, proposed this approach. The committee believed that the target of 60,000 aircraft (45,000 tactical planes and 15,000 trainers) was "unfeasible" but felt that a "public announcement of a revision of objectives downward is undesirable[62]." Thus, the committee recommended that 60,000 "be retained as a goal, but that there be a redistribution of types so as to provide a greater number of trainers and a lesser number of tactical planes…[63]" Indeed, the 8-I schedule (at the end of January 1942) set its initial and ultimate objectives at 17,287 trainers instead of 15,000[64].

In 1943, the gap between objectives and actual production widened compared to 1942. As noted earlier, after the aircraft production goal for 1943 was set at 107,000 in late 1942,

59 For example, at the 55th meeting of WPB, it was pointed out that the current schedule was "over-optimistic," and this "led to the dissipation of productive resources." WPB meeting, no. 55, April 27, 1943, Box 741. Donald Nelson to William D. Leahy, April 14, 1943, attached to J.C.S. 146/14, April 14, 1943, R1, SI, RJCS pt. 1.

60 Nelson to Leahy, April 14, 1943.

61 Military aircraft were classified into "tactical" types and trainers. Tactical types included "combat" aircraft, such as bombers, fighters, and naval reconnaissance, as well as other types such as transport and communications aircraft.

62 The WPB Planning Committee, meeting, no. 14, March 25, 1942, Box 1, Minutes and Transcripts of Proceedings of Meetings, WPB Planning Committee, RG 179, NARA.

63 "Report of Planning Committee for the Period from February 20 to April 4," Robert R. Nathan (Chairman of Planning Committee, WPB) to Donald M. Nelson, April 7, 1942, Box 737, Office, Undersecretary of War, Administrative Office, Subject-numerical, 1941-1945, RG 107.

64 For the 8-I schedule, see note 37. The actual production of trainer aircraft in 1942 was 17,599. Progress Report to WPB, January 1943, p. 4, Box 740.

Table 3: Aircraft Production Estimates and Record for 1943.

type	Jan.	Feb.	April	May	July	Sep.	Oct.	Nov.	Dec.
All	112,038	111,000	101,266	95,212	93,472	90,154	86,288	85,993	85,420
Combat	74,032	72,719	64,412	62,336	60,701	57,684	59,751	54,607	54,091
Bomber	41,040	40,699	34,652	34,615	33,309	31,836	29,650	29,552	29,362
LR	11,384	11,431	10,610	10,511	10,178	9,723	9,326	9,325	9,292
VLR	-	-	-	-	146	140	121	104	92

Source: Monthly Reports to the War Production Board.

Donald Nelson argued that it should be reduced to a maximum of 95,000. As shown in Table 3, the target was adjusted to approximately 95,000 in May 1943, but the actual production in 1943 was only 76% of the January estimate for the year. Although it might seem that performance in 1943 was worse than in 1942, the number of aircraft produced should not be viewed in isolation. Nelson informed William Leahy in May 1943 that "it would appear to be much more practicable for future consideration to standardize on the use of weight of planes rather than numbers." At this point, the quality of aircraft became more critical than quantity, particularly regarding heavy bombers[65]. The production of heavy bombers remained relatively steady.

Nevertheless, the WPB was always concerned about the disparity between goals and objectives. The reasons for poor aircraft production varied over different periods: a shortage of machine tools in the first half of 1942[66] and a lack of critical materials, including aluminum and copper, as well as an inadequate distribution system in the latter half of the year[67]. To address the distribution issue, the WPB developed the Production Requirement Plan, but it did not solve the problem. Subsequently, in November 1942, the WPB announced the Controlled Material Plan, which was fully implemented by July[68]. This plan contributed to the efficient allocation of critical materials, leading to a reduced focus on material shortages in WPB discussions. Instead, from the latter part of the year onward, the WPB identified the primary factor for the shortfall as a lack of manpower in the aircraft industry[69].

The problem of labor shortages was prevalent in newly operating factories, including those related to the B-29. The B-29 was one of the latest weapons, with development beginning in 1940. Boeing, its designer, started constructing a second plant in Wichita specifically for B-29 manufacturing in June 1941. Other factories producing B-29s included Renton (Washington, operated by Boeing), Omaha (Nebraska, operated by Martin), and Marietta (Georgia, operated by Bell). These plants began operations relatively late. For example, construction of the Marietta plant started at the end of March, but it was not completed until July 1943 due to the shortages of steel and labor. According to Jacob Meulen,

65 Nelson to Leahy, May 4, 1943, attached to J.C.S. 146/ 16, May 6, 1943, R1, SI, RJCS pt. 1.

66 WPB meeting, no. 5, February 17, 1942, Box 736; WPB meeting, no. 14, April 21, 1942, Box 737.

67 Kawamura [1998] pp. 160-162, 239-243; Wiltse, Charles M. [1946] "Aluminum Policies of the War Production Board and the Predecessor Agencies, May 1940 to November 1945," no. 22 of *Historical Reports on War Administration: War Production Board*, p. 142.

68 The official history of the WPB concluded that "The success of CMP by the end of the year [1943] meant the achievement of a highly ambitious and difficult approach to distribution…manufacturers had found CMP workable, and had achieved the highest production level the Nation had ever known." USCPA, *Industrial Mobilization for War*, vol. 1, pp. 485-501, 663-682, quotation from p. 682.

69 The problem of labor shortage was not fully overcome until 1944. In the aeronautical industry, employment peaked at 1,326,000 in November 1943. AAF Historical Office [1946] "Expansion of Industrial Facilities under Army Air Forces Auspices, 1940-1945", no. 40 of *Army Air Forces Historical Studies*, pp. 171-172.

"Many unemployed people lived in the area when planners selected Marietta. But by the time the plant was ready to put large numbers of people to work, most had already found jobs." As a result, the Bell plant relied on women, who made up "nearly 60 percent of the workforce[70]." World War II and the U.S. entry into it abruptly absorbed the unemployed labor pool. According to the U.S. Bureau of Labor Statistics, the U.S. unemployment rate in 1940 was 14.6%, but it gradually improved. By 1943, the unemployment rate dropped to 1.9%, making it difficult for any new plant at that time to secure a labor force[71]. Overall, 1943 was a transition period for establishing a mass production system for aircraft[72].

The role of women in the aircraft industry is noteworthy. Symbolized by "Rosie the Riveter," many women worked in manufacturing factories. For unskilled female laborers to play an active role in factories, the manufacturing process needed to be simplified and segmented. Traditionally, the mass production system was not suited for aircraft production, which relied heavily on skilled labor. The military also doubted that the mass production system could meet specifications and requests for various changes. However, achieving production targets would be impossible without this system. As mentioned in Section 1, industrial policy authorities arranged for automobile firms, such as Ford, to produce airframes and engines, while aircraft companies collectively introduced a line-assembling system. For example, the Willow Run factory operated by Ford produced 6,792 B-24 Liberators (designed by Consolidated), and Ford's Dearborn plant in Michigan manufactured 57,178 R-2800 engines (designed by Pratt & Whitney). Although automobile firms did not participate in producing airframes for the B-29, Dodge, a division of Chrysler, produced 18,349 R-3350 engines (designed by Wright Aeronautical)[73].

As the military feared, the introduction of the mass production system into the aircraft industry caused issues: mass-produced and standardized airplanes required repeated modifications to adjust to different battlefields or tactics. When the AAF faced the choice between quality and quantity, it opted for both: the AAF established modification centers across the United States, where standardized aircraft were sent to be modified for specific battlefields and tactics. According to the official history of the AAF, the U.S. government spent $100 million to create 21 modification centers, 19 of which were constructed by the AAF at a cost of $75 million. Although the centers required many skilled workers, maintenance staff from civil airliners were hired to meet the demand[74]. This approach was particularly useful for aircraft with numerous technical issues, such as the B-29. Thus, cross-industrial cooperation arranged by government economic agencies and innovative strategies for meeting demands for quality and quantity laid the groundwork for women's contributions in manufacturing factories[75].

Although the gap between actual aircraft production and objectives widened from 1942 to 1943, the production situation for LR bombers, the primary weapon for strategic bombing—including the B-17 and B-24—was relatively better than for other types. As stated in Section 2, the AAF emphasized strategic bombing against Germany, developed air war

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70 Meulen [1995] pp. 76-81, quotation from pp. 78, 81.

71 U.S. Bureau of Labor Statistics, "Employment status of the civilian population, 1940 to date." (https://www.bls.gov/cps/aa2009/cpsaat1.pdf; March 24, 2025)

72 Another factor is the increasing share of sub-contracting. Nishikawa [2000] pp. 63-64.

73 Holley [1989:1963] pp. 577, 580.

74 Craven and Cate [1983c:1955] pp. 316, 336.

75 According to Chitose Sato, the number of workers in the aircraft industry at its peak was 1,326,345, of which 486,037 (36.7%) were women. She argues that in the process of incorporating women into the workforce, various tasks were "discovered" and created as jobs suited for women, in other words, the work was "gendered." Sato [2003] pp. 85-173.

plans such as the AWPD series, and estimated munitions requirements accordingly. The relatively favorable situation for LR production reflected these military policies. Indeed, from the summer of 1943, AAF in Europe began massive-scale operations, including attacks on Regensburg and Schweinfurt, despite unacceptable losses. Starting with the Münster bombing in October, the AAF also targeted cities[76]. Meanwhile, to classify aircraft produced in the Monthly Report to the WPB, the Top Preference and Lower Preference categories were established in October 1943, with LR bombers, including the B-29, placed in the former category[77]. This suggests a shift in emphasis from quantity to quality in aircraft production at that time. The focus on manufacturing LR bombers interacted with the development of the bombing campaign in Europe, which will be discussed in another paper.

In the overall U.S. munitions program, aircraft production, particularly of long-range bombers, was prioritized based on U.S. military policies emphasizing strategic bombing. However, the requirements set by the military and the objectives outlined by the President were unfeasible from the economic standpoint of the WPB. Consequently, the WPB influenced munitions programs as much as possible, insisted on scaling down the production goals, and made necessary adjustments. Simultaneously, the WPB contributed to stabilizing aircraft production, including LR bombers, by addressing priority issues and creating an efficient distribution system for critical materials. The prioritization of LR bombers was particularly aligned with the expansion and diversification of bombing operations in Europe. However, it is important to note that the B-29 production, at least in its early phases, cannot be placed within the context of the relatively better situation for LR bomber production. The mass production of the B-29 was delayed, which also postponed the start of the bombing campaign against the Japanese mainland, known as MATTERHORN. Further details will be discussed in the next section.

4. Delay of the Production of the B-29 and Operation MATTERHORN

Beginning in June 1944, Operation MATTERHORN was a bombing campaign against Japanese-occupied East and Southeast Asia, as well as the Japanese homeland. The 20th Bomber Command, the primary force conducting MATTERHORN, established its headquarters in Kharagpur, India, and its attacking unit's outpost in Chengdu, China. While the straight-line distance from Chengdu to Fukuoka, Kyushu, is about 2,500 km (5,000 km round trip), the B-17's range was approximately 3,000 km and the B-24's approximately 4,500 km, making a round trip to Kyushu nearly impossible. In contrast, the B-29 had a range of 6,000 km, making it the only weapon capable of conducting bombing operations against Japanese homeland[78]. In other words, the development and mass production of the B-29 was the requisite for bombing Japanese homeland (whether the B-29s flew from Chengdu or the Mariana Islands).

However, it was not initially assumed that the B-29 would be used solely for bombing Japan. On the contrary, at the outset, VLR bombers such as the B-29 were expected to be deployed in the European theater, but the production situation did not permit their use

76 Until then, the AAF had officially conducted precision bombings, principally targeting military and industrial sites. By contrast, the Royal Air Force (British Air Force) conducted nighttime bombing operations against cities, that is, indiscriminate bombing. Schaffer [1985].

77 Monthly Report to the War Production Board, October 1943, Box 744.

78 For specifications of the bombers, see the website of the National Museum of the United States Air Force (https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/WWII-Gallery/; March 24, 2025).

Table 4: Delivery Numbers of B-29 for Each Factory

	Renton (Boeing)	Wichita (Boeing)	Marietta (Bell)	Omaha (Martin)	Sum for month
July, 1943	—	7	—	—	7
August	—	4	—	—	4
September	—	15	—	—	15
October	—	13	—	—	13
November	—	17	1	—	18
December	—	31	3	1	35
January, 1944	—	46	4	2	52
February	—	47	6	2	55
March	4	51	5	0	60
April	3	36	12	0	51
May	3	65	19	1	88
June	5	64	10	3	82
July	8	64	1	2	75
August	15	61	11	7	94
September	20	63	29	10	122
October	12	70	27	16	125
November	30	75	34	24	163
December	35	80	43	32	190
January, 1945	50	86	45	40	221
February	60	100	50	50	260
March	80	100	56	55	291
April	100	105	62	55	322
May	140	95	60	55	350
June	150	100	65	55	370
July	160	100	60	55	375
August	119	100	50	50	319
Sum	994	1,595	653	515	3,757

Source: Meulen [1995] p. 54.

against Germany. Development of a bomber superior "in all respects to the B-17B and B-24" began in November 1939. The VLR production goal was ambitious both before the U.S. entry into the war and during its early phases. As mentioned earlier, AWPD-1 envisioned 24 B-29 or B-32 (VLR) bombardment groups (BGs) and 44 BGs with a 4,000-mile radius to be ready (at that time, it was assumed that one VLR BG would consist of 28 VLR bombers; in fact, one VLR BG was authorized to have 45). This totaled 5,780 aircraft. The total B-29 production reached 3,757 actually. In November 1941, the production schedule aimed to establish a target of 1,000 LR and VLR aircraft per month, with 285 allocated for VLR (150 B-29s, 25 B-32s, and 110 B-33s) [79]. A year later, the 8-K schedule, effective November 1942, set a target of 700 B-29s for 1943. The 8-L schedule revised the B-29 production target downward to 361 B-29s[80]. In contrast, only 92 B-29s were produced in 1943,

[79] Sitterson, "Aircraft Production Policies," p. 100. Only the B-29 was actually mass-produced.
[80] Monthly Report to the War Production Board, December 1942, p. 30.

and it was not until November 1944 that the production of 150 B-29s per month was finally achieved (see Table 4).

The delay in VLR mass production critically impacted its deployment. The AWPD series outlined a strategy for the air war against Germany that planned to deploy most VLR units to the European theater. However, even in the latter half of 1943, when the AAF intensified the bombing campaign against Germany, B-29 production was lagging, with only an estimated 146 units produced by July 1943. As mass production of LR bombers succeeded, the use of scarce B-29s in Europe became less critical. In 1944, it was decided to focus B-29 operations exclusively against Japan, culminating in the launch of Operation MATTERHORN in June. How did the production situation influence the planning of the bombing campaign against Japan?

Beginning in March 1943, the U.S. military seriously considered a bombing strategy against Japan for the summer [81]. On August 20, AAF planners presented a memorandum titled "Air Plan for the Defeat of Japan" to the JCS, which was circulated to the British and U.S. Combined Chiefs of Staff (CCS) [82]. This plan proposed continuous bombing of industrial facilities on the Japanese homeland from bases in Mainland China. It assumed that 10 BGs (28 B-29s per group) would be operational by October 1944, with 20 groups by May 1945. While this assumption was more ambitious than reality, it was not as unrealistic as the AWPD series. The plan anticipated that 4 BGs (one bombardment wing, BW) would be ready by June 1944, aligning more closely with the actual production schedule.

Notably, C.C.S. 323 stated that a "minimum striking force of 100 B-29 airplanes is desirable to conduct effective strategic operations against Japanese mainland objectives[83]." This recognition indicated that meaningful results from strategic bombing could not be achieved without a sufficient number of B-29s. Therefore, mass production of the newly developed VLR bombers was essential for launching a strategic bombing campaign. Importantly, "sustained" bombing operations—emphasized by the title of the Joint Staff Planners' paper—were necessary, rather than isolated missions such as the Doolittle raid in August 1942.

In late 1943, JCS began developing more concrete plans for the strategic bombing of Japan. After discussions within the AAF, it was decided that forward bases in China would be located in Chengdu[84]. On November 9, Joint Staff Planners drafted a plan titled "Early Sustained Bombing of Japan," ultimately codenamed MATTERHORN. This plan anticipated the deployment of 150 B-29s (4 BGs) to Calcutta, from which operational forces would be transported to forward bases in Chengdu, China, by March 1944, with an additional 150 B-29s by September. The plan aimed to initiate the first attack "no later than April 1944 to be followed by a minimum of one mission per month of 100 aircraft each until September 1944[85]." However, there was not unanimous agreement on utilizing forward bases in China. In January 1944, the Joint Intelligence Committee (JIC) presented a paper titled "Optimum Use, Timing, and Deployment of V.L.R. Bombers in the War against Japan," which deemed a campaign against oil industries in Southeastern Asia from bases in Darwin or Broome, Australia, as the most desirable option. The second preference was attacks against Truk (now Chuuk Lagoon) or Palau from Port Moresby, followed by operations from Chengdu.

81 Craven and Cate [1983b:1953] p. 17.

82 C.C.S. 323, Air Plan for the Defeat of Japan, August 20, 1943, Reel 1 (R1), the Pacific Theater (PT), Records of the Joint Chiefs of Staff, part 1: 1942-1945 (RJCS pt. 1), microfilm, Meiji University.

83 C.C.S. 323, p. 5.

84 Craven and Cate [1983b:1953] pp. 17-22.

85 J.P.S. 320, Early Sustained Bombing of Japan, November 9, 1943, R1, PT, RJCS pt. 1.

In this document, JIC did not prioritize bombing the Japanese homeland, although it identified the Mariana Islands as the best forward bases when they became available[86].

Subsequently, Joint Staff Planners authored a paper of the same title (authorized as J.C.S. 742), suggesting that the Mariana Islands were the most suitable bases for bombing operations, though unavailable at the time. Given availability, potential operations included bombing the Kuril Islands from the Aleutians, targeting the Netherland East Indies (now Indonesia) from northwestern Australia or Ceylon, and conducting operations against the Korean Peninsula, Manchuria, and southern Japan, specifically Kyushu. The conclusion was as follows:

> A balancing of the factors of base availability, target nature, and B-29 capabilities indicates that the best initial use for this weapon is
> a. Against iron and steel in the form of coke ovens and shipping in congested harbors from available bases in China, and
> b. Against the petroleum refineries in the N.E.I., primarily those at Palembang, from bases in Australia or Ceylon.

J.C.S. 742 anticipated that the first 4 groups would be deployed by April 1944 and 10 groups by October. It assumed that the first phase of the campaign would involve four groups and that operations with fewer than four groups would adversely affect long-term effectiveness. It was affirmed that the "8-group MATTERHORN project has been assigned first priority on the highest level; hence, the first 8 groups must be allocated to MATTERHORN[87]."

As shown in Table 5, the Joint Staff Planners accelerated the schedule for the deployment of the first four B-29 groups, indicating that J.C.S. 742 was more ambitious than C.C.S. 323. C.C.S. 323, made in August 1943, projected that four groups would be available by June 1944, implying that operations would begin at that time. In contrast, J.C.S. 742 set the deployment date for the same forces to April 1944. Two factors likely influenced the Joint Staff Planners' decisions.

First, the production situation of the B-29s was a significant concern. As noted earlier, B-29 production was lagging, particularly in 1943 (see Tables 3 and 6), leading to the decision that B-29s would be deployed only in the Pacific theater. The cautious estimates in C.C.S. 323 likely reflected this challenging production environment. However, by early 1944, the WPB revised its VLR production estimates upward due to performance improvements in many factories. Specifically regarding VLR, a monthly report to the WPB noted that with the Seattle plant (that is Renton in Table 4) making good progress in B-17 production, "the switch-over to SUPERFORTRESS [B-29] production will be quickened and that schedule has been increased beginning late in 1944[88]." Notably, the Renton factory delivered the first 3 B-29s in March 1944, and the commencement of B-29 production at the Marietta and Omaha factories in late 1943 contributed to a more optimistic outlook.

The second factor appears to be more critical: President Roosevelt pressed the military to initiate MATTERHORN early. In the Pacific theater, there was an urgent need to support

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[86] J.I.C. 152/2, Optimum Use, Timing, and Deployment of V.L.R. Bombers in the War Against Japan," January 18, 1944, R1, PT, RJCS pt. 1.

[87] J.C.S. 742, Optimum Use, Timing and Deployment of V.L.R. Bombers in the War against Japan," March 2, 1944, R1, PT, RJCS pt. 1.

[88] The Monthly Report to WPB, March 1944, p. 12, Box 744.

Table 5: Schedule of the Deployment Numbers and Actual Number of the B-29 Groups

	C.C.S. 323 (Aug. 1943)	J.C.S. 742 (March 1944)	Actual Groups Deployed
April 1944	-	4	-
May	-	4	4
June	4	4	4
July	6	4	4
August	7	6	4
September	8	8	4
October	10	10	8
November	11	12	8
December	13	14	10
January 1945	15	16	12
February	16	18	14
March	18	20	16
April	19	22	16
May	20	24	18

Source: Reel 1, Pacific Theater, Records of the Joint Chiefs of Staff, part 1: 1942-1945; Office of Statistical Control, *Army Air Forces Statistical Digest, World War II*,1945, p. 11.

Table 6: Aircraft Production Estimates and Record for a part of 1944.

Type	January	February	April	May	December
All	107,000	107,813	106,426	10,3899	95,272
Combat		83,255	82,039	79,699	60,701
Bomber		40,721	38,996	38,342	35,008
LR		16,096	16,204	16,171	15,173
VLR	1,333	1,482	1,437	1,443	1,161

Source: Monthly Reports to the War Production Board.; Office of Statistical Control, *Army Air Forces Statistical Digest, World War II*, p. 112.

the Chinese to prevent their morale from deteriorating and to keep them engaged in the war against Japan. “So it was that the B-29s came to figure prominently in discussions both of long-term Pacific strategy and of immediate aid to China[89].” In this context, AAF planners scheduled operations to begin by June 1944. After consultations within the AAF, Henry Arnold asked Brigadier General Kenneth B. Wolfe, who “had earlier been responsible for the B-29 production program[90],” to review existing plans and prepare an operational plan. Wolfe established a timeline that set the first mission for June 1, 1944, in accordance with C.C.S. 323. However, this timeline was deemed too late to motivate the Chinese and thus “to comply with the President’s desire for an immediate show of force in China[91].” As a result, Wolfe moved D-Day to April 1, 1944, and Arnold even expedited the schedule by a month when he informed FDR about the plan in October 1943[92]. In this context, as men-

89 Craven and Cate [1983b:1953] p. 14.
90 Craven and Cate [1983b:1953] p. 20.
91 Craven and Cate [1983b:1953] p. 20.
92 Craven and Cate [1983b:1953] p. 21. FDR did not satisfy even with the accelerated schedule, suggesting the use of bombers other than B-29s, probably without fully considering the feasibility of operations.

tioned earlier, Joint Staff Planners developed the plan (J.P.S. 320) to commence operations "no later than April 1944," without regard for the B-29 production situation[93]. At that time, strategic planning was primarily influenced by political considerations rather than economic and strategic feasibility. J.C.S. 742, designated by the Joint Staff Planners, indicated that four VLR groups would be ready by April 1944, slightly more moderate than J.P.S. 320 but more ambitious than C.C.S. 323.

In this manner, political and diplomatic considerations dictated the "planning" of when and how VLR was used, rather than economic feasibility or strategic importance. However, it was the B-29 production situation that ultimately determined when and how the plan would be executed. It was not until June 1944 that the 20th Bomber Command could commence operations with a "minimum striking force of 100 B-29 airplanes." The first mission of the 20th Bomber Command was launched on June 5, 1944, targeting Bangkok with 112 B-29s (14 of which were aborted), followed by the first raid on the Japanese homeland on June 15 against the Imperial Iron and Steel Works at Yawata on Kyushu. In that latter mission, 68 B-29s took off, but only 47 reached the target, resulting in "only one direct hit on the iron and steel works[94]." The B-29s involved fell significantly short of the standard for a "minimum striking force." Although the number of attacking bombers was not the sole factor, the results of the June 15 attack were considered insignificant.

Subsequently, B-29 production stabilized and expanded from late 1944, although the initial objectives of that year were not achieved. By then, the aircraft industry had established mass production systems by creating an effective distribution network for raw materials and implementing efficient labor utilization policies. Furthermore, in the summer of 1944, production of LR was scaled down, and various resources were redirected to manufacturing the B-29[95]. These changes contributed to the mass production of the B-29, the newest weapon in the U.S. arsenal. Although the buildup of B-29 forces did not reach the levels anticipated in J.C.S. 742, by early 1945, with more groups deployed in the Mariana Islands, the AAF was able to conduct area bombing operations targeting cities, including the Tokyo air raid on March 9-10, 1945[96]. The subsequent buildup of VLR bomber forces allowed for diversified operations, including mining operations in Japanese waters, tactical support for the invasion of Okinawa, ongoing precision bombing of the Japanese aircraft industry, and nighttime precision bombing of the oil industry using newly developed radar equipment[97]. Overall, wartime economic conditions dictated how the United States conducted World War II.

Conclusion

This article examined the interaction between wartime economy and the planning and execution of military strategies in the United States during World War II, demonstrating that the production status of B-29 bombers, essential for strategic bombing operations against the Japanese mainland, significantly influenced the timing and methods of such

93 See note 85.
94 Craven and Cate [1983b:1953] pp. 95-96, 100-101; Correll [2009] p. 63.
95 Wilson [2016] p. 157.
96 Fujita [2021]; Fujita [2024].
97 Ultimately, the 21st Bomber Command comprised 23 bombardment groups, totaling over 1,000 B-29s.
Thanks to the new AN/APQ-7 radar system, the 21st Bomber Command was able to conduct nighttime precision bombing operations against oil-related targets in Japan. See Fujita [2024].

operations.

Initially, prior to the U.S. entry into the war, strategic bombing operations targeting Germany (and Japan) using LR bombers, as exemplified by AWPD, were prioritized. These strategic objectives informed military calculations regarding necessary resources, leading to production plans and President FDR's aircraft production targets. However, these plans were deemed unrealistic from an economic perspective by the WPB. Within its authority, the WPB worked to make these unattainable plans as feasible as possible, exerting influence to prioritize aircraft production and ensure effective allocation of critical resources, thereby establishing a functional aircraft production system. While a detailed examination is warranted, the WPB may have directly and indirectly contributed to the relatively stable production of LR bombers amidst overall delays in aircraft production.

Conversely, the establishment of a mass production system for the new B-29 bomber faced delays, which had decisive impacts on the operational timing and scale of MATTERHORN, a strategic bombing campaign against Japan. This delay, combined with the solid production of B-17 and B-24 bombers, led to the decision to deploy the B-29 exclusively against Japan. During the early planning stages for bombing campaigns against Japan, the operation's start date, reflecting delays in B-29 production, was set for June 1944—a timeline that aligned with reality. However, political and diplomatic considerations from FDR necessitated visible support for China in the Pacific theater, prompting the advancement of D-Day during the winter of 1943–1944. Military planners understood that sustained bombing operations required a sufficient number of bombers for effectiveness. Ultimately, MATTERHORN commenced on June 5, 1944.

This discussion underscores the importance of incorporating various factors (economic, scientific, and technological) that enabled strategic bombing operations into the overall narrative. Such factors are not exclusive to U.S. operations during World War II. Strategic bombing continues to be conducted after the war, as military historian Tami D. Biddle noted,

> Through more than eighty years and the experiences of World War II, Korean, and Vietnam, the underlying philosophy and central implementing ideas of strategic bombing have changed remarkably little. The *tools* of air warfare have changed dramatically…but it is striking just how little the basic ideas behind the *use* of those tools have changed[98]. (emphasis original)

Why have military actions defined as strategic bombings been adapted despite much criticism against them? To answer this question, one method is to elucidate the factors enabling their execution. The cheaper and technologically easier it becomes to implement strategic bombing, the more likely it is to be carried out. This point will be discussed in another paper.

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98 Biddle [2002] p. 300.

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