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Out of the Air: The Role of Communications Intelligence in the Strategic Bombing Campaign Against the German Oil Industry and Transportation System in World War II

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OUT OF THE AIR:
THE ROLE OF COMMUNICATIONS INTELLIGENCE
IN THE STRATEGIC BOMBING CAMPAIGN
AGAINST THE GERMAN OIL INDUSTRY AND TRANSPORTATION SYSTEM
IN WORLD WAR II
by
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A Thesis submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
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Approved by:

Carl Boyd (Director)
ABSTRACT

OUT OF THE AIR:
THE ROLE OF COMMUNICATIONS INTELLIGENCE
IN THE STRATEGIC BOMBING CAMPAIGN
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IN WORLD WAR II

Darrell Nolen
Old Dominion University, May 1995
Director: Dr. Carl Boyd

During World War II communications intelligence (ULTRA) was used to evaluate the effectiveness of the Allied strategic bombing campaign against the German oil industry and transportation system. In the case of the oil campaign communications intelligence provided confirmation of serious damage inflicted on the German war economy. This conformed nicely to the prewar American doctrine of precision daylight bombardment of critical nodes of an enemy industrial system. The intention of this policy was to cause the collapse of the enemy’s military capability. The campaign against the German transportation system did not fit into this doctrinal framework as precisely; consequently, it did not enjoy the same high level of advocacy among high level decision-makers. As a result fewer intelligence assets were dedicated to analysis of available ULTRA information on dislocation of German transportation. The focus of British air power doctrine was area bombing of German cities. Communications intelligence provided little help in evaluating the effectiveness of the area bombing campaign. Microform ULTRA intercepts were used as primary resources in the writing of this paper.
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CHAPTER 1
INTRODUCTION

During World War II intelligence derived from interception and exploitation of enciphered Axis communications, often referred to as communications intelligence (COMINT), or ULTRA, provided the Allies with remarkable advantages. It played important roles in the Battle of the Atlantic against German U-boats, in the American submarine campaign against Japanese merchant shipping, and in numerous land campaigns. ULTRA was also used to evaluate the effectiveness of the Allied strategic bombing offensive against German industry, the chief concern here under investigation.

The strategic bombing offensive against Germany in World War II has long been a source of controversy. Critics have painted it as inhumane and wasteful in assets; furthermore, the critics assert that strategic bombing was not a decisive instrument of policy. Strategic air power advocates maintain that the bombing offensive would have been more effective (even decisive) had Allied decision-makers not been distracted by "panacea" targets and peripheral (i.e., non-strategic) campaigns, such as the attacks on U-boat operating bases and building yards, the V-weapon launching sites, the German aircraft industry, and carpet bombing operations in support of ground forces.

Despite this controversy, there were two unequivocal examples of
strategic bombing's capability to achieve decisive disruption of the German economy. It can be said without reservation that the "oil campaign," which began in May 1944, and the "transportation campaign," as it was carried out after September 1944, had a greater effect on reducing the German economy's ability to support the war effort than any other element of the strategic bombing offensive.

Communications intelligence played an important role in the evaluation of the effectiveness of the oil campaign as it was conducted by the Allied strategic air forces. This ULTRA intelligence was highly reliable, and it clearly indicated that the oil campaign was severely hurting the Germans in a vulnerable sector of their wartime economy. The recognition of the success of the oil campaign made possible by ULTRA influenced the decision to concentrate sufficient assets against the German oil industry on a prolonged and sustained basis. This constant and unrelenting pressure prevented the Germans from restoring their oil production capability. The resulting shortage of fuel and other products derived from oil severely curtailed the operational flexibility of the Wehrmacht.

The role of ULTRA in evaluating the effectiveness of the strategic bombing campaign against the German transportation system was not so clearly apparent as in the oil campaign, especially in its initial stages. In large part this was due to the fact that the German transportation network was a much more extensive and robust "target system" than the oil industry, with more inherent redundancy. Furthermore, it was much harder to assemble the multitude of fragmentary evidence of damage to small links in the transportation system into a coherent picture and to visualize the overall
impact of the incremental disruption of German transportation capability. It was only in the closing stages of the transportation campaign that intelligence derived from communications intercepts was able to recognize clearly the progress strategic bombing had made in disrupting the German economy through its attacks on transportation targets.

Raw ULTRA intercepts in the Old Dominion Library microform collection were used as primary sources in the writing of this paper. Comparison of these intercepts with histories of the strategic bombing campaign against Germany refined and focused previous understanding of this subject. This allowed the development of insights on the use of communications intelligence from two perspectives. First, ULTRA intercepts provided a straight-forward means of assessing the effects of strategic bombing. Second, the level of receptivity of decision-makers to this source of intelligence depended on how closely the type of target being attacked conformed to existing doctrine. When there was a mismatch between target systems being attacked and doctrine, ULTRA intelligence was often discounted, as in the British area bombing campaign. When there was a close match between doctrine and target system, as in the oil campaign, ULTRA intelligence was considered carefully and played a key role in decision-making.
CHAPTER 2
THE DOCTRINAL BACKGROUND OF STRATEGIC BOMBING

Prior to World War II prophets of air warfare predicted that strategic air bombardment of an enemy's homeland would in itself be a decisive instrument of war that would obviate the need for a land or naval campaign. The Italian Giulio Douhet in his 1921 book Command of the Air presented one of the earliest treatises on this subject. British Air Marshal Hugh Trenchard and American Brigadier General Billy Mitchell were also early proponents of strategic bombing. The underlying assumption was that air power could destroy critical industrial chokepoints, irreplaceable production facilities, and psychologically vital targets, whose loss would deprive the enemy of the means and will to continue to fight.¹ In a clean, quick, surgical campaign, the enemy would be defeated without recourse to a long, drawn out, bloody war of attrition as had occurred in World War I.²

This belief in the efficacy of a "knockout blow" was incorporated into the doctrine developed by the US Army Air Corps Tactical School in the 1930s. It was strongly evident in the US Army Air Force's Air War Plans Division Plan 1 (AWPD 1) of September 1941, which became the basis of the US strategic air campaign against Germany. This document was written to estimate the


aircraft production requirements necessary for the coming war, but its creators went beyond this limited goal and outlined a strategy spelling out the most effective use of those aircraft. AWPD 1 prioritized the critical target systems in Germany as (1) the electric power grid, (2) the transportation network, and (3) the oil sector. Fifty targets were identified as critical to the electric power system, twenty-seven to the oil industry, and forty-seven to the transportation industry. However, it was realized that to accomplish the destruction of these objectives, it was first necessary to neutralize the Luftwaffe fighter defense force.

The role of intelligence in supporting the development of AWPD 1 was to provide a basic background on the German economy and air defense capability. Most of this intelligence was derived from (1) publicly available economic information, (2) interpolation based on American industrial models, (3) information provided by the British, and (4) reports produced by American defense attachés stationed in Germany prior to the outbreak of war. Communications intelligence played no role in the process of developing AWPD 1 because the plan’s originators did not have access to this sensitive source.

The next iteration of this plan (AWPD 42) maintained the overall thrust of the original plan, but added submarine building yards as the top priority

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5Ibid., 181.
target system. When AWPD 42 was written in September 1942 German U-boats were inflicting tremendous losses on Allied shipping; placing the U-boat building yards and operating bases as the top priority target was an expedient way of dealing with this crisis. Transportation was the second priority, electric power third, and oil fourth. Aluminum and synthetic rubber plants were added as the fifth and sixth priority objectives.\(^6\)

By September 1942 American planners gained access to British wartime intelligence. This included a great deal of aerial reconnaissance photography. Communications intelligence had not yet emerged as an important element in the targeting and bomb damage assessment process.

The British never defined a strategy to use their air power as clearly as the Americans, who focused on attacking the physical aspects of enemy war capability. The British held a somewhat vague belief in the 1930s that air bombardment would undermine the morale of the enemy population; this was very much in keeping with Douhet's theories. This tendency was reinforced by the generally-held view that it was the collapse of civilian morale that caused the capitulation of Imperial Germany in 1918.\(^7\) In a future war against Germany, a bombing campaign would augment and accentuate the maritime blockade, thus hastening economic collapse.

The joint American/British plan for the Combined Bomber Offensive agreed to in Casablanca in January 1943 shuffled the target priorities specified in AWPD 1 and AWPD 42. Many additional objectives were added

\(^6\)Ibid., 105.

due to the influence of new players in the air strategy formulation process. In the opinion of the original planners, this weakened the thrust of the strategic bombing campaign. The list of objectives for the Combined Bomber Offensive formulated at Casablanca was as follows: (1) the German aircraft industry, (2) ball bearings, (3) oil, (4) grinding wheels and crude abrasives, (5) non-ferrous metals, (6) synthetic rubber, (7) submarine building yards and bases, (8) military motor transport, (9) transportation, (10) coking plants, (11) steel, (12) machine tools, (13) electric power, (14) electrical equipment, (15) optical precision instruments, (16) chemicals, (17) food production, (18) nitrogen, and (19) antitank and antiaircraft artillery factories.8

The belief in the independent war-winning potential of the strategic bomber continued to be emphasized in the initial phases of the Combined Bomber Offensive, at least by the “bomber barons” of the US Army Air Forces. General Frederick Anderson, commander of the Eighth Air Force Bomber Command, optimistically stated in July 1943 that his command was

destroying and [would] continue to destroy the economic resources of Germany to such an extent that [he] personally believed no invasion of the Continent or Germany will ever take place, with the consequent savings of thousands and possibly millions of lives.9

This belief in the efficacy of strategic air bombardment became a rally point for the US Army Air Forces. In order to make this philosophy a reality, bomber commanders tried to adhere closely to the concept of using air power only against strategically significant targets. These bomber commanders resented

8Hansell, Air Plan, 158.

the siphoning off of strategic air power by ground commanders interested in tactical support to land operations. This made it more difficult for the air commanders to achieve their goal of demonstrating air power's decisiveness.

In effect, the intent was to conduct a type of economic warfare, similar in its goals to maritime blockades in the past. The doctrine of strategic bombing was based on the premise that the enemy civilian population and factories were the weak links of a nation's war-making capability, and the premise that bombers could destroy the industrial base of an enemy country.10

The Combined Bomber Offensive consisted of a British and an American component. The British had suffered heavy losses during daylight operations in the early months of World War II; they quickly shifted to night operations to improve bomber survivability.11 Because of limitations in navigation, training, and poor weather, the night campaign was initially ineffective. These factors made it difficult to locate precise targets.

Consequently, the Royal Air Force's Bomber Command settled on a policy of area bombing, in which entire cities were the target. The intention of area bombing was to destroy cities, thereby eliminating whatever industry was within them, as well as killing critical industrial workers whose skills would be hard to replace. It was also believed that the unrelenting punishment inflicted upon German cities by this policy would undermine morale "until the enemy became a nation of troglodytes, scratching in the

10ibi., 3.

ruins," in the words of military historian Max Hastings. These night raids killed between 200,000 and 600,000 German civilians and burned out most of the urban centers of their country during the years 1940 to 1945. But in the opinion of Noble Frankland, one of the most objective air power historians, area bombing never achieved the goal of breaking German morale; nor did it substantially reduce German war production. This judgment is echoed by some German historians. That German morale was never broken is probably due to the resilience of the German people and the power of the German police system. On the other hand, while German morale did not break, individual productivity of workers was certainly degraded, and much greater levels of efficiency could have been achieved had there been no bombing campaign.

For the first three years of Bomber Command's campaign against Germany, ULTRA provided little useful information. This was due to the fact that so little damage was being done by the British bombers that it was not noteworthy enough to be discussed in German radio communications. This is not to say that the British bombing effort was of no value. Having no other way to strike directly at the Germans, the British bombers carried the war


to the enemy while demonstrating (after June 1941) to the Russians that they were contributing to Hitler’s defeat.

The American contribution to the Combined Bomber Offensive was precision daylight bombing of critical industries. The US Army Air Forces relied on the theory that mass formation daylight raids using the Norden bombsight would achieve “pickle barrel” accuracy against German targets. AWPD 1 and its successor plans went so far as to calculate the quantities and types of bombs necessary to achieve the desired levels of destruction. The planners also calculated the time necessary to accomplish the intended goals.17 The American air forces relied on strongly-built, well-armed bombers (epitomized by the B-17 “Flying Fortress”) to penetrate German defenses. Invulnerability was to be achieved through speed, ability to fly above antiaircraft ceilings, and use of a heavy defensive gun armament to ward off fighter attack.18 There was a school of thought that believed “the bomber will always get through,” exemplified by an Army Air Corps Tactical School instructor’s opinion that “a well-planned and well-conducted bombardment attack once launched, cannot be stopped.”19 Aviation historian James L. Cate saw an indirect cultural influence behind this faith in technology and in a new form of warfare. He attributed it to the “American tradition of expert marksmanship” and an ethical “distaste for indiscriminate bombing of civilian

17Hansell, Air Plan, 105; Michael Knight, Strategic Offensive Air Operations (London: Brassey’s, 1989), 23.


19Hansell, Air Plan, 105.
areas."20

The American strategic bombing offensive got off to an inauspicious start. The first use of American B-17s was in minor raids against targets in occupied France. A campaign against submarine pens along the French coast and submarine building yards in northern Germany accomplished little.21 By August 1943, the Eighth Air Force, flying from English bases, was ready to conduct deep raids into Germany in order to hit more critical targets. However, Luftwaffe fighter defenses proved too formidable for unescorted bomber formations to operate over Germany. In the August and October 1943 raids against the German ball bearing industry, production was temporarily reduced by 65 percent, but the bombers suffered unacceptable losses (up to 20 per cent).22 By the end of 1943 ball bearing production was back up to its normal levels. A campaign against the German aircraft industry begun in the summer of 1943 was also relatively unsuccessful in terms of its long-term effect on the German war economy. Hitler's Minister of Armaments and War Production, Albert Speer, attributed the lack of effectiveness of the attacks on the German aircraft industry to targeting the wrong sector of that industry. He said that

the enemy always demonstrated a lack of consistency; he switched from target to target or attacked in the wrong places. In February 1944 he bombed the enormous airframe factories of


the aircraft industry rather than the engine factories, although the most important factor in airplane production was the number of engines we were able to turn out. Destruction of the plants making these would have blocked any increase in aircraft manufacture, especially since, in contrast to the airframe plants, engine factories could not be dispersed among forests and caves.23

Speer recognized that the initial failure of the American bombing campaign was due to two primary faults: poor target selection and a failure to put heavy enough pressure on a vital sector over an extended period of time. These faults would be rectified in the oil campaign and to a lesser extent in the transportation campaign.

CHAPTER 3
THE OIL CAMPAIGN

By May 1944, the commanders of the Allied strategic air forces decided that their previous efforts against German industry were not having the desired effect. At this time several key American commanders and the specialized experts advising them began to advocate that the German oil industry be massively and consistently targeted. Among those advocating the oil campaign was a group of civilian economic experts organized in London as the Enemy Objectives Unit (EOU) of the Economic Warfare Division of the US Embassy. The committee’s task was to use these experts’ “knowledge as economists of the structure of production to develop and apply criteria for the selection of one target system versus another.” The EOU believed that the German oil industry was the most lucrative target for the strategic bombing campaign. This view was shared by General Carl A. Spaatz, the commander of the US Strategic Air Forces in Europe. However, when Spaatz proposed this plan to General Dwight D. Eisenhower (Supreme Allied Commander in Europe) for approval, Air Chief Marshal Arthur W. Tedder (Eisenhower’s Deputy for Air) opposed it. Tedder preferred to concentrate instead on bombing European railroad marshalling yards and other transportation targets. Eisenhower initially accepted Tedder’s viewpoint on the grounds that interrupting rail traffic and other lines of communications would help prevent the Germans from reinforcing the Normandy area. This policy would directly

support Operation Overlord, the upcoming invasion of northern France. However, Spaatz’s persistence finally won permission from Eisenhower for a limited campaign against oil targets.2

The German oil industry had been recognized as a critical target in AWPD 1, and sporadic attacks had been conducted as early as the Ploesti (Rumania) raid of August 1943. However, it was not until May 1944 that the German oil industry was systematically targeted. Allied intelligence on German oil facilities was incomplete. Estimates were based mainly on information obtained from open-source German publications and through evaluation of photo-reconnaissance imagery. COMINT was still very sparse in regard to the oil industry and at best contributed only indirectly to an understanding of this critical sector of the German war economy. Now and again, however, interception and decryption of enemy communications would provide an insight. An example of the indirect nature of the COMINT of this period was an intercept of a 30 March 1944 message from the Japanese naval attaché in Berlin reporting that the Allied attacks on the aircraft industry was having little effect on production, and that synthetic oil plants (“an obvious target”) had not yet been attacked, “perhaps because the plants were widely dispersed.”3 A somewhat more solid indication of the critical importance of oil was an intercept which originated from the Quartermaster General of the German High Command (OKW) on 13 December 1943.

At a decisive hour, we will not be able to move either our tanks or our fast units if there is no motor fuel. The motor fuel

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situation is serious. In 1944 it may become still more serious. Restrictions have to be imposed in January [1944]. It is impossible to give more [fuel] than there is.4

This dire prediction of the consequences of a fuel shortage influenced Allied planners and decision-makers to focus their attention on the German oil industry. Communications intelligence confirmed the earlier identification of the oil industry as a critical node of the German war economy which was susceptible to massive disruption. This opportunity conformed to the American doctrine of using air power against vital physical targets in an enemy’s economy. Consequently, American decision-makers in control of bomber assets were receptive to this sort of intelligence.

The Allied target list for the German oil industry included eighty-one facilities at the beginning of the campaign. An additional fifty-four facilities were added during the course of the campaign, but most of the later additions were minor storage sites.

Approximately ninety percent of German oil production was concentrated in fifty-four large refineries and synthetic oil plants. In March 1944 the total German oil production capability (including imports from Eastern Europe) was 968,000 tons per month. The sources of production are given in Table 1.

Crude oil refineries were concentrated in three main areas: at Ploesti, in northwest Germany at Hamburg and Hanover, and at Vienna and Budapest near the Austrian and Hungarian oilfields. Refined mineral (crude)
oil accounted for 44 percent of the oil available to the Germans. The natural oil refineries were relatively small and thus harder to hit, but they were critically important because they made all of Germany's lubricating oil in addition to motor fuel.5

Table 1

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<th>German Synthetic Oil Production</th>
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<tr>
<td>341,000 tons</td>
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<tr>
<td>Bergius and Fischer-Tropsch synthetic plants</td>
</tr>
<tr>
<td>201,000 tons</td>
</tr>
<tr>
<td>other synthetic plants in Germany</td>
</tr>
<tr>
<td>191,000 tons</td>
</tr>
<tr>
<td>domestically refined from crude oil</td>
</tr>
<tr>
<td>49,000 tons</td>
</tr>
<tr>
<td>produced in occupied countries</td>
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<tr>
<td>186,000 tons</td>
</tr>
<tr>
<td>imported from Hungary and Rumania</td>
</tr>
<tr>
<td>968,000 tons</td>
</tr>
<tr>
<td>Source: Alan J. Levine, The Strategic Bombing of Germany, 1940-1945 (Westport, CT: Praeger, 1992), 144.</td>
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The remaining 56 percent of oil production was obtained by synthetic processing using coal as a raw material. The primary concentrations of these synthetic oil facilities were near the coalfields of the Ruhr, around Leipzig in central Germany, in Upper Silesia, and in Czechoslovakia. There were eighteen plants that used the Bergius hydrogenation process; these were the most important sources of Germany's fuel. In the Bergius process the complex carbon molecules of coal are split under high pressures (4,000 pounds per square inch) and high temperatures (850 degrees Fahrenheit). Catalysts such as molybdenum oxides are used to force hydrogen (obtained from coke in water-gas generators working at pressures of 3,000 to 10,000 pounds per square inch) to react with the solid coal molecules to form liquid hydrocarbons. Large, heavy compressors and reactor vessels are required, the manufacture of which is comparable to manufacturing naval guns. In the Fischer-Tropsch process, molecules of hydrogen and carbon monoxide, 

obtained by heating coal with steam until it breaks down molecularly, are re-synthesized under much lower pressures; however, intricate and complicated apparatus is required. Both processes essentially liquify coal by super-enrichment with hydrogen. The Bergius plants provided approximately 35 percent of all liquid fuels and 90 percent of all aviation grade gasoline. Two mainplants (Merseburg-Leuna, near Leipzig, and Pölitz, near Stettin) accounted for one third of Bergius production, each producing approximately 600,000 tons per year (i.e., 50,000 tons per month). The Bergius facilities were good targets for strategic bombing because they covered large areas, and they were usually in rural areas; this made them easy to locate either visually or by radar. They were also very vulnerable to bomb damage. The Bergius plants also produced by-products (nitrogen, methanol, etc.) which were essential for making synthetic rubber, explosives, fertilizers, and other chemical products.

There were nine plants using the Fischer-Tropsch synthetic process, but they produced only low-grade fuels. All but three of these plants were in the Ruhr. There were also more than eighty small benzol plants which processed coke by-products to produce low-grade fuels and small amounts of aviation gasoline. Most of these plants were in built-up urban areas. The oil campaign began in earnest on 12 May 1944, when 935 Eighth Air Force bombers struck Merseburg-Leuna and six other synthetic plants in central Germany at Zwickau, Brüx, Lützkendorf, Böhlen, Zeitz and Chemnitz. All the

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6US Strategic Bombing Survey, Oil Division, Final Report, 10-11, 16.
7Levine, Strategic Bombing, 144
8Ibid., 145.
9Murray, Luftwaffe, 258.
targets were damaged, some very heavily. Brüx, Böhlen, and Zeitz were temporarily knocked out of production. In a fortunate coincidence, a heavy water plant at Merseburg-Leuna, involved in Germany's atomic bomb project, was destroyed.\textsuperscript{10} This stroke of luck was discovered through the US Strategic Bombing Survey's comprehensive examination of the Merseburg-Leuna plant after the German defeat. The other component of the US Strategic Air Forces in Europe, the Fifteenth Air Force in Italy, had been attacking the Ploesti refineries since 5 April 1944. The nearby marshalling yards were used as aimpoints to avoid violating Eisenhower's directive to concentrate on transportation targets.\textsuperscript{11}

It was immediately apparent from ULTRA intercepts that this attack and subsequent ones had finally struck a German nerve. In relation to the strategic bombing campaign, this was the juncture where communications intelligence came into its own. From this point ULTRA consistently provided unambiguous intelligence on the effectiveness of bombing against oil facilities. Furthermore, it revealed the impact that the damage done to these facilities was having on the overall German war effort.

Supreme Court Associate Justice Lewis F. Powell, who was an ULTRA intelligence officer during World War II, stated in an interview in 1987 that we usually had damage assessment reports from ULTRA following an attack. We would get a report on bomb damage, usually the day after the attack. I remember one from Leuna [sic] advising Speer that we had reduced its capacity to some 12 to 15 percent, and that it would be six weeks before they could get production back to a significant level. The great beauty of this


\textsuperscript{11}Rostow, "Waging Economic Warfare," 38.
was that we knew when to attack again.  

Powell also recalled that the Allies very quickly realized the significance of these operations. In the same interview, he stated that “we knew almost as soon as Albert Speer did that we had found the vital organ of the German economy in the synthetic oil plants.”

Speer stated in his 1970 book Inside the Third Reich that the campaign against the oil industry was the crucial factor in the defeat of Germany. In his opinion,

the technological war was decided on 12 May 1944 when 930 American bombers struck several fuel plants in eastern and central Germany. Until then we had managed to produce approximately as many weapons as the armed forces needed, in spite of their considerable losses. [The attack on the fuel sector] meant the end of German armaments production.

Speer recognized the significance of the attack on Germany’s oil industry and described the consequences of this development to Hitler on 19 May 1944:

The enemy has struck us at one of our weakest points. If they persist at it, we will soon have no fuel production worth mentioning. Our only hope is that the other side has an Air Force General Staff as scatterbrained as ours.

Speer detailed the specific level of damage to the German oil industry as follows: “After this attack [on 12 May 1944] our daily output of 5,850 metric tons dropped to 4,820 metric tons.”


13Ibid., 40.

14Speer, Inside the Third Reich, 412-13.

15Ibid., 413.

16Ibid.
The German armed forces were also acutely aware of the danger. A Luftwaffe report acquired by the US Strategic Bombing Survey after the war stated that

the greatest danger lies in the threat to the fuel supply. Here the destruction of a relatively limited number of targets would result in completely paralyzing the German Air Force, all motorized units, the military and civilian means of transportation, and the Navy.17

Allied intelligence officers received a variety of ULTRA intercepts confirming the impact of the reduction in German oil production capability. On 16 May 1944 an ULTRA intercept revealed that major revisions to antiaircraft defenses were being made. Four heavy and four light or medium flak (i.e., antiaircraft artillery) batteries from Luftflotten 1 and 6 (Air Fleets 1 and 6), previously intended to reinforce German defenses in France, were rerouted to defend the hydrogenation plant at Tröglitz. Furthermore, four heavy flak batteries defending aircraft factories at Oschersleben, Leipzip-Erla, and Weiner Neustadt were ordered to move to defend other synthetic fuel plants.18 The Germans were expecting the Allies to open a Second Front in France at any time, and the aircraft factories were of obvious long-term importance to the German war effort. It was a key revelation that the Germans regarded protecting the oil facilities as more important than reinforcing France or defending the aircraft factories at this critical time.

On 21 May 1944, another ULTRA intercept revealed that an unidentified authority on the 19th of June had ordered that


18PRO DEFE 3/156, KV4021, 16.5.44., 0558Z, quoted in Murray, ULTRA: Some Thoughts, 59.
consumption of mineral oil in every form [must] be substantially reduced ... in view of effects of Allied action in Rumania and on German hydrogenation plants, [and] extensive failures in mineral oil production, a considerable reduction in the June allocation of fuel was to be expected.19

ULTRA intercepts thus provided a clear and unambiguous picture of the effectiveness of the oil campaign shortly after it was initiated. The effects of the oil campaign obviously were having a direct effect on the German military. This was exactly what the American doctrine of precision daylight bombing had predicted.

Poor weather and commitment to attacking targets in support of the upcoming Normandy invasion prevented a resumption of attacks on the synthetic oil plants in Germany until 28 May 1944, when the Eighth Air Force sent 1,282 bombers against five oil targets in Germany.20 The Luftwaffe strongly opposed this raid; this provided further evidence of just how sensitive these facilities were to the Germans. On 29 May 1944 the primary objectives for most of the bomb groups of the Eighth Air Force were aircraft plants, but 224 B-24s hit and heavily damaged the Pölitz synthetic plant; this was the first time this facility had been attacked.21 In the meantime, the Fifteenth Air Force continued to attack Ploesti, with strikes on 5 May, 31 May, and 6 June 1944. Speer described the effects of these raids in his memoirs as follows:

On 28-29 May 1944, 400 Eighth Air Force bombers hit oil targets in eastern and central Germany again, while Fifteenth Air Force

19ULTRA: Secret German Messages from World War II (Old Dominion University Library; Bethesda, MD: University Publications of America, 1987, text-microform), reel 21, CX/MSS/T191/74, 212054Z/5/44.

20Levine, Strategic Bombing, 146.

21Craven and Cate, Army Air Forces 3:178.
bombers hit the Rumanian oil fields at Ploesti; overall production was reduced by half.\textsuperscript{22}

Germany's oil industry was dealt a severe blow by these first few raids. The Germans certainly understood the "handwriting on the wall," and ULTRA was the key which allowed the Allies to read that handwriting.

ULTRA intercepts immediately revealed the effectiveness of these strikes. A message sent by the Luftwaffe High Command (OKL) on 5 June 1944 reported that

as a result of renewed interferences with production of aircraft fuel by Allied actions, most essential requirements for training and carrying out production plans can scarcely be covered by the quantities of aircraft fuel available. Baker four allocations only possible to air officers for bombers, fighters and ground attack, and director general of supply. No other quota holders can be considered in June. To assure defense of Reich and to prevent gradual collapse of German Air Force in east, it has been necessary to break into OKW reserves. All units are to arrange operations so as to manage at least until the beginning of July with permanent stocks or small allocation which may be possible. Date of arrival of quantities available for adjustments, provided Allied situation remains unchanged. In no circumstances can greater allocations be made. Attention again drawn to existing orders for most extreme economy measures and strict supervision of consumption, especially for transport, personal, and communications flights.\textsuperscript{23}

This intercept revealed that non-vital flight operations were being curtailed. Operations by fighters, bombers, ground attack planes, and supply aircraft were not effected yet.

On 8 June 1944 the Chief of the British Air Staff, Marshal of the RAF Sir Charles Portal (who clearly recognized the significance of this piece of intelligence), attached a note (quoted below) to a transcript of the ULTRA

\textsuperscript{22}Spee, Inside the Third Reich, 415.

\textsuperscript{23}PRO DEFE 3/166, KV6673, 6.6.44, 2356Z, quoted in Murray, ULTRA: Some Thoughts, 59.
decryption of the 5 June OKL message, and sent it to Prime Minister
Winston S. Churchill. Portal recommended concentrating on the oil targets,
largely on the basis of this ULTRA intelligence.

I regard this as one of the most important pieces of information
we have received. On the strength of it the Chiefs of Staff have
asked for a completely up-to-date appreciation from the JIC
[Joint Intelligence Committee] and the oil experts. I think there
is little doubt that in the light of this appreciation the strategic
bombers should be turned over to synthetic oil plants as soon as
OVERLORD can spare them. I think it would be wrong to attack
these targets piecemeal with small forces over a long period. I
shall suggest that we wait a little and then choose a period of
fair weather to concentrate the whole force on these targets.24

This note is perhaps the strongest available testimony of the direct
persuasiveness of communications intelligence on Allied decision-makers. It
is quite obvious that Portal implicitly trusted this source of information. In
contrast, other British officers did not recognize the importance of the oil
campaign. Consequently, the weight of the British night bombing effort
continued to be directed against German morale.

Photo-reconnaissance provided complementary intelligence which
confirmed the ULTRA-derived assessment of the effects of bombing.
However, photo-reconnaissance was often handicapped by poor weather and
at times could not photograph targets immediately after they were bombed.
In some cases the Germans were able to conceal the damage to targets prior
to their being photographed.

The intelligence derived from ULTRA intercepts (and confirmed by
photo-reconnaissance) was convincing enough to Allied intelligence officers
that the JIC issued a report on 27 May 1944:

24Dir/C Archive, 6715 of 8 June 1944, quoted in Hinsley, et al., British
Intelligence 3 (2):502.
Although it is impossible to be precise on the time factor, we feel convinced that there is now sufficient evidence to justify the conclusion that a concerted and successful attack on German sources of oil production would, within a period of from 3-6 months, produce a shortage of oil so serious that it would render it impossible for her to carry out full operations on three major fronts. Both in the short and the long term, oil has therefore become a vital factor in German resistance.25

This military estimate, though somewhat qualified in its terminology, synthesized the available intercepts to arrive at an optimistic conclusion. Although German military operations did not grind to a halt within three to six months, the general trend of a decline in German capabilities due to fuel shortages was forecasted accurately. This type of intelligence prediction provided operational commanders the input necessary to guide their force allocations.

The oil campaign had a direct impact on the success of Operation Overlord, the invasion of Normandy on 6 June 1944. Fuel shortages, combined with the destruction of German lines of communication, greatly restricted German mobility. The overall commander of German forces in France, Field Marshal Gerd von Rundstedt, observed that “the crisis in the fighting [in Normandy] had been exacerbated by ammunition and fuel shortages.”26

The recognition of the success achieved by the heretofore limited effort against the German oil industry prompted the Allied military commanders to expand the efforts of the Eighth and Fifteenth Air Forces. On 8 June 1944 Spaatz directed that the oil facilities were to be the first priority targets for

25CAB 121/418, JIC (44) 218(0) of 27 May 1944, quoted in ibid., 501-02.

26ULTRA: German Secret Messages, reel 35, CX/MSS/T219, 149, 140255Z/6/44.
the US Strategic Air Forces in Europe. The evidence of American success also prompted the British Air Staff to bring RAF Bomber Command into the effort against ten synthetic oil plants in the Ruhr which produced thirty percent of German synthetic oil. The chief of Bomber Command, Air Marshal Sir Arthur T. Harris, was unenthusiastic about the oil campaign. His attitude was typical of British bomber thinking during this period. However, by mid-June 1944 Bomber Command began limited strikes against oil targets. The first large-scale RAF raids against synthetic oil targets in the Ruhr occurred on 12-13 June 1944. An ULTRA intercept confirmed that this raid had put the Gelsenkirchen synthetic plant out of action “for several months.”

The Eighth Air Force renewed its efforts against the German oil industry on 14 June 1944, with a sixty-one plane attack on a refinery at Emmerich, near the Dutch-German border. On 15 June 1944 172 B-17s continued the momentum of the oil offensive with a strike on the refineries at Hanover. On 18 June 1944 the entire Eighth Air Force attacked eleven different oil targets at Hamburg, Bremen, and Hanover. On 20 June 1944 the Eighth Air Force conducted its largest strike yet (1,361 bombers) against the synthetic oil plants at Magdeburg and Pölitz and the refineries at Hamburg, Harburg, Misburg, Hanover, and Ostermoor. This was the last big anti-oil mission in June 1944. This series of missions reduced German aviation fuel production by 90 percent

28Levine, Strategic Bombing, 166.
29Craven and Cate, Army Air Forces 3:283-84.
30Ibid., 284.
and overall oil production by almost 40 percent.31

Small raids against oil installations occurred during the last part of June 1944 to keep up the pressure and to interfere with repair efforts. On 21 June 1944 145 B-17s raided Ruhland, the site of the largest of the Fischer-Tropsch plants. On 24 June 1944 smokescreens over the target and cloudy weather caused a 340-plane mission against a refinery at Bremen to fail. And on 29 June 1944 eighty-one B-17s hit the Bergius plant at Böhlen.32

The Fifteenth Air Force, with some British help, continued its attacks on the refineries at Ploesti. The British effort, though small, had a major impact; it consisted of the RAF’s 205 Group dropping mines in the Danube, which disrupted the movement of oil barges carrying the Ploesti oil to Germany.33 Fifteenth Air Force attacks in May 1944 had reduced Ploesti’s production from 370,000 tons per month to 160,000 tons. On 10 June 1944 thirty-six P-38 Lightning fighters attempted to bomb Ploesti from low altitude, but they suffered heavy losses. On 23 and 24 June 1944 the Fifteenth Air Force bombed Ploesti through the German defensive smokescreens. Production at Ploesti was reduced to 75,000 tons per month (about 20 percent of the pre-campaign level) by the June raids.34

In order to better coordinate the oil campaign, the British Air Staff and the headquarters of the US Strategic Air Forces in Europe set up a new

31US Strategic Bombing Survey, Oil Division, Final Report, 28-33, 84, 91.
32Craven and Cate, Army Air Forces 3:280, 284-86.
33Ibid., 177.
34Levine, Strategic Bombing, 154.
working committee on 7 July 1944. The committee included representatives of Eisenhower’s staff, Bomber Command, Spaatz’s command, the British Air Ministry, British intelligence, and the Economic Objectives Unit. The committee’s task was to analyze “scientifically” the selection of individual targets for the oil campaign, assign priorities for attacking those targets, and decide when re-attacks would be necessary, in short to make the oil campaign more systematic. ULTRA was one of the primary sources of information used by the Oil Targets Committee. Throughout the summer, German engineers and construction crews labored to repair the damage to the oil plants. However, Allied repeat strikes quickly undid the reconstruction efforts, as the commanders of the Allied strategic bomber forces remained focused on Germany’s oil industry. Their sustained attacks prevented the Germans from ever regaining a significant and lasting recovery in their oil production.

Williamson Murray observed that

Speer’s hopes [for restoring oil production] were not realized, largely because ULTRA intelligence relayed to Allied air commanders both the size and success of German reconstruction efforts, as well as the serious damage and dislocations to Germany’s military forces that the bombing of the plants was causing.

Thus ULTRA played a major role in keeping the focus of the bombing campaign on the oil plants.

The Allied strategic air forces were still heavily committed to supporting

35Ibid., 152.
36Hinsley, et al., British Intelligence 3 (2): 503.
37Putney, ed., ULTRA, 38.
the Normandy campaign. Furthermore, attacks on V-1 launching ramps on the English Channel coast siphoned off still more assets, as did continuing attacks on the German aircraft industry. Despite these competing commitments, the campaign against the oil industry achieved considerable success by late June 1944. The JIC estimated on 3 July 1944 that ten out of the fourteen known Bergius synthetic oil plants and three out of the nine known Fischer-Tropsch synthetic oil plants had been damaged. The damage to mineral oil refineries had also been severe. The JIC estimated that German oil production had been reduced from 1,200,000 tons per month to about 670,000 tons, about 330,000 ton per month less than the German armed forces needed for normal operational efficiency.\textsuperscript{39} It should be noted that the JIC estimates of German oil production were somewhat inaccurate in regard to monthly figures, but they did track the overall trend of declining production with adequate accuracy. (See Table 2.) The US Strategic Bombing Survey (USSBS)\textsuperscript{40} determined in 1945-1947 that German oil production was reduced from a total of 968,000 tons in March 1944, including 180,000 tons of aviation gasoline, to 511,000 tons in June, including 54,000 tons of aviation gasoline.\textsuperscript{41} The 5 June 1944 OKL intercept had made it clear that there was no fuel

\textsuperscript{39}Hinsley, et al., \textit{British Intelligence} 3(2):503.

\textsuperscript{40}The most comprehensive study of the German oil industry that exists was done by the US Strategic Bombing Survey in the aftermath of World War II, with German records available to assist their analysis. The results of this survey are probably the most complete and accurate which will ever be assembled.

\textsuperscript{41}US Strategic Bombing Survey, Oil Division, \textit{Final Report}, 78-83.
reserve to ameliorate this sudden drop in production. Based on this, it logically followed that the scarcity of fuel would curtail German operational flexibility and efficiency. This analysis encouraged the Allied commanders to maintain the pressure on the oil targets.

<table>
<thead>
<tr>
<th></th>
<th>JIC</th>
<th>USSBS</th>
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<tr>
<td>April</td>
<td>1,344,000 (100%)</td>
<td>810,000 (100%)</td>
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<tr>
<td>May</td>
<td>1,082,000 (80%)</td>
<td>734,000 (91%)</td>
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<tr>
<td>June</td>
<td>800,000 (59%)</td>
<td>511,000 (63%)</td>
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<tr>
<td>July</td>
<td>671,000 (50%)</td>
<td>438,000 (54%)</td>
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<tr>
<td>Aug</td>
<td>526,000 (39%)</td>
<td>345,000 (43%)</td>
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<tr>
<td>Sept</td>
<td>330,000 (25%)</td>
<td>281,000 (35%)</td>
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<tr>
<td>Oct</td>
<td>385,000 (29%)</td>
<td>316,000 (39%)</td>
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<tr>
<td>Nov</td>
<td>430,000 (32%)</td>
<td>337,000 (42%)</td>
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The Allied strategic bombing offensive against oil targets resumed with vigor in July 1944. But while oil was nominally the priority target, many other competing demands for strategic bomber assets diffused the focus of the effort. The Eighth Air Force was used to conduct close air support and interdiction missions against German troops in Normandy and continued make regular strikes against plants in Germany producing V-weapons and tanks. The Fifteenth Air Force devoted much of its effort to interdicting transportation targets to support Soviet ground operations and to hitting aircraft production plants. On 7 July 1944 the Eighth and Fifteenth Air Forces conducted a massive attack against oil targets. The Eighth Air Force launched 1,129 heavy bombers against Merseburg-Leuna, Böhlen, and Lützkendorf in
central Germany, while the Fifteenth Air Force sent almost as many bombers against oil targets in Silesia, Austria, Hungary, and Yugoslavia.42

As a result of orders from Eisenhower’s staff, Bomber Command resumed its attacks on the German oil industry on the night of 18-19 July 1944. During July RAF bombers conducted five raids on oil plants in the Ruhr. Photo-reconnaissance and ULTRA intercepts confirmed that oil production at two of these plants had been halted.43 But Harris, never enthusiastic about the oil campaign because of his fixation on the effort to break German morale, used the bulk of his forces for area bombing. In August Bomber Command conducted a strike against the Sterkrade synthetic plant, its only night attack on an oil target that month.44 However, on 27 August 1944 RAF bombers conducted a successful daylight attack on a Fischer-Tropsch oil plant at Homberg. In September 1944 Bomber Command increased the number of day attacks it conducted on oil targets to thirteen.45 Harris has been criticized for ignoring the “irrefutable intelligence” of ULTRA indicating that the oil campaign was the most effective use of strategic air power.46 Because of his determination to finish what Bomber Command had started in regard to the effort against German morale, he preferred to emphasize his area bombing (“city busting”) campaign to the exclusion of all else.

42Hinsley, et al., British Intelligence 3 (2):505.


44Ibid., 505.

45Levine, Strategic Bombing, 149.

The Fifteenth Air Force continued to concentrate its efforts against Ploesti during July and August 1944. On 9 July 1944 it used radar for the first time to achieve better results by bombing through the German smokescreens defending Ploesti. Additional radar attacks were conducted on 15 July and 22 July 1944. A decryption of a 29 July 1944 ULTRA intercept reported on the damage inflicted by the 15 July raid. Only one of the eight refineries attacked had been seriously hit. It was knocked out of operation for about ten days. Furthermore, oil production would be 12,300 tons per day after 21 July 1944. This intercept also described Allied bombing tactics, recommended countermeasures, and emphasized the use of smoke generators.47 Allied intelligence knew that the 22 July 1944 raid had been ineffective because of an ULTRA intercept. The commander of the Luftwaffe defenders of Ploesti reported the results of the raid as follows:

Total fighter sorties: 42 German Air Force, 10 Bulgarian ME-109s. One missing, three crash landed. Smoke generators operating from 0750 to 1020 hours. Effect of raid very slight. Attacking formations probably split into small groups by strong fighter defense and well-aimed flak over target. Smoke and decoy fires also considered effective. Bomb carpets were all outside target mostly south and east.48

This was a typical ULTRA bomb damage report. From it and others like it, analysts could derive a wealth of information. They could assess Luftwaffe strength and losses and the effectiveness of German defensive measures, and the degree of damage inflicted on the target. They could also get a good idea of how effective US tactics were in defending formations of bombers; this

47DEFE 3/63, XL 3926 of 29 July 1944, quoted in ibid., 507.

48ULTRA: German Secret Messages, reel 35, CX/MSS/274/175, 130728Z/8/44, 130732Z/8/44.
type of knowledge was very useful to operational commanders seeking to minimize losses.

Further attacks on Ploesti on 28 July and 31 July inflicted severe damage to the oil refining machinery. By mid-August oil production at Ploesti had been cut to 37,000 tons per month, 10 percent of its normal output.49 When the Soviets captured Ploesti in late August 1944, they found it reduced to rubble.

In late July 1944 Speer sent a memorandum to Hitler to explain the severity of the oil crisis facing Germany. He explained that the reduction in fuel production meant that the German armed forces would soon consume “most of [their] reserves of aircraft and other fuels, and that afterward, there will be a gap we could no longer close, which would inevitably lead to tragic consequences.”50 The late July attacks by the Allied strategic air forces had reduced daily oil output to 120 tons; ninety-eight percent of German aviation fuel plants were inoperative. By dint of devoting 300,000 skilled workers to repairing the oil facilities, production of aviation fuel was raised to 10 percent of pre-campaign output in August 1944; it fell to 5.5 percent in September, but was back up to 10 percent in October. Speer said that “in November 1944 we ourselves were surprised when we reached 28 percent (1,633 metric tons daily).”51

During the July attacks an explosion of ULTRA intercepts began to reveal a growing level of disruption of German military operations due to fuel

49Levine, Strategic Bombing, 154.
50Speer, Inside the Third Reich, 417.
51Ibid.
shortages. A message from Luftflotte 3 to its subordinate units on 26 June 1944 (deciphered on 8 July 1944) reported that “Allied attacks had caused considerable reduction in fuel supplies . . . [and that] the June allocation would have to last into July.” Another ULTRA intercept disclosed that on 5 July Göring had banned all non-essential flying because of fuel shortages.

The Japanese Embassy in Berlin was a source of additional ULTRA intelligence concerning the German fuel crisis. The Japanese Ambassador to Berlin, Ōshima Hiroshi, reported on 18 July 1944 that the Allied strategic bombing of synthetic oil plants was “a source of very great concern” and that the level of damage made it questionable “whether large scale operations by the German Army may not be affected.” The Japanese naval attaché in Berlin, Admiral Abe Katsuo, reported that General Günther Korten, the German Chief of the Air Staff, had told him in a 22 July 1944 interview that the Allied attacks on synthetic oil plants had forced Germany to begin dispersing oil production to 3,000 small plants. On 7 August 1944 the naval attaché reported even more emphatically that “oil is Germany’s problem.” Ōshima reported to Tokyo on 9 August 1944 in a message deciphered on 18 August 1944 that Speer had told him that the Allied daylight air attacks on the oil industry could possibly have “fatal” consequences for Germany. The

53DEFE 3/54, XL 1671 of 11 July 1944, quoted in ibid.
54BAY/XLs 49 and 53 of 19 and 20 July 1944, quoted in ibid., 507.
55BAY/XL 64 of 28 July 1944, quoted in ibid.
56BAY XL 95 of 12 August 1944, quoted in ibid., 511.
ULTRA intercept of his entire report can be found in Appendix I.

Ōshima’s report contained a wealth of information and provided a high-level German assessment of the effects of the strategic bombing campaign on the German war economy. It revealed to Allied intelligence that their estimates of raids against munitions and aircraft factories had been too optimistic, and that up to the end of July German munitions productivity had been largely unaffected. However, the attack on oil was pointed out as a very serious development which could cut armaments production if the oil campaign was continued on a sustained basis. The production figures given for munitions and aircraft were also valuable to Allied military planners.

Japanese intercepts also provided specific information on the effects of individual raids on oil facilities. The Japanese consul in Vienna reported on 10 July 1944 that raids in June 1944 on two oil plants near Vienna had halted production from 10 July to 10 August. Furthermore, he reported that all fuel stored above ground (amounting to several hundred thousand tons) had been destroyed, and that Hitler had sent Speer to Vienna on 4 July to survey the damage.57 Another message from the Japanese naval attaché to Berlin, deciphered on 21 August 1944, described the heavy damage inflicted in a dozen raids in July and predicted that if similar raids continued, “Germany’s capacity to prosecute the war will be seriously affected” and that “if things continue as at present, stocks of oil will not last more than six months.”58

This type of information gave Allied intelligence an extremely clear and

57BAY/XL 53 of 20 July 1944, quoted in ibid., 507.

58BAY/XL 117 of 23 August 1944, quoted in ibid., 511.
unambiguous picture of the German war economy and pointed out its vulnerabilities. Oil was consistently highlighted as a glaring weakness by ULTRA intercepts. As this became apparent to Allied intelligence analysts, it was presented to operational commanders, who could employ forces against those vulnerabilities. The JIC estimated in a 14 July 1944 paper that Germany would probably collapse because of a shortage of oil and non-ferrous minerals by the end of 1944. In another estimate promulgated on 20 July 1944 the JIC clearly pointed out that Germany's critical vulnerability was her fuel supply. Another estimate on 24 July 1944 calculated German oil requirements as 923,000 tons per month and current production at 573,000 tons per month; it repeated that the air attacks on the oil sector would force a German capitulation by December 1944. On 7 August 1944 the JIC estimated that German military fuel consumption in July 1944 had exceeded production by almost 50 percent. It predicted that this situation would soon lead to complete exhaustion of German fuel reserves. The JIC also warned in the 7 August estimate that unless the Allies continued to attack the oil industry on a consistent basis, the Germans could disperse their production facilities and restore production to perhaps 75 percent of normal output. The JIC was aware of the special attention that repair and dispersion efforts of the oil facilities had been given, including priority for labor and materials over weapons production.

It was the recognition of the potential for the Germans to repair the oil

59JIC (44) 302 of 14 July 1944, quoted in ibid., 508.
60JIC (44) 301 (0) of 20 July 1944, quoted in ibid.
61JIC (44) 320 (0) of 24 July 1944, quoted in ibid.
62JIC (44) 346 (0) of 7 August 1944, quoted in ibid., 508-509.
facilities and restore production that led the US Strategic Air Forces in Europe to intensify their efforts against the oil industry in August 1944. The oil campaign reached its highest level of intensity in this month, with approximately sixty raids on oil targets throughout Europe. As discussed above, these included four raids against Ploesti by the Fifteenth Air Force (on 9, 17, 18, and 19 August 1944) which completely shut down refining operations. The Eighth Air Force struck the synthetic plants at Blechhammer (on 7 August and 22 August 1944) and Pölitz on 25 August 1944.63

ULTRA became even more important in August 1944 because bad weather and the increasing effectiveness of German smokescreens and camouflage degraded aerial reconnaissance photography of targets. ULTRA became the primary source of intelligence due to the lack of aerial reconnaissance imagery.

References to the growing fuel crisis became increasingly common in August and September 1944. Several ULTRA intercepts in the first half of August 1944 cited the fuel shortage as the cause of operational constraints for ground German forces in France.64 The Luftwaffe was also affected. An ULTRA intercept of an OKL order to Luftflotte 3 on 11 August 1944 stated that further damage to fuel production demands further considerably greater reduction of flying activity. Only fighter operations in defense remained unrestricted. Reconnaissance operations only when essential for general conduct of operations and security. All operations by Westa 1, 6, 26, 27, 76 to be discontinued. Only Westa 5 and 2 to fly daily. Bomber and group attack operations to be limited to decisive actions. Operations by HE-177 and JU-290 except two staffel O.B.D.L.

63Ibid., 509.

64Ibid., 265.
only with permission of Berlin. Fuel quantities allotted are highest possible. Consumption to be regulated accordingly. Secondly, same day, general order throughout Luftgau West France insisted that in all evacuations all fuel stocks down to the last drop be taken back. Destruction only if capture by Allies inevitable.65

An OKL message on 15 August warned Luftflotte 3 that operations had to be further reduced (to allow replacement aircrew training); failing that, only one third of the replacement aircrew quota could be trained.66

The JIC, relying almost entirely on COMINT, issued an estimate on 21 August 1944 which continued to emphasize the effectiveness of the oil campaign. It concluded that “the Allied policy of attacking German oil production [is] threatening her with a potentially fatal situation,” but stressed that repair efforts could restore production unless oil facilities were periodically reattacked.67 It is clear that the Ōshima intercept of 5 August 1944 (see Appendix I) formed the basis of this assessment, particularly in the use of the word “fatal” and the emphasis on the importance of a sustained oil offensive. The next JIC estimate (on 4 September 1944) calculated that German oil production in August had been thirty-nine percent of the pre-campaign level, of which only 90,000 tons was low grade gasoline or diesel fuel, and none was aviation gasoline. Once again the JIC warned that consistent and sustained (i.e., repeated) attacks were necessary to keep oil plants permanently out of action.68

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65ULTRA: German Secret Messages, reel 35, CX/MSS/T273, 148, 121020Z/8/44.
67JIC (44) 390 (0) of 21 August 1944, quoted in ibid., 511-12.
68JIC (44) 390 (0) of 4 September 1944, quoted in ibid., 512.
During September 1944 the weight of attacks on German oil targets declined. In part this was due to a renewed commitment of American strategic bombers to support ground forces, but it was also due to Harris’ disinterest in the oil campaign. During September 1944 the frequency of COMINT references to the effects of strategic bombing on the oil industry declined, in comparison to August. However, an ULTRA intercept on 7 September 1944 revealed that the Luftwaffe was soliciting volunteers from bomber, transport, and reconnaissance squadrons to replenish the personnel strength of its fighter arm. To obtain fuel, the Germans were reduced to draining the bunkers of coastal vessels in the Baltic, according to an ULTRA intercept of 15 September 1944. Ground operations were affected on the Eastern Front. On 15 September 1944 Brigadier General von Grolman, Chief of Staff of Army Group South Ukraine, had complained to the Wehrmacht High Command (OKW) that the fuel situation of his army group was “strained to the utmost, jeopardizing any tactical freedom of movement.” An ULTRA intercept on 22 September 1944 revealed that one corps subordinate to Army Group E had been informed by the latter that “no fuel allocation of any kind was to be expected for the next few months. Army fuel situation therefore catastrophic.”

The JIC estimate of 18 September 1944 discussed the reinforcement of antiaircraft defenses at Pöltitz, Merseburg-Leuna, Brüx, and Zeitz. The

69DEFE 3/459, ZTPG 283825; GPD 2970DD2, quoted in ibid.
70ULTRA: German Secret Messages, reel 42, CX/MSS/T318/10, 251125Z/9/44.
71Ibid., CX/MSS/T315/14, 221422Z/9/44.
72JIC (44) 403 (0) of 18 September 1944, quoted in Hinsley, et al., British Intelligence 3 (2):513.
Combined Intelligence Committee estimated on 20 September 1944 that "provided Allied air attacks continue on a heavy scale, the German Air Force will be reduced to a nullity by the middle of November 1944." It went on to estimate that only three of ninety-one synthetic plants were in full production, with another twenty-eight in partial production; however, others could be restarted if consistent repeat attacks were not conducted.

On the basis of this estimate, the Eighth and Fifteenth Air Forces launched a series of intense attacks in the latter half of September 1944 against oil targets at Merseburg-Leuna, Bremen, Blechhammer, Odertal, Auschwitz, and Budapest. Bomber Command made a marginal contribution with daylight attacks on three synthetic oil refineries in the Ruhr. German oil production fell to its lowest ebb in September, of which only 10,000 tons was aviation gasoline. The JIC estimated on 2 October 1944 that German oil production had been reduced to 25 percent of the normal level (300,000 tons). It noted that more than half this output originated in eighty benzol plants which had not yet been deliberately targeted. This forced the Germans to reduce fuel deliveries to the Luftwaffe by half and to end all training of novice pilots. Production of explosives, propellants, and other munitions was also severely affected.

With Allied armies firmly established in Europe, operational control of the British and American strategic air forces was transferred from Eisenhower.

73JIC (44) 410 of 20 September 1944, quoted in ibid.
74JIC (44) 423 (0) of 2 October 1944, quoted in ibid.
to the Combined Chiefs of Staff on 16 September 1944. Oil was immediately established as the number one target system, transportation as number two, and the Luftwaffe as the third priority. Harris was specifically directed to adhere to this program. However, he continued to concentrate heavily on area bombing rather than complying with these orders.

The US air forces continued to concentrate on the oil targets through October 1944, despite the onset of poorer weather and increased smokescreens, decoys, and camouflage. In October 1944 the Eighth Air Force struck ten synthetic plants in central Germany, three installations in the Ruhr, the Hamburg refineries, and Pölitz. The Fifteenth Air Force conducted strikes against four synthetic oil plants in eastern Germany and Austria: Odertal, Blechhammer, Brüx, and Vienna. In contrast Bomber Command launched only six small day attacks on oil targets in October. This amounted to only 6 percent of its effort.

At the beginning of September 1944 the British Air Staff set up the Combined Strategic Targets Committee (CSTC) to advise the commanders of the British and American strategic air forces on setting priorities regarding target systems, and on specific target selection within target systems. The CSTC included working committees on oil, aircraft production, tanks and motor transport production, and transportation.


78 Craven and Cate, Army Air Forces 3:642.

79 Levine, Strategic Bombing, 170.

80 Webster and Frankland, Strategic Air Offensive 3:69, 213.
Figure 1. System of Control of Strategic Air Forces and Channels Used in Determining Bombing Policy, September 16, 1944 to May 24, 1945.

reports on the progress of the strategic bombing offensive were issued by the CSTC. The committee recognized that German repair efforts were becoming increasingly sophisticated and were achieving some success in restoring oil production. ULTRA was one of the primary sources of intelligence used by the CSTC, as weather during the remaining months of 1944 allowed only sporadic aerial photo-reconnaissance.

Allied intelligence continued to enjoy a rich harvest of ULTRA intercepts attesting to the effects of the oil campaign on the German armed forces. Two Luftwaffe messages originated on 14 October 1944 and 18 October 1944 revealed a severe shortage of aviation gasoline.

Three requests from branch at Goslar of OKL Director of Luftwaffe Technical Armament; On 18th [September 1944] to Berlin office of same directorate. Urgently request again that Luftwaffe Reich or Luftgau 11 be told to deliver aircraft fuel, as all aircraft dry and no testing or ferrying possible.81

Luftflotte 6 by October 14th [1944] unable to give adequate fighter protection to German naval battle group. (Comment, consisting of heavy units bombarding Russian army in eastern Baltic) because it would mean exhausting all aircraft fuel. New supplies not expected for some days and Luftflotte must keep something in hand in view imminent large scale attacks on East Prussia.82

Similar fuel shortages plagued the German ground forces at a time when Allied armies were also driving into Germany from the west. Despite this crisis fuel had to be rationed and conservation measures imposed.

Commander-in-Chief West Quartermaster on 25th [October 1944]. Further stringent measures necessary to cut down consumption of Oboe [probably octane] fuel. Daily maximum probable allocations to Commander-in-Chief West in next ten

81ULTRA: German Secret Messages, reel 47, CX/MSS/T346/31, HP 4279, 231742Z/10/44.
82Ibid, CX/MSS/T346/31, HP 4279, 231742Z/10/44.
day period: 250 CBM for Army Group B, 150 for Army Group G. For others only when necessary and for special projects. Priority as decided by Commander-in-Chief West. All commands therefore to resort to diesel, producer gas, and H/T. Number of authorized Oboe fuel M/T [motor transport] to be checked. Supply of motorized, PG [panzer grenadier], and panzer formations to be ensured by formation of H/T echelons.83

Allied intelligence analysts thus had a very accurate picture of the fuel resources available (or not available) to the German army groups which opposed the Anglo-American offensive into the Reich. Knowing how much fuel was available, it was much easier to predict accurately the possible enemy courses of action. Knowing this, Allied offensives could be conducted so as to take maximum advantage of the German weakness in fuel.

The JIC estimated on 30 October 1944 that the "effects of repairs outstripped destruction" during the preceding month. It also noted that Pölitz was protected by 301 heavy antiaircraft guns, and pointed out that Berlin was defended by 325 guns. The fact that a single synthetic oil plant was defended by almost as many antiaircraft guns as the German capital and seat of Nazi political power highlighted the importance of oil to the Germans. This estimate relied heavily on ULTRA intelligence. It recommended maintaining heavy pressure on the German oil industry to prevent the Germans from making up for the severe losses they had suffered in September. The JIC believed that the German oil output had been 430,000 tons in October (32 percent of March 1944 production), up 8.5 percent from September.84 The US Strategic Bombing Survey determined in its exhaustive postwar analysis that

83Ibid., CX/MSS/T348/86, HP 4546, 2600012/10/44.

84JIC (44) 450 of 30 October 1944; quoted in Hinsley, et al., British Intelligence 3 (2): 520.
the actual production figures were 316,000 tons, including 21,000 tons of aviation gasoline.85

The Allied strategic bombing offensive was undercut by its lack of unity of effort. By October 1944 the transportation campaign was competing with the oil campaign for bomber assets, but the Combined Chiefs of Staff still defined oil as the primary objective. They issued a new directive on 1 November 1944 to Harris in another futile attempt to get him to reallocate assets he was using for area bombing and contribute them to the oil and transportation campaigns.86 Harris, still stubbornly concentrating on area bombing, believed that his efforts were close to the point of breaking German morale. Harris was disdainful of technical “experts” recommending “panacea” targets and the reliability of the intelligence supporting such a course of action. He believed that the “fixation” on the oil campaign was just another attempt to find, in his own words, “a quick, clever, easy, and cheap” solution to a problem that required dogged persistence and determination. Harris was convinced that the area campaign was the German’s most serious problem, and that it was “idiotic” to discard a policy that “was seven-tenths complete” in favor of the “panacea” solution.87 Aviation historian Alan J. Levine is of the opinion that “Harris’ ability to persist in the area offensive despite inter-Allied directives, and the views of Portal and the Air Staff (not to mention reason and evidence), defies fully satisfactory explanation to this day.”88

85Levine, Strategic Bombing, 170.
86Webster and Frankland, Strategic Air Offensive 3:65-66.
87Harris, Bomber Command, 220-25; Hinsley, et al., British Intelligence 3 (2):522.
88Levine, Strategic Bombing, 173.
Harris rejected a request on 3 November for Bomber Command to attack Merseburg-Leuna and Pölitz. He estimated that German night fighter and anti-aircraft artillery defenses would inflict too great a loss rate on his forces for this to be a viable option. However, the constant pressure of his superiors led him by late November 1944 to devote a part of his effort to the oil campaign. Bomber Command conducted eleven day and five night attacks on oil targets in November 1944 (about to 24.6 percent of British bombs dropped). Bomber Command's area bombing attacks on targets in the Ruhr and at Hamburg, often destroyed small benzol plants in urban areas.

Poor weather restricted the success of American day bombing efforts in November; combined with German repairs the lower intensity of Allied bombing allowed a remarkable recovery in oil production. Production figures for November 1944 rose slightly to 337,000 tons (USSBS figures), of which 39,000 tons were aviation fuel. Furthermore, the weight of attacks on transportation targets exceeded those against oil targets beginning in November 1944; this effectively lowered the oil campaign to a second place emphasis.

ULTRA intercepts provided ample raw evidence that the transportation campaign was effective in reducing German industrial production as well as impeding the movement of German military forces and supplies. In part this was due to the fact that strategic bombing had so damaged landline

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90Levine, Strategic Bombing, 171.

telephone and telegraph networks that the Germans were forced to use radio communications for routine matters. Two German railway codes (Rocket II and Stevenson) were exploited, and the ULTRA intelligence derived from these sources provided abundant proof of German logistics problems.92 However, this fragmentary evidence was not analyzed as effectively as the intelligence relating to the oil campaign. Consequently, the actual effectiveness of the transportation campaign was not yet apparent to Allied decision-makers.

Because of the slackening of the oil campaign after September, the Germans were able to accumulate a small fuel reserve by December 1944. This enabled them to launch the Ardennes offensive on 16 December 1944. Poor weather prevented the US strategic air forces from conducting heavy operations in early December (except for two attacks on Merseburg-Leuna), and once the Ardennes offensive was launched, support of Allied ground forces became the highest priority. Bomber Command actually assumed most of the responsibility for the oil campaign in December 1944. In that month the British conducted two daytime and three night attacks against oil targets. The targets included Merseburg-Leuna and Pölitz. On 31 December 1944 the Eighth Air Force sent 526 bombers against oil refineries at Hamburg and Misburg.93

ULTRA intercepts in December continued to reinforce the opinion that the oil offensive was hitting the Germans hard, despite their repair and

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93 Craven and Cate, *US Army Air Forces* 3:645-46.
recovery efforts. Ambassador Ōshima reported in a message to Tokyo that German oil production was only 300,000 tons per month and estimated that oil was "clearly Germany's greatest worry."94

Once the Ardennes offensive was over, the Allied air forces returned to the strategic bombing offensive. On 15 January 1945 a new directive was issued which retained oil and transportation as the top two priorities of the Allied air campaign. Bomber Command now played a much larger role in the attacks on oil facilities, launching about 25 percent of its sorties against oil targets in January 1945. These British missions involved many more aircraft per raid than previously. On the night of 15-16 January 1945 Bomber Command attacked Merseburg-Leuna with a force of 561 bombers. Other attacks were conducted against Pölitz; the big Bergius plant at Brüx; the synthetic plants at Zeitz, Lützkendorf, and Böhlen; and the oil refineries at Hamburg, Harburg, and Misburg.95 These raids were very accurate and destructive; they virtually shut down German oil production by the middle of February 1945. F. H. Hinsley is of the opinion that

in light of this outcome it is not possible to doubt that, effected in July or August and maintained into the autumn, comparable marginal diversion of [Bomber Command's] effort from area bombing to the oil offensive could have brought forward to an earlier date the reduction of the German production to the low level it reached in September and would at least have prevented it from recovering.96

The US strategic air forces also continued to attack oil targets, but were

94BAY/HP 135 of 14 December 1944, quoted in Hinsley, et al., British Intelligence 3 (2):530.
95Levine, Strategic Bombing, 181.
96Hinsley, et al., British Intelligence 3 (2):531.
hindered by poor weather. The first attack in 1945 by the Eighth Air Force against oil facilities occurred on 14 January; the targets were synthetic oil plants at Magdeburg and a refinery at Hemmingstedt. The next day the Eighth hit the Magdeburg oil facilities again as well as those at Ruhland. On 17 January 1945 the Eighth Air Force struck refineries at Hamburg. After this the weather was too poor for the attacks to be continued. The Fifteenth Air Force attacked oil targets at Vienna and Regensburg in mid-January, but poor weather curtailed further operations until the end of the month. The shortages of fuel imposed on the German armed forces by the oil campaign and the difficulty of transporting what fuel was available to where it was needed paid handsome dividends in the first quarter of 1945. A message originated by the German Air Force Command West on 20 January 1945 gave Allied intelligence insight to how seriously fuel supply shortages were degrading operations by the newly introduced German jets.

On 20th [January 1945] GAF Command West quoted OKL order of 18th: Previous fuel economy orders apply equally to JIG 2 fuel and Aircraft 162 [He-162], Me-262, Ar-234. Monthly production so small compared with possibilities of consumption that current fuel needs must be met by eating into stocks, also very small. Owing high fuel consumption of these aircraft, taxying before takeoff and after landing forbidden. Consumption of JIG 2 in M/T [motor transport] also forbidden. One Me-262 while taxying five minutes consumes 200 litres JIG 2. Thus five Me-262s consume in this time as much fuel as required by one aircraft Type 162 for one operation.99

Allied intelligence derived even more than an appreciation of the effects of the fuel shortage on the Luftwaffe from this message. Because fuel

97Craven and Cate, Army Air Forces 3:723.

98Ibid., 724.

99ULTRA: German Secret Messages, reel 63, CX/MSS/T467/7, BT 5321, 211522/2/45.
consumption figures for a new type jet aircraft, the He-162, were given, technical analysts were able to deduce its flight endurance, as reported in the following analytical note.

Comment from DDI 2 on JIG 2 fuel economy orders in BT 5321 [quoted above]. This is the most striking evidence yet afforded of shortages of JIG 2 diesel fuel oil. This shortage likely to have considerable effect on scale of jet activity. Fuel capacity of the He-162 is 220 gallons which is a reasonable figure for a single jet fighter. With Jumo 004 [engine] this would give full-thrust endurance of about 40 minutes at sea level. Increasing to about 105 minutes at 20,000 to 30,000 feet.\textsuperscript{100}

Despite having such exact fuel consumption figures, Allied intelligence overestimated the endurance of the He-162. According to British test pilot Eric Brown, who test-flew the He-162, the correct endurance figures were twenty minutes at sea level and fifty-seven minutes at 30,000 feet.\textsuperscript{101}

The weather continued to be a problem through February 1945 especially for daylight operations. When the weather allowed US bombing efforts were often in support of the ground campaign. By now most of the oil facilities were so badly wrecked that it was impossible to repair them. The Fifteenth Air Force conducted several missions against oil facilities at Vienna in February 1945, while the Eighth continued to pound oil targets in western and central Germany. Missions against the crude oil refineries at Hamburg on 24 February, 5 March, and 11 March completely destroyed them; they never resumed production.\textsuperscript{102} Bomber Command concentrated on the largest

\footnotesize{\textsuperscript{100}Ibid., reel 64, CX/MSS/T467/7, BT 6039, 011650Z/3/45.}

\footnotesize{\textsuperscript{101}Eric Brown, Wings of the Luftwaffe: Flying German Aircraft of the Second World War (Garden City, NY: Doubleday, 1978), 22.}

\footnotesize{\textsuperscript{102}Craven and Cate, Army Air Forces 3: 737-40.}
remaining Bergius plants at Merseburg-Leuna and Brüx.103

The Bergius and Fischer-Tropsch plants produced 13,000 tons of fuel in February 1945 and 12,000 tons in March, of which about 500 tons were aviation gasoline.104 Allied strategic bombing shut down all synthetic oil production by the end of March 1945, except for a few benzol and coal-tar distillation plants. The last American attack on an oil target was against oil storage tanks in central Germany on 31 March 1945.105 Bomber Command’s last oil attack was against Lützkendorf on 8-9 April 1945.106 It is an ironic fact that despite Harris’ negative attitude toward the oil campaign, Bomber Command dropped more than 63,000 tons of bombs on oil targets between May 1944 and April 1945, while the Eighth Air Force dropped approximately 45,000 tons.107

Numerous intercepts of German communications during the last four months of the war confirmed that the shortage of fuel had virtually immobilized the German armed forces. The JIC concluded in its 3 April 1945 report (the last it would issue) that the “final stage in the destruction of Germany’s oil resources had been reached by the third week of March.”108

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103Levine, Strategic Bombing, 183.

104US Strategic Bombing Survey, Oil Division, Final Report, 23.

105Craven and Cate, Army Air Forces 3:751.

106Levine, Strategic Bombing, 183.

107Frankland, Bomber Offensive, 143.

108JIC (45) 110 of 3 April 1945, quoted in Hinsley, et al., British Intelligence 3 (2):606.
Figure 2. Total German Synthetic Fuel Production, 1940-1945.

It is clear that ULTRA played a critical role in evaluating the effectiveness of the strategic bombing campaign against the German oil industry from May 1944 to the spring of 1945. ULTRA provided unambiguous, concise, and abundant intelligence identifying the damage inflicted on oil installations and its consequent degradation of German military capabilities. Furthermore, Allied air commanders were able to adjust the details of the oil campaign to achieve maximum effectiveness because of ULTRA intelligence.

However, the role of ULTRA in the transportation campaign was much less straight-forward; Allied decision-makers did not fully realize just how damaging was the disruption of the German transportation system. Although a plethora of fragmentary evidence was available in ULTRA intercepts, the communications intelligence analysts were not able to piece together the total picture until about February 1945. There were several reasons for this. German railway communications intercepts were given a lower priority for decryption; this slowed their processing. 1 Because these intercepts were assigned a lower priority for decryption and processing, there was a natural tendency to place a lower value on their content. But the more extensive size, complexity, robustness, and redundancy of the German transportation system (relative to the oil industry) was of even greater significance in delaying the

recognition of the effectiveness of the transportation campaign. It was relatively easy to understand the impact of loss of oil to the German armed forces and the limitations on German military capabilities caused by the consequent shortages of fuel and ammunition. Furthermore, there were relatively few oil installations. However, the German transportation system was much more complex; this made it much more difficult to assess the progress being made by Allied strategic bombers in disrupting it.

The German war economy depended on the efficient movement of raw materials and finished products via a highly developed and multifaceted transportation network. It included a dominant railway component and an efficient inland waterway system consisting of a network of rivers and canals. Coastal shipping and highways were of relatively minor importance. In a typical year in the pre-war era, the German national railway system (Reichsbahn) handled approximately 73 percent of all freight traffic. Privately-owned railway lines carried an additional 3 percent of freight. The waterways and coastal shipping network handled 21.5 percent of traffic, most of it via the inland waterways. Highways carried only 2.5 percent of freight moved.2

The state-owned railway system was hierarchically organized; this facilitated exploitation of communications between its components by Allied intelligence. The Reichsbahn, including components in Austria, Alsace-Lorraine, and Poland, consisted of 48,968 miles of track in late 1944. It was subdivided into thirty-one administrative districts known as Direktionen. For

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purposes of coordinating train movements and maintenance, particularly of rolling stock, several Direktionen were grouped into GBLs (General Betriebsleitungen). Subordinate units of this system reported to higher echelons and received direction down the chain of command in part via enciphered radio links using the Enigma machine. Two of the codes used for railway communications (Rocket II and Stevenson, later called Blunderbuss and Culverin) were exploited by Allied communications intelligence.3

The Reichsbahn was built to high standards of quality and was well maintained, “a model of efficiency,” according to aviation historians Wesley F. Craven and James L. Cate. This made it a difficult target system to destroy by strategic bombing. Marshalling yards, repair facilities, locomotive shops, terminals, cargo handling facilities, and associated structures and equipment were built in excess of normal service requirements; many structures were strongly reinforced during construction to increase their durability and survivability in case of bombing. Accordingly, the German railway system was extremely resistant to strategic bombardment, a fact appreciated by Allied air planners.4 The recuperative power of the Reichsbahn was very high. Marshalling yards were usually back in partial operation within four days of the first bombing strike. It generally required from two to four weeks to


4Craven and Cate, Army Air Forces 3: 650; US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 7.
Figure 3. Main Freight Arteries of the German Reichsbahn.

regain 80 per cent of pre-raid capacity.5

Table 3
Structure of Pre-War German Freight Traffic*

<table>
<thead>
<tr>
<th>Mode</th>
<th>Traffic (ton kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Railways</td>
<td>97,832,600,000</td>
</tr>
<tr>
<td>Private Railways</td>
<td>3,700,000,000</td>
</tr>
<tr>
<td>Waterways</td>
<td>28,972,600,000</td>
</tr>
<tr>
<td>Highways</td>
<td>3,254,000,000</td>
</tr>
</tbody>
</table>

*Figures given in ton kilometers for the year 1937


The German railway system was very dense; this required multiple cuts to prevent re-routing trains to bypass damaged sections. Furthermore, repairs could often restore damaged sections of track fairly quickly. The complexity of the railway system made it difficult for Allied intelligence analysts to keep track of the status of its individual sectors. It demanded a high degree of detailed familiarity by the intelligence analysts that took time to develop. In the Ruhr alone there were seven major marshalling yards: Hamm (the biggest in Germany), Soest, Geisecke, Hagen-Vorhalle, Wedau, Hohenbudberg, and Münster. There were also eighteen bridges and viaducts, of which the most critical were the Bielefeld Viaduct on the rail line between Hamm and Hanover, and the Altenbecken Viaduct (near Paderborn) on the line between Soest and Hildesheim.6

The German inland waterway system, totalling some 7,750 miles of navigable channels, connected the five main rivers of north Germany and

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5 US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 4.

6 Ibid., 17-18, 50-53, 81.
their tributaries with a network of canals. The Danube River, although not connected by canals with the north and west German waterways, provided transportation of freight to and from the Balkans. Much of the oil produced at Ploesti was shipped via barges on the Danube.7

The German waterway system was much more vulnerable to strategic bombardment than was realized at the time because it contained vulnerable choke points which could not be bypassed. Postwar analysis by the United States Strategic Bombing Survey identified four vulnerable key points which would have quickly paralyzed Germany’s inland water transport system had they been attacked. These targets were the Münster locks in the Dortmund-Ems Canal, the Datteln locks in the Wesel-Datteln Canal, the Rothensee ship lift, and any bridge over the Rhine. (Dropping a bridge into the Rhine would have formed a barrier to barge traffic.) These locks and the ship lift were never attacked, a subject to be discussed shortly. The Allies recognized that the Ruhr in particular depended on inland waterways, especially the Dortmund-Ems and Mittelland canals. The Dortmund-Ems Canal connected the Rhine, the Ruhr industrial area, and the Ems River, while the Mittelland carried traffic from the Ruhr to the Elbe, and via the Rothensee ship lift, east to Berlin. Allied targeteers, using aerial photo-reconnaissance intelligence, identified as vulnerable points the spots where the Dortmund-Ems Canal crossed the River Glane in the vicinity of Ladbergen, and the spots where the Mittelland Canal crossed the River Aa near Gravenhorst and the River Weser near Minden. The Mittelland Canal was carried across the Weser by a raised aqueduct. At the other two points the rivers Glane and Aa flowed under the canals in concrete tunnels; the canals were raised above the surrounding

7Ibid., 6.
countryside by earthen embankments at these points. The destruction of these embankments would allow the water in the canal to escape, thus halting navigation.8 As in the case of the railways, repair work on the waterways was coordinated through hierarchical organizations known as regional field offices and the Schadenschilfe which reported to the Waterways Administration of the Armaments Ministry in Berlin.9

The German transportation system had been recognized as a critical component of the German war economy by the planners who wrote AWPD-1 in 1941. They had prioritized it as second in importance only to the electric power system and more important than the oil industry. AWPD-42 also identified transportation as the second most important target for the strategic bombing campaign. However, the Casablanca Directive in January 1943 lowered transportation to ninth priority. This priority was maintained in the Pointblank Directive of June 1943. The size and complexity of the German transportation system made it seem to the decision-makers at Casablanca that the limited air assets available to the Allied air forces at that time were insufficient to deliver a crippling blow to the German transportation system. This impression was still strong in 1944 when Allied air power finally achieved air superiority over Europe and built up a numerically overwhelming strength in aircraft.10 AWPD-1 had initially listed forty-seven critical transportation targets in Germany,11 but many more targets were added as the war

8Ibid., 17-22.
9Ibid., 22.
10Copp, Forged in Fire, 462; Hansell, Air Plan, 229.
11Hansell, Strategic Air War, 52.
Figure 4. German Inland Waterway System.

progressed and as new photographic intelligence became available.

During most of the strategic bombing offensive against Germany attacks on transportation targets were a low level or subordinate objective. Although every ground operation was supported by attacks on local lines of communication near the area of operations, the domestic German transportation system was not treated as a primary strategic objective. The US Strategic Bombing Survey attributed this to the "size and complexity [of the German transportation system] and the limited capabilities of the [Allied] air forces." Up until September 1944 transportation targets in Germany were attacked as alternate targets when weather conditions prevented attacks on primary objectives. Thus the transportation campaign was characterized by much less forceful execution than the oil campaign, where the German oil industry was clearly identified as a critical objective by determined proponents in control of the assets necessary to carry out the strategy.

Although the effects of bombing the German railways and waterways were primarily economic, and therefore broadly strategic, the transportation campaign as a whole was not planned or executed for this purpose. Ironically, tactical considerations were usually paramount in the selection of targets. Allied intelligence decision-makers never ordered the formulation of a basic study of the flow of German economic traffic in order to understand where best to hit it in order to interfere with its efficiency.

\[12\]US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 12.

\[13\]Ibid., 2.

\[14\]Ibid., 4.
An early example of this was the bombing campaign against French and Belgian railway targets conducted in the spring of 1944 to assist in the isolation of the English Channel coast from German reinforcement preparatory to the landings in Normandy. This campaign was not strategic in nature, as it was intended strictly to support an operational ground campaign. Proponents of the oil campaign, as well as those favoring the use of strategic air power against other segments of the German war economy, viewed the French railway campaign as a dispersion of effort, a waste of strategic assets in pursuit of non-strategic objectives. They believed that the medium and light bombers of the Ninth Air Force with its fighter bombers and those of the Allied Second Tactical Air Force were sufficient to carry out this task.15

The primary proponents of the pre-Normandy transportation plan were Air Chief Marshal Tedder and a civilian scientist, Solly Zuckerman.16 The plan devised by Zuckerman called for attacks against seventy-six railway centers in France and Belgium.17 Zuckerman believed that extending the campaign into western German rail centers “would contribute to both reducing the volume of military traffic flowing westward” and to “halt[ing] industrial activity in the Reich.”18 These ideas were derived from Zuckerman’s analysis of the results of interdiction efforts against Italian railways in 1943.19

15Hansell, Air Plan, 239.


17Mierzejewski, Collapse of German War Economy, 81.

18Ibid., 182.

On 25 March 1944 Eisenhower decided in favor of the pre-Normandy transportation campaign over the oil plan, choosing short-term benefits to the invasion over long-term damage to the German economy.\textsuperscript{20} By late June 1944 much damage had been done to rail targets in Western Europe. German military movements in France were greatly impeded. However, the rail system proved much more resilient than planners had anticipated. Damage was quickly repaired, and trains were re-routed very efficiently over undamaged sectors of the system.

Allied intelligence found it difficult to assess the effectiveness of these attacks. It was not due to a lack of raw intelligence data; rather it was due to the difficulty in correlating the multitude of fragments of information into a coherent picture. Some examples to illustrate the fragmentary nature of these intercepts and the difficulty in assessing their significance follow:

Railroad station La Chapelle attacked by 12 fighter bombers 0700 hours 10th [June 1944]. Installations damaged.\textsuperscript{21}

Attack by 12 bombers at 0830 hours [10 June 1944] on railroad bridge at Pesaro. Partly destroyed. Traffic will be interrupted for about 14 days.\textsuperscript{22}

To chief railway officer with Army Group G. Bridge at Arles completely destroyed. Closed indefinitely. Bridges at Chasse sur Rhone and St. Rambert-Peyraud closed until 10 August [1944]. Ardeche bridge at St. Just-Pont D'espirit hit by bombs and closed indefinitely. Thus both Rhone routes interrupted. Traffic through Miramas railway station and the section outside Toulon blocked by air attack.\textsuperscript{23}

\begin{itemize}
\item \textsuperscript{20}Mierzejewski, \textit{Collapse of the German War Economy}, 84.
\item \textsuperscript{21}ULTRA: German Secret Messages, reel 35, CX/MSS/T214/133, 132352Z/6/44.
\item \textsuperscript{22}Ibid., CX/MSS/T214/58, 131554Z/6/44.
\item \textsuperscript{23}Ibid., CX/MSS/T27/91, 94, 092146Z/8/94.
\end{itemize}
Road bridge on Route N-100 twenty-two kilometers northeast of Digne damaged, but open for vehicles under ten tons. Suspension bridge at Pertius damaged by sabotage. Diversion over Mirabeau and Cadenet. Road bridge over River Lieral at Luc blown up. Traffic between Luc-St. Etienne de Lucdares indefinitely interrupted. Traffic bridge Beaucaire-Tarascou bombed on 6th. Bridge Arles-Lunel destroyed. Bridge over Rhone at Avignon received bomb hit on 6th. Closed at present.24

Information of 31st [July 1944]. Air attacks in area of Commander-in-Chief Southeast. Number of locomotives lost increased from 86 in June to about 250 in July.25

To make use of these fragments of information, Allied intelligence analysts required a degree of familiarity with the intricate French, Belgian, Dutch, and German rail networks which they did not have. Interdiction of any one point or segment of track meant little unless there were no alternate routes. However, knowledge of an alternate route could have allowed intelligence analysts to recommend to targeting officers that it be attacked. Such synergism could have made the transportation campaign more effective. The technique of analyzing relationships between parts of a complex system described above is known as link analysis.

Although attacks by strategic bombers on rail facilities, particularly marshalling yards, in the pre-Normandy transportation campaign were viewed as only a partial success, attacks on bridges by tactical aircraft of the Ninth Air Force were extremely successful. Attacks against moving stock by fighter bombers were also highly successful.26 As part of the pre-invasion campaign, the Allies bombed some marshalling yards in western Germany. These attacks continued through July and August 1944. The damage done

24Ibid., CX/MSS/T271/119, 100225Z/8/44.
25Ibid., CX/MSS/T271/4, 091303Z/8/44.
to the French railways began to be felt in Germany, especially in the Saar. This consisted primarily of a dropoff in raw materials from France being delivered to German factories. However, Allied intelligence did not realize this. The focus continued to be on the more clearly apparent results of the oil campaign.

Proponents of the oil campaign and others advocating strikes against the German aircraft and tank production industries opposed the allocation of strategic bombing assets to the transportation campaign. Despite this opposition Tedder was able to convince the Combined Chiefs of Staff in September 1944 that German transportation facilities should be targeted whenever possible as a key element of the Combined Bomber Offensive. Tedder viewed the German transportation system as a "common denominator" which could be attacked by both strategic and tactical air assets. This campaign against the German transportation system proper (though still limited in aspect and unsystematic) began on 5 September 1944. The Eighth Air Force began to inflict, in the words of aviation historian Richard Davis, the "death-of-a-thousand cuts" on the German transportation system. Prior to this time only sporadic attacks had been conducted against German transportation targets because a strategic focus or emphasis had not been defined by the decision-makers in the air war. Therefore, efforts prior to September 1944 against the German transportation system were fitful in nature and were not conducted with a coherent plan guiding them. The US Strategic Bombing Survey determined that "no significant deterioration in

27Craven and Cate, Army Air Forces 3: 640, 649-50.

28Davis, Carl Spaatz and the Air War in Europe, 508.
the ability of [the German transportation system] to handle traffic can be traced to the effects of these sporadic attacks."29

In April 1944 the British and American strategic bomber forces had been placed under Eisenhower’s operational control so that he could coordinate their actions to best support Operation Overlord. By September 1944 the Allies were firmly established on the European continent, and the requirement for tactical and operational level support to land operations by the strategic bombers was less urgent. At the Quebec Conference in September 1944, it was decided to restore command and control of the Allied strategic air forces to the Combined Chiefs of Staff. Portal, Chief of the (British) Air Staff, and General Henry H. Arnold, commander of the US Army Air Forces, were designated to exercise command of the strategic bombers for the Combined Chiefs. In the opinion of aviation historian Alan Levine, this change probably worked to the detriment of the strategic air offensive. As noted earlier in the section on the oil campaign, Portal was less than forceful in controlling Harris’ tendency to ignore his superiors’ instructions. Eisenhower and his Deputy for Air, Tedder, would probably not have allowed Harris to set his own objectives. Thus this change, in Levine’s opinion, “delayed and diluted the concentration of effort” against the German transportation system.30

In September 1944 the Combined Strategic Targets Committee (CSTC) was formed. It combined for the first time experts in economic and

29US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 2, 46.

30Levine, Strategic Bombing, 160-62.
communications intelligence and officers experienced in air operations. However the CSTC was dominated by proponents of the oil campaign; this diluted the emphasis on transportation targets in the fall of 1944.\textsuperscript{31} There was an element of bureaucratic infighting apparent in all this which is still detectable in articles written forty to fifty years after the events in question. For example, Walt Rostow in 1991 described Zuckerman’s prior qualifications as a targeteer as a “scholar of the sexual and social life of apes.” Rostow goes on to say that “there are Americans (and some British) who to the end of their days regarded (or will regard) the last year of the struggle in Europe as a war against Solly Zuckerman rather than Adolf Hitler.”\textsuperscript{32} This infighting degraded the efficiency of the intelligence process relative to support of the transportation campaign. In any case the CSTC remained critical of the efficacy of the transportation campaign until the spring of 1945. Tedder, the strongest advocate of the transportation campaign, had to force the CSTC to form a transportation subcommittee in October 1944, so low was their interest and emphasis on Germany’s railways and waterways. Tedder believed that the campaign against German transportation was inadequately planned (“a patchwork quilt”) and did not adhere to the principle of concentration of effort.\textsuperscript{33} Since many American attacks against transportation targets were scheduled during periods of poor weather when the preferred targets could not be visually bombed, radar techniques had to be used. The inaccuracy of

\footnotesize{
\begin{itemize}
\item \textsuperscript{31}US Strategic Bombing Survey, Transportation Division, \textit{Effects on Transportation}, 167; Davis, \textit{Carl Spaatz and the Air War in Europe}, 167.
\item \textsuperscript{32}Rostow, “Waging Economic Warfare,” 37.
\item \textsuperscript{33}Davis, \textit{Carl Spaatz and the Air War in Europe}, 496; Levine, \textit{Strategic Bombing of Germany}, 167.
\end{itemize}
}
radar bombing made these attacks more akin to the RAF’s area bombing than the doctrinal American precision technique.

The first big success of the transportation campaign against German targets occurred on the night of 23-24 September 1944 when one hundred and thirty-six Lancasters of Bomber Command’s 5 Group attacked the Dortmund-Ems Canal near Ladbergen. The raised earthen banks of the canal were breached; this allowed the water to escape. The canal was not reopened until 21 October 1944.34

The next success was the result of a lucky accident. On 14 October 1944 an attack on the Cologne marshalling yards accidentally set off demolition charges which the Germans had placed under the 1,000-foot Cologne-Mulheim Bridge; the massive span fell into the Rhine and blocked barge traffic for the rest of the war.35 This interruption of navigation was reported via Enigma by the Germans and was intercepted and exploited by Allied communications intelligence.

On 22nd [October 1944] Commander-in-Chief West reported a very large number of workmen employed in making as quickly as possible a navigable channel at the site of the Rhine suspension bridge at Koeln-Muelheim which was destroyed by air strikes on 14th. In addition last serviceable heavy lifting equipment of Waterways Directorate Coblenz and of the Todt Gruppe being employed.36

Had Allied intelligence analysts realized the significance of blocking the

34Harris, Bomber Command, 239; US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 17.

35US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 18.

36ULTRA: German Secret Messages, CX/MSS/T352/25, HP 4921,
Rhine, strategic bombers could have built upon this success. It does not appear that any deliberate attempt was made to capitalize on the initial blocking of the Rhine. An obvious target would have been the “last serviceable heavy lifting equipment” that was being used to try to remove the debris from the barge channel.

The campaign against the German canal system was more focused than the attack on the Reichsbahn. On 26 October 1944 an Eighth Air Force strike cut the Mittelland Canal at Minden. German repair efforts succeeded in reopening both major canals. This required that Allied bombers conduct repeat strikes. On the night of 4-5 November 1944 Bomber Command’s 5 Group again breached the Dortmund-Ems Canal. Strikes on the night of 21-22 November 1944 shut both canals down once again, but German repair crews reopened them by the end of December. On 1 January 1945 both canals were breached again by 5 Group. The final attack on the Mittelland Canal occurred on the night of 21-22 February 1945. This attack shut down the Mittelland Canal for the rest of the war. The Dortmund-Ems Canal was shut down by a strike on the night of 3-4 March 1945. This series of strikes and German repair measures demonstrates just how vital it was to conduct periodically repeat strikes against these targets in order to keep them non-operational.

The success of these attacks against the waterway system was clearly

291339Z/10/44.

37US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 18.

38Ibid.
evident to Allied photo-reconnaissance. As with the oil campaign there were only a limited number of targets. It was relatively easy for Allied intelligence analysts to recognize the level of success against this segment of the German transportation system and to advise air commanders when repeat strikes were necessary. ULTRA intelligence was not necessary to this process, and in fact, there is very little reference to the inland waterways in the ULTRA intercepts.

The effect of the destruction of the inland waterway system was to throw the burden of moving coal onto the already overloaded railways. Coal movement by water in Germany fell from 2,214,000 tons in August 1944 to 724,000 tons in October, then to 454,000 tons in November.39

The attacks on the German inland waterways beginning in late September 1944 had been rewarded with early and continued success. However, attacks on the German railway system took longer to achieve comparable results. Poor weather in the fall of 1944 often forced changes from primary targets to attack secondary targets such as marshalling yards. Large, well-defined targets such as marshalling yards were relatively easy to find on radar through clouds. Heavy tonnages of bombs were dropped on the basis of radar signatures, but the accuracy of this technique was poor. Despite this a great deal of incremental damage was being done to the German railroads; its cumulative effect began to mount in October and November 1944.40

Allied intelligence analysts had not yet developed a sufficiently detailed insight into the German railway network to assess accurately the cumulative

39Ibid., 17-25, 83.

impact of the bombing campaign. Allied intelligence analysts tended to underestimate the level of damage. A great deal of enciphered German railway traffic was available and readable, but this type of communications intelligence had a low priority for processing. Furthermore, the routine, small-scale scope of individual messages did not mean much by themselves without a detailed and comprehensive knowledge of the German railway system.\textsuperscript{41} A typical such report read:

\begin{quote}
Flak Report of 26th [October 1944]. (Comment. Incomplete.) Bombs on Courcelles railway station. (Queen 0257). No damage. At 1020 hours bombs on communications, entrenching work, and flak positions area Buss. (Queen 3275) and Wehrden (Queen 3572). Fair indications no damage. At 1210 hours bombs on Bergweiler and railway stretch Meksweiler-Fuerstenhausen. Line interrupted. Four bombs on machine factory Langhammer, five in neighborhood of Gerweiler, one UXB [unexploded bomb] in the town. At 1120-1150 hours thirty [P-47] Thunderbolts in Hagenau area. Bombs on railway station. Eleven locomotives damaged.\textsuperscript{42}
\end{quote}

While such an intercept gave a detailed picture of bomb damage in one small area, it did not relate this damage to the overall operational efficiency of the transportation system.

However, there was at least one attempt to put together some of these fragmentary reports to make them useful in understanding how the German railways were functioning under the pressure of Allied strategic air bombardment. Extremely detailed reports of railway activity passing through the small German border town of Bentheim (about 35 miles northwest of Münster) were received on a regular basis. An analytical overview based

\textsuperscript{41}Hinsley, et al., \textit{British Intelligence} 3 (2):526-28.

\textsuperscript{42}ULTRA: \textit{German Secret Messages}, reel 47, CX/MSS/T350/49, HP 4715, 121753Z/10/44.
on five of the Bentheim rail activity intercepts was issued by Allied intelligence on 23 October 1944 and is quoted below.

Following is an analysis with comment. Train movements through Bentheim in HPs 3224, 3226, 3428, 3447, 3651. [ULTRA intercepts] Of total sixty one trains from 7th to 15th October [1944], thirty-three trains passed in direction Holland, twenty-eight trains to Germany. Movements to Germany mainly evacuation material and small scale troop. Of total movement to Holland, only one fuel train (origin TK Hanover). Of twelve trucks and six ammunition trains (TK origins: Hanover three, Karlsruhe one, Munich one, unknown one). Recorded, remainder small scale troop and equipment. Noteworthy that approximately fifty per cent of total movement both directions made during daylight. Tempo lowest between 1100 and 1600 hours; peak reached between 2200-0200 hours. Origins of trains passing to Holland scattered throughout northern Germany, but areas of TK Hanover and Hamburg most prominent. Not known whether Bentheim traffic completely covered by these details.43

Despite the somewhat tenuous nature of the above analysis, it indicates that at least one communications intelligence analyst was on the right track. If more of this kind of analysis had been done, it is likely that the transportation campaign would have benefited from better intelligence.

There were other messages available which could have provided insights on a higher plane concerning the disruption of the German railways. Had these been interpreted correctly, Allied intelligence would have understood the impact of strategic bombing and the consequent effects on the German war economy and military capabilities. A message from the German armed forces high command sent on 20 October 1944 quoted Speer as reporting that 30-35 percent of munitions and armament plants were shut down because of an inability to move raw materials (primarily coal, needed for generation of electricity, for making steel, and for processing synthetic oil, chemicals, and

43Ibid., HP 4283, 231808Z/10/44.
munitions). However, this intercept did not receive much attention until February 1945, when a review of ULTRA intelligence relating to the transportation campaign was conducted.

Another intercept from a German naval command gave a clear picture of how the bombing campaign was forcing a reallocation of fighter assets in an effort to improve air defense of the Reich, despite a desperate need for those fighters on the operational fronts.

Situation report circulated by a chief naval command on 18th [October 1944]. Strong pressure on all German fronts and new large scale attacks expected. Nevertheless, transfer into the Reich of further fighter forces taking place. In present ground situation Allied air strategy needs particularly close watching. As no large scale army attack yet in West [Luftwaffe needs] to cause Allies such heavy losses as to enforce abandoning systematic destruction of armaments industry and communications network. Conclusion for German Air Force, defense of Reich to be the main task, unambiguously and without reservation. OKL must therefore contemplate a further weakening of the front Luftwaffe fighter forces to strengthen defense of the Reich. At the present stage of the war, benefits of successful Reich defense would be shared by all elements of the armed forces and would affect the conduct of the war to a very high degree.

It is obvious from this intercept that the strategic bombing campaign was causing much damage to the German economic infrastructure. The Germans were forced to shift badly needed fighters from support to the fighting fronts to home defense. The strategic attack on German industrial targets thus paid specific dividends in the strictly military sphere as well as generally weakening the German war economy.

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44 Ibid., CX/MSS/T347/46, HP 4394, 241929Z/10/44.

45 Mierzejewski, Collapse of the German War Economy, 167.

46 ULTRA: German Secret Messages, reel 47, CX/MSS/T349/42, HP 4627, 262123Z/10/44.
ULTRA intercepts were not the only sources of communications intelligence on the effects of the transportation campaign. Diplomatic cables (MAGIC) also provided intelligence which was usually on a higher plane than the more tactically oriented ULTRA intercepts. The Japanese Embassy in Berlin continued to be a particularly lucrative source of intelligence. On 2 October 1944 the Japanese naval attaché, Admiral Abe, reported that the disruption of transportation networks in Germany was severely impeding the movement of coal and munitions from the Rhineland.47

Alfred Mierzejewski, the author of an in-depth study on the strategic bombing of the German transportation system, claims that much of the failure of intelligence analysts to develop an accurate appreciation of the success of the transportation campaign can be attributed to bureaucratic obstructionism. He is of the opinion that organizations opposed to the transportation campaign, particularly the CSTC and the Enemy Objectives Unit (EOU), deliberately withheld information from analysts and operational air commanders. At the very least, according to him, they improperly managed the processing of communications intelligence relating to the transportation campaign. Mierzejewski believes that if the available ULTRA intelligence on the damage to the German transportation system had been handled objectively, it would have undercut the emphasis on the oil campaign. The implication he suggests is that since the oil campaign was the preferred policy of the intelligence decision-makers and their superiors, the commanders of the strategic air forces, this lack of action protected the oil campaign from

47BAY/HP 44 of 10 October 1944, quoted in Hinsley, et al., British Intelligence 3 (2): 526.
Car placing is an index of railroad activity. It measures the operation of the marshaling yards. A car placing is the insertion of one car into a train. The hard coal units index compares movement of coal in ten-ton units. The average capacity of a German coal car was 20 tons.

Figure 5. Armaments Production and Railroad Performance, 1943-1945.

competition. He believes that this was done deliberately.48

The number of ULTRA intercepts concerning the effects of bombing on transportation targets increased greatly beginning in November 1944.49 Damage to land line telecommunications increasingly forced the German railways to use radio to coordinate routine operations (especially rerouting of trains to avoid bombed sections of the line), maintenance, and administrative matters.50 Repeated references to logistics problems in Luftwaffe and German ground forces communications intercepts were thus reinforced by communications intelligence evidence of an increasing level of general economic dislocation.51 An early example of the inability of the Germans to move raw materials, as revealed by ULTRA, is quoted below.

SS Mountain Corps Chief of Staff on 7th [October 1944] requested cancellation of present orders to develop railway line Metkovic-Brod for bauxite transport program of 40,000 tons per month, owing very reduced capacity of the railway, overloading of line by important troop movements, and great lack of fuel for bauxite vehicles.52

Here we have an example of the inability to move a critical raw material because of the “reduced capacity” of the German railroads. Competing demands for troop movements took priority over bauxite shipments for the remaining capacity of the system. The ever-present fuel shortages, a result

48Mierzejewski, Collapse of the German War Economy, 162-71.

49Hinsley, et al., British Intelligence 3 (2):527.

50US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 50; Davis, Carl Spaatz and the Air War in Europe, 510.

51Hinsley, et al., British Intelligence 3 (2):527.

52ULTRA: German Secret Messages, reel 47, CX/MSS/R342/E/45, HP 4278, 2317322/10/44.
of both the oil campaign and the inability to move what fuel was available, are also evident in this intercept.

In November 1944 the bombing of railway marshalling yards and other railway targets continued to erode the efficiency of the system. Individual bombing attacks generally did not shut down very much of the system, but the effects of bomb damage was cumulative. The Strategic Bombing Survey estimated that it took an average of six major attacks to wreck completely a typical marshalling yard. The necessity for periodic repeat strikes against these facilities, as was the case with the oil industry, was often highlighted in ULTRA intercepts. These intercepts sometimes gave estimates of the time required to restore a transportation facility to more or less normal operational status. A typical example is quoted below.

Road bridge next to rail bridge over South Beveland Canal (D24) unserviceable on 18th [September 1944]. Repair time three to four months. Rail bridge again serviceable.

Knowing how long it would take to repair such a facility simplified the targeteer’s job. In keeping with the military principle of economy of force, no strikes need be scheduled until this facility was close to being restored to operational status.

Some of the more spectacular attacks of the transportation campaign were conducted during this period. An Eighth Air Force attack on the Bielefeld Viaduct on 2 November 1944 closed it for nine days. A repeat strike on 29 November 1944 closed it for eleven days. The Altenbecken Viaduct was

53US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 4.

54ULTRA: German Secret Messages, reel 42, CX/MSS/T313/79, 211004Z/9/44.
also closed by Eighth Air Force bombers on 26 November 1944; it was not reopened until 12 February 1944. These key targets were strongly built and not easily damaged by the 500-pound bombs normally used by American bombers. The much larger bombs which the British bombers were capable of carrying (2,000-, 4,000-, and the so-called 12,000-pound "Tallboy") would have been much more effective against these targets.

The transportation campaign was not limited to strategic bombers. Medium and light bombers from the Ninth Air Force were also assigned transportation targets just as they had been in the pre-Normandy air campaign. Fighter bombers from both the Eighth and Ninth Air Forces joined in as well; they proved to be very effective against bridges, moving trains, and other small targets. An example of the effectiveness of strikes by tactical aircraft on transportation targets was provided by the following intercept:

To Reichminister for Armament and War Production [Speer] from Armaments Commission Wehrkreis 12 on 29th [December 1944].
Favored by clear weather Allied fighter bombers have destroyed, during last few days, traffic installations on an extensive scale. Repair work nullified within a few hours. (Strong indications railway) and tele-communications interrupted. Telephone facilities hardly exist. As a result of rerouting rail transport almost impossible and armaments production being crippled. Coal and armaments transport hardly possible. Request again fighter protection for this area. Everything possible done to repair installations but without fighter protection almost pointless. Above points applicable to Westmark and Gau Moselland.

55US Strategic Bombing Survey, Transportation Division, Effects on German Transportation, 65.
56Knight, Strategic Offensive Air Operations, 34.
57Craven and Cate, Army Air Forces 3:654.
58ULTRA: German Secret Messages, reel 56, CX/MSS/T416/34, BT 913, 0116282/1/45.
Fighter bombers were able to direct their strikes with far more precision than massed heavy bomber formations. Fighter bombers usually attacked individually and dropped one bomb per attack run from low altitude. All heavy bombers in a formation usually dropped all their bombs simultaneously from high altitude. Consequently, heavy bombers were effective against large area targets, but many bombs were wasted in attacks against small targets such as bridges and tunnels. Here again we have a situation that mitigated against the transportation campaign having a strong proponent. Since the heavy bombers were not really suitable for use against transportation targets, the bomber commanders could not demonstrate the war-winning decisiveness of their premier weapon, the heavy bomber, in this arena. Therefore, the tendency was to avoid getting involved in the transportation campaign, and to try to use the heavy bombers where they could show their power to best effect.

It is ironic that tactical aircraft proved very effective in attacks against small components of the German transportation system. Taken together these attacks by tactical aircraft had a strategic effect in that they efficiently contributed to the success of the transportation campaign and the dislocation of German industry.

The damage to the railways was so debilitating to German logistics that the armed forces were ordered to use the already badly damaged inland waterways to meet their supply needs, despite the increased time of exposure to air attack of goods in transit. The decryption of this order is quoted below.

According Army Group Baker on 2nd [November 1944]: (1) To relieve railways part of supplies for 15th Army and Commander-in-Chief Armed Forces Holland to be forwarded by inland waterways. (2) Following two routes projected for time being.
(Able) Emden-Groningen-Lemmer-Amsterdam-Utrecht. (Baker) Meppen-Hoogeveen-Meppel-Amsterdam-Utrecht. (3) Carrying out transport in Dutch area, to Army Group terminal point of Utrecht, to be undertaken by Admiral Netherlands. (4) From Utrecht or conveniently situated stations enroute 15th Army or Commander-in-Chief Armed Forces Holland to fetch supplies with own transport.  

The most efficient procedure for logistics support, had there been no air campaign, would have been for the German supply system to deliver necessary supplies all the way to the 15th Army's depots. Inefficiency was introduced into the system by handing off supplies to the German navy for intermediate handling. Further inefficiency was caused by requiring the hard-pressed operational forces to provide their own pickup and final delivery service. The costs in pilferage and confusion must have outweighed any gains in survivability of supplies. 

Despite the sort of intelligence available through ULTRA cited above, it was not used as systematically and effectively in the transportation campaign as it was in the oil campaign. Success against the German railways was due more to persistence and weight of numbers than to a precise focusing of effort through the use of communications intelligence. The campaign against the German railways became a struggle between German repair crews on the one hand and the Allied bombers on the other. The persistent attacks on rail facilities began to achieve important results in November 1944. Damage to marshalling yards often made it impossible to form trains, and destruction of bridges often caused bottlenecks and subsequent congestion on detour routes. Rail service became intermittent and undependable. Daytime

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60Mierzejewski, Collapse of the German War Economy, 124-130.
movement of trains was made impossible by strafing and bombing attacks by Allied fighters throughout a large part of western Germany. By the end of November transportation woes were causing severe problems for German operational forces. On 25 November 1944 Speer requested that trucks be requisitioned from the armed forces to assist in railway reconstruction.

To repair with all speed damage to [lines of] communications from Allied air raids, armed forces requested by Speer to provide lorry space for Ruhr. Despite difficult transport situation in Italy, Commander-in-Chief Southwest ordered to surrender 500 lorries of Oboe Tare. [This term probably means octane.] Italian lorries not yet commandeered and German lorries not in service to be drawn on for replacements.

Once again the transportation campaign had imposed a penalty on German operational forces. The trucks that they were forced to give up certainly hindered German tactical flexibility. The Germans were forced to sacrifice operational needs to the demands of maintaining a certain level of domestic industrial infrastructure. Rather than adding to the German operational capability, the German war economy now was draining assets from the fighting forces.

In the following months even more drastic limitations were imposed on the German armed forces by the inability of the logistics network to supply them properly with the tools of war. A remarkable testimony to this situation is quoted below.

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61US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 50-61, 78-80.

62ULTRA: German Secret Messages, reel 52, CX/MSS/T383/91, HP 8243, 300609Z/11/44.
OKW (Quartermaster) order of 10th [December 1944] quoted. To Commander-in-Chief Southeast on 11th reference formation of ammunition reserves. (1) Demand for sufficient ammunition for large scale fighting could (owing raw material, production, and transport situation) be met only by restriction of employment to Schwerpunkte and the most stringent economy on quiet fronts. In spite of all previous orders expenditure on quiet fronts had reached figure which made formation of an ammunition reserve impossible and endangered supply for areas where large scale fighting taking place. German ammunition expenditure in no way comparable with Allied.63

Remainder of order concerning formation of ammunition reserves (BT 2635) now available. Continues: (2) Therefore necessary to (Able) ruthlessly to restrict expenditure ammunition in short supply and suspend its use in certain sectors according tactical situation. In this connection even engagement of worthwhile targets would have to be foregone. [Italics are author's.] (Baker) By expedient ammunition tactics to use instead more ammunition types not listed in short supply. (Charlie) To adapt ammunition expenditure to that of Allies. (Dog) Ammunition reserves to be used against small identified preparations for attack only on order of GOCs [general officers commanding] armies and army groups. (3) OKH and OKL also to take further steps to build up ammunition pools in accordance with OKW order of 6th October [1944]. OKM [German Navy] to make relevant arrangements in its sphere of command. (4) OKH, Commander-in-Chief West, Commander-in-Chief Southwest, and Commander-in-Chief Southeast to report by 25th OKW steps taken to save ammunition.64

Even more drastic ammunition problems were caused by the combined effects of the oil campaign and the transportation campaign. Strategic bombing of the oil industry curtailed the supply of nitrogen (used in explosives and propellants). Attacks on the transportation system, which delivered the finished product (ammunition) to the armed forces, often made it impossible to move available ammunition from the factories to where it was needed. Insufficient ammunition was available for use even in routine but critical situations as defending against the Allied bombers, as revealed in the

63Ibid., reel 58, CX/MSS/T432/87, BT 2635, 180605Z/1/45.

64Ibid., reel 59, CX/MSS/T435/41, BT 2879, 202101Z/1/45.
following intercept:

Flak Division 25 on 1st [March 1945] ordered quote further unquote cuts in expenditure of 8.8 centimeter ammunition for the time being, owing losses in production and transport difficulties. Allied bomber formations flying past to be fired on only if favorable conditions exist and only on a quite restricted scale. [Italics are author’s.] Above restrictions to apply also to 9 centimeter units.65

It is ironic that the strategic bombers thus increased their survivability by degrading the German antiaircraft defenses. During the last few months of the war, radar-controlled flak was used with increasing frequency by the Germans. Radar greatly increased the accuracy of flak. Had there been a more plentiful supply of ammunition, Allied bomber losses would have been higher.

One clear measure of effectiveness in analyzing the success of the transportation campaign is the movement of coal by rail, the basic fuel of German industry and the basic raw material for the production of synthetic oil. The number of coal cars moving over the German railway system declined steadily due to the effects of the bombing campaign, from 127,000 in August 1944, to 115,000 in September, to 105,000 in October, to 99,000 in November, and finally to 83,000 in December. The number of all types of railcars moving over the rail net also declined steadily, from 3,940,944 in August 1944 to 3,442,133 in September, to 3,241,506 in October, to 2,976,302 in November, to 2,570,707 in December.66 It became increasingly difficult to move coal and iron ore to steel plants; these raw materials piled up in the mining regions.

65Ibid., reel 64, CX/MSS/T475/83, BT 6076, 020650Z/3/45.

66Ibid.
The level of production in German industry began to fall because of the lack of basic raw materials. Much of what could be produced with the last remaining inventory of raw materials could not be shipped because of the damage to the railways.

To a degree the severity of the coal shortage on the German war economy was revealed by ULTRA, although the exact figures given above were not available until after the war. A very explicit message on the coal situation was intercepted at the end of January 1945, however.

Commander-in-Chief Southwest on 23rd [January 1945] informed OKW operations staff that, by using up all available coal stocks and coal coming-up on 22nd in the Italian area, the emergency program for railways, shipping, troops, industry, and economics, could operate until 1st March. Emergency program envisaged in essence: (1) covering of most urgent troop supplies. Tactical troop movements as far as absolutely necessary. [Probably refers to the use of coal as locomotive fuel for troop movements.] (2) Greatly reduced continuation of industrial and economic work. (3) Emergency supplying of the population. (4) Considerable restriction of transport of building materials for constructing positions. (5) Severest restriction of deliveries in large capacity trucks to Reich with exception of traffic through Switzerland. Continuation of emergency program beyond 1st March for another month possible if delivery made by 20th February of 25,000 tons for railway, 75,000 tons of coal and coke for industry, 20,000 tons for military purposes (including 5,000 tons for Navy).67

The Germans in Italy thus had to prioritize the allocation of the small stocks of coal that were available. Even if emergency measures were implemented, coal stocks would run out in five weeks unless additional deliveries could be made. Allied communications intelligence analysts had available sufficient intercepts such as the one above to have indicated that coal was as critical a vulnerability as oil. The focus of the bombing offensive

67ULTRA: German Secret Messages, reel 59, CX/MSS/T445/38, BT 3750, 302045Z/1/45.
remained on oil, however.

Despite the steady success of the transportation campaign through the end of 1944, Allied intelligence still did not fully appreciate its effectiveness.68 A new directive on bombing priorities on 5 December 1944 lowered transportation to third priority; direct support to Allied land armies was made second priority, while oil was retained as the top priority.69

By January 1945 German rail traffic had been reduced by sixty per cent of pre-campaign levels, and by the spring of 1945 it was reduced to twenty per cent. The efficiency of the German marshalling yards had been so badly degraded that backlogs of freight cars could not be sorted efficiently and "classified" for rerouting to their destinations; this forced the Germans to begin taking large numbers of freight cars out of service to reduce the congestion caused by bomb damage.70 The supply of coal in non-coal producing areas dropped to critical levels in the winter of 1944-1945 because of transportation difficulties. This meant that not only did the German populace suffer from lack of heating fuel for their homes but that German industry was to enter a period of precipitous decline. In February 1945 coal deliveries fell to 25 percent of pre-campaign levels. In March coal deliveries declined to 16 percent, and by the beginning of April 1945 to 4 percent of normal.71 Part of this loss was due to the campaigns which resulted in

68US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 4.

69Mierzejewski, Collapse of the German War Economy, 126.

70US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 54.

71Ibid., 13.
the capture of the Saar and Upper Silesia (major coal producing regions) by
the advancing Allied ground forces.

ULTRA intercepts continued to contain information on the damage
being done to the rail system and the consequences it was having on German
industry during the winter of 1944-1945. These effects also continued to hurt
the German armed forces, as is clearly apparent in the following ULTRA
intercepts.

Air raid damage, 1745 hours 15th [December 1944]. Junkerath-
damage to railway. Grevebroich-railway goods and shunting
station destroyed, army rations dump burning. Bombs dropped
on Bonn area. Railway line Frankfurt-Mainz-Ruedesheim-
Neiderhausen temporarily interrupted. Mannheim-several bomb
carpets on traffic installations and harbor area. Goods railway
station severely hit. One hit on Ludwigshafen-Mannheim bridge,
traffic interrupted. Railway line to Kreuznach and Mainz
interrupted.72

Firm Ernest Leitz at Wetzlau not supplied with sufficient fuel and
would have to close down if sufficient coke not delivered within
eight days.73

From Army Group Baker, situation report of 2 January 1945.
Entire traffic on West Rhine Railway continued at complete
standstill. Supply situation remained extremely strained.74

Analysis of reports such as these could have provided Allied operational
commanders with an understanding of the true state of the German
capability for continuing the war. Industrial plants were forced to shut
down due to lack of coal rather than because of direct bomb damage. The
fact that all traffic on the West Rhine Railway was stopped attested to the

72ULTRA: German Secret Messages, reel 58, CX/MSS/R418,
120146Z/1/45.

73Ibid., CX/MSS/R413, 120116Z/1/45.

74Ibid., CX/MSS/T426/72, 112347Z/1/45.
paralysis of a significant segment of the *Reichsbahn*. It did not require a comprehensive knowledge of the intricacies of the German railway system to recognize the significance of this development.

Despite the unsystematic nature of the transportation campaign up to January 1945 and into February, the last major industrial area left to the Germans (the Ruhr) was effectively cut off from the rest of the Reich by damage to the railways and waterways. Speer referred to the region as an "island" on 18 January 1945, and on 30 January 1945 he reported to Hitler in a hand-delivered memorandum that the war was lost. The German armaments industry could no longer meet the needs of the armed forces.75

Three primary factors prevented the Allies from reaching a proper assessment of the success of the transportation campaign in the winter of 1944-1945. First, poor weather conditions hampered photo-reconnaissance. Second, the long-standing failure of Allied intelligence decision-makers to focus sufficient assets on basic analysis of the German transportation system had not been rectified. Third, insufficient priority was given to processing the available ULTRA intercepts on transportation targets. Many important air commanders and staff officers remained unconvinced of the wisdom of devoting assets to attacking transportation targets. When compared to the German view expressed in the paragraph above, it is obvious that Allied intelligence missed the mark in this instance. During this period the intelligence staff of the US Strategic Air Forces kept daily situation maps of the damage to German railways and waterways. The primary source used was

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75 Speer, *Inside the Third Reich*, 502; Mierzejewski, *Collapse of the German War Economy*, 146.
photo-reconnaissance. The Germans kept their own daily situation maps. When the US Strategic Bombing Survey compared the American and the German situation maps after the war, they found that the “difference was so great that the Air Force [situation] maps [were] of no value” because of their glaring inaccuracies.76

In February 1945 Air Marshal Norman Bottomley, Assistant Chief of the [British] Air Staff (Operations), ordered a review of how effectively ULTRA intelligence had been used in supporting the transportation campaign. This review determined that a great number of ULTRA intercepts (20,000 weekly) on the German economy and transportation problems had been processed but not given the appropriate level of attention and analysis. Mierzejewski goes on to say that “the study demonstrated that for months the CSTC had been suppressing Enigma information on the Reichbahn and the economy.”77

Despite the increased level of interest in the transportation campaign by Bottomley, the CSTC (on 17 January 1945) had lowered the priority of transportation as a target system. The committee recommended that attacks on transportation facilities be limited to targets just behind the front lines. However, Tedder maintained his steadfast support for the transportation campaign. By 10 February 1945 he managed to exert enough pressure to reverse the de-emphasis and to obtain agreement to conduct a new transportation campaign. Its goal was to sever completely the Ruhr’s links with the rest of Germany. This would assist Eisenhower’s planned double

76US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 63.

77Davis, Carl Spaatz and the Air War in Europe, 537-38; Mierzejewski, The Collapse of the German War Economy, 167.
envelopment of the Ruhr as well as exacerbate Germany's economic problems. Thus, the objectives of this plan (usually referred to as the Interim Plan) were both tactical and strategic. The British Joint Intelligence Committee (JIC) belatedly acknowledged the success of the transportation campaign on 8 February 1945. On that date the JIC suggested that halting all coal shipments from the Ruhr would have "effects as important as oil."\(^7^9\)

The campaign to isolate the Ruhr quickly attained its goals. Strategic bombers, medium and light bombers, and fighter bombers were used effectively against a limited number of key targets. Eighteen bridges and viaducts were selected for attack. British bombers using 22,000-pound "Grand Slam" bombs permanently destroyed the resilient Bielefeld Viaduct on 13 March 1945. British Tallboys and Grand Slams were also used to destroy the Altenbecken Viaduct and several key bridges. By 24 March 1945 sixteen of the eighteen targets initially selected had been destroyed. For all practical purposes the Ruhr was isolated.\(^8^0\)

The tone of ULTRA intercepts concerning German transportation problems became almost plaintive in January, February, and March 1945. The following intercepts emphasize the degree of paralysis inflicted upon the Germans by the strategic bombing offensive.

Report from depot Wittenberg. Transport situation further deteriorated, scarcely any trains now coming through from

\(^7^8\)Craven and Cate, *Army Air Forces* 3:718-19; Levine, *Strategic Bombing of Germany*, 186.

\(^7^9\)JIC(45)50 of 8 February 1944, quoted in Hinsley, et al., *British Intelligence* 3 (2):607.

\(^8^0\)US Strategic Bombing Survey, Transportation Division, *Effects on Transportation*, 63-68.
Westphalia, since rail lines extensively destroyed.81

According unspecified [military] authority in Italy on 1st [March 1945]: Mobility limited to a degree hardly endurable owing to lack of fuel and very bad tire situation. Thus rapid shifting of reserves jeopardized.82

The Allied air forces continued to attack transportation targets for the remaining few weeks of the war. Given the absence of other types of targets, transportation was finally made the number one priority for strategic bombing in March 1945.83 The German ability to move raw materials and finished goods to support the war effort declined to an extremely low level after March 1945. So great was the devastation that no useful statistics on railway damage were kept after March 1945.84 By the end of March strategic bombing attacks were no longer productive and were largely stopped, as it was obvious that the Germans were nearing collapse and that further bomb damage would impede the Allied advance and the postwar occupation of Germany more than it would hurt the enemy.85

Haywood Hansell in The Strategic Air War against Germany and Japan evaluated the accomplishments of the Allied strategic bombing campaign. He commented that

81ULTRA: German Secret Messages, reel 64, CX/MSS/T476/13, BT 6093, 021431Z/3/45.

82Ibid., CX/MSS/T480/30, BT 6495, 062219Z/3/45.

83US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 61.

84Ibid.

85Craven and Cate, Army Air Forces 3:753.
Figure 6. The Ruhr Railway Network.

the attack on transportation beginning in September 1944 was the most important single cause of Germany’s ultimate economic collapse. From December 1944 onward, all sectors of the German economy were in rapid decline. Even if the final military victories that carried the Allied armies across the Rhine and Oder had not taken place, armament production would have come to a virtual standstill in May; the German armies, completely bereft of ammunition and motive power, would almost certainly have had to cease fighting by June or July [1945].

Hansell, one of the original air campaign planners who wrote AWPD-1, believed that the transportation campaign was more effective than the oil campaign. His opinion agrees with the analysis of the US Strategic Bombing Survey.

Aviation historian Richard Davis summarized the transportation campaign succinctly in his biography of Carl Spaatz as follows:

This deluge of bombs played havoc with the German rail system or Reichbahn. The Reichbahn and, to a lesser extent, the German river and canal transport system, like the bloodstream carrying oxygen, carried coal to German industry. In striking the marshalling yards and canals, the Eighth tightened the same deadly tourniquet around the artery supplying coal to the German war economy as it had around the synthetic oil plants feeding the German war machine.

Davis eloquently draws a connection between the oil and transportation campaigns. He views the effects of the oil campaign as primarily military, whereas the effects of the transportation campaign were much broader. The transportation campaign weakened the basic structure of the German war economy.

Allied intelligence analysts did not clearly recognize the degree of vulnerability of the German transportation system. This was because of a

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86Hansell, Strategic Air War, 125-26.

87Davis, Carl Spaatz and the Air War in Europe, 507.
doctrinal prejudice and bureaucratic mindset and also because of the magnitude of the information management problem. The assessment of the damage done to the German transportation system was also hampered by poor aerial reconnaissance. The US Strategic Bombing Survey commented that "there was a failure to centralize the results of such reconnaissance as was undertaken for the purpose of interpreting it as a whole and keeping abreast of current developments." This statement could apply equally well to the handling of communications intelligence, but the Strategic Bombing Survey could not allude to the ULTRA secret at the time. The US Army Air Force history of the role of ULTRA in target planning, quoted in Mierzejewski’s book, concluded that

now that the full returns are coming in (autumn 1945), it seems probable that Allied intelligence officers did not at the time have a full appreciation of what railway bombing was doing to the German economy.89

Thus the failure to support the transportation campaign by analyzing properly the available intelligence limited its potential effectiveness.

88 US Strategic Bombing Survey, Transportation Division, Effects on Transportation, 4.

89 US Army Air Forces, Target Planning, 29, quoted in Mierzejewski, Collapse of the German War Economy, 251.
ULTRA intelligence provided a priceless advantage to the commanders of the strategic air offensive against Germany, which was used extensively in the oil campaign. ULTRA was not used as effectively in the transportation campaign. The reasons for this difference had their roots in strategic bombing doctrine, but were influenced also by the ambitions of air power leaders, the perception of immediate versus long-term benefits of each campaign, and bureaucratic and institutional factors.

The evidence provided by ULTRA suggesting that the oil campaign was achieving a high degree of success against the German oil industry coincided with the American strategic bombing philosophy. The US commanders had preconceived ideas that such a blow against a vital sector of the German war economy would cripple Germany. On the other hand, the British were committed to the area bombing campaign and tended to be less receptive to a strategy of bombing vital centers of German war production. The British tended to oppose precision bombing because it would take away assets from their area bombing campaign. Consequently, Air Marshal Harris did not utilize the gift of ULTRA to the extent that the American commanders did. Area bombing did not depend on precise intelligence that German targets had been destroyed. The targets for area bombing were entire German cities, and the effectiveness of this campaign was measured on an imprecise scale.
The true measure of effectiveness of the area bombing campaign was the breaking of German morale.

ULTRA intercepts indicated from the onset that the oil campaign was striking a particularly sensitive part of the German economy. Intercepts clearly confirmed that severe damage was being inflicted on Germany's oil industry and that German commanders were very concerned that the combat capability of their forces was being sharply reduced. The decline in oil production forced the Germans to make adjustments in order to defend their critical oil facilities and compensate for the lack of fuel. Allied leaders were aware of these deficiencies in German capabilities and were able to tailor their operational plans to take advantage of the concomitant vulnerabilities.

Allied intelligence officers tracked the progress of the oil campaign using ULTRA intercepts and photo-reconnaissance intelligence. Independently, neither was a complete source of information, but together they provided a full picture of the effectiveness of the oil campaign. ULTRA intelligence on the oil campaign ranged from bomb damage reports regarding raids against individual oil facilities, to German orders that fuel allocations be reduced because of declining production. Diplomatic intercepts, originating particularly in the Japanese Embassy in Berlin, provided an even broader picture of the overall effect of declining fuel resources.

German repair efforts to bring damaged oil facilities back into production were also exposed by ULTRA intercepts and by photographic reconnaissance. This exposure allowed the Allied air forces to conduct repeat strikes at the appropriate time to prevent a resumption of production. The sustained pressure against a selective and critical portion of the German war
economy resulted in a great reduction of the overall German war-making capability. Previous strategic bombardment campaigns (such as those against the ball bearing industry and German aircraft factories) failed because they did not maintain heavy and unrelenting pressure on such a narrow sector.

Without the benefit of intelligence derived from German communications, the Allied air commanders would have been much less sure of the effectiveness of the oil campaign. Competing demands for strategic bombing assets could have curtailed the oil campaign in mid-stream. However, the evidence of the effectiveness provided by ULTRA encouraged Allied air commanders to maintain the pressure against the German oil industry. The steady accumulation of specific data and the development of broader insights over an extended period was possible because of ULTRA intelligence. This reduced the number and degree of variables that Allied decision-makers had to consider.

The role of communications intelligence in the transportation campaign was not as influential as it was in the oil campaign. Although air power planners identified the German railways and waterways as important target systems early in the war, Allied decision-makers did not recognize transportation as a vital component of the German war economy until the campaign was well underway. The transportation campaign did not enjoy the full-fledged support of the commanders of the Allied strategic air forces. Consequently, the intelligence assets necessary to process the available information in order to derive finished intelligence were never allocated. Target selection and evaluation of the effectiveness of the transportation campaign depended less on current communications intelligence than on basic familiarity with the intricacies of Germany's railway and waterways
networks. This detailed expertise was never thoroughly developed, although the basis for it existed in scattered prewar data bases. The effort to sift and sort through the existing records and to integrate new intelligence in order to formulate an accurate assessment and analysis would have been too time-consuming and costly in intelligence assets from the point of view of management. It is noteworthy that communications intelligence was not required to achieve a full understanding of the structure, functioning, and vulnerabilities of the German transportation system. Allied intelligence leaders became used to having the inside information provided by ULTRA intercepts. Until strains were imposed on the German transportation network, there was little information available in ULTRA intercepts concerning the effectiveness of the campaign. In the absence of these cues, Allied decision-makers did not recognize the success of the transportation campaign until early 1945. Lacking the basic encyclopedic understanding of the German transportation system, there was plenty of latitude for divergent opinion about what the available communications intelligence really meant and about which targets should be attacked. Compounding this problem was the fact that the objectives for the transportation campaign were never clearly defined; they were too vague to guide the establishment of priorities and the selection of targets. Furthermore, the level of cooperation between the American and the British strategic air forces in the transportation campaign was less than optimal. Therefore the transportation campaign suffered from a lack of concentration of effort.

There was also a key doctrinal dimension to the difference in the less extensive use of communications intelligence in the transportation campaign. The oil campaign in the summer of 1944 conformed to prewar American
doctrines of precision strategic bombardment. American air power was
directed toward a target system (oil production) which was clearly recognized
as vital to the German armed forces. The German oil industry consisted of a
small number of critical and vulnerable facilities for which there was no
replacement. American strategic bombers conducted a precision bombing
campaign using visual aiming techniques. This effort had immediate success
in cutting off the supply of fuel to the German armed forces. This close
association between action and result was in keeping with prewar doctrine.
The transportation campaign was more a case of serendipitous expedience
than adherence to the doctrine of precision bombardment. Poor weather
over Western Europe in the last quarter of 1944 often made consistent visual
bombing impossible. Marshalling yards, easily identifiable on radar, were at
first attacked through cloud cover as alternate or secondary targets, when the
preferred critical industrial targets could not be attacked using visual
techniques. Marshalling yards and other transportation targets were
regarded as less valuable targets than critical industrial facilities, especially
given the redundancy and perceived ability to repair damage of the
transportation network. Perhaps even more influential on the decision-
making process was the fact that attacks on German transportation targets
would not have had a direct military benefit for the US armed forces. Intra-
German transportation was important to German industry, but the effects of
attacks on it would only be felt in the long term. Nevertheless, the cumulative
damage to the railway and waterway systems of Germany eventually
undermined the entire German economy.

Despite the strategic bombing campaign most of Germany’s industry
was still intact at the end of the war. Even in the Ruhr, the most heavily
bombed region of Germany, only 30 per cent of factory machinery had been
destroyed and another 20 per cent damaged. In the words of Alan Levine, it
was "the links between mines and industries, and the vital oil industry, which
produced the lifeblood of so many of the others, that had been destroyed." 1

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1Levine, Strategic Bombing, 188.
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APPENDIX I

According to Japanese Ambassador Berlin on Twelfth; Minister of Munitions Speer told him on Ninth: (Able) After big raid on Hamburg last summer Germany has been anxious for future but Allies had not carried out raids on unified plan. Allied raids had been like attacks upon delta in lower reaches instead of upon the source of the river and however much one attacked at such divergent points it was impossible to achieve a fatal blow. For instance, where the destruction of one factory, 'a', automatically involved a stoppage of work in factory, 'b', the Allies had many times raided 'b' in addition to 'a', the result from the German point of view being same as if only 'a' had been destroyed, while during time 'a' being restored it had been possible to get 'b' going again. (Baker) Fundamental errors in Allied claims that raids had brought about a falling off of 20 to 30 percent in production of munitions. Actually Germans had planned for normal rise and had carried out their plans. Steepness of upward curve only affected. Since Hamburg raid Germans had reduced percentage of damage in proportion to quantity of bombs dropped by 60 or 70 percent. Munitions production at Hamburg now 140 percent of what it had been before the bombing. (Charlie) Change however when daylight raids with long distance American fighters became main feature of raids, particularly against oil. Then for the first time really scientific raiding began which might deal a fatal blow to Germany. Problem of oil was the greatest now confronting them. (Dog) Air raids might become a danger to munitions production if systematically carried out. Only way to overcome danger is to regain air superiority. There is no intention of allowing German production of fighters and 'Zerstroerers' to fall behind production of twin-engined planes however big American production might become. If Germany's manpower and oil were not wiped out (and there is no expectation of that) they would be able to free themselves from danger now existing and thereafter increase production of oil and stocks. (Easy) By February this year production of fighters and 'Zerstroerers' had fallen to 1250 per month but by July production had reached 4500 and he proposed to bring figure to 6500 or seven thousand by end of year. (Fox) Underground factories at present amount to 800,000 square metres and would soon reach one million square metres. When that is reached monthly production in underground facilities alone would be one thousand and by end of year planned to have three million square metres underground. (George) As to effects of raids, some industries were relatively vulnerable and others not. Aircraft production came under the latter category and there were many instances of factories which Allies claimed to have totally destroyed having been got going again in two days and restored to 50 percent of normal efficiency in two weeks. (How) The proportion of fighters and 'Zerstroerers' to all other types, including bombers, recce, transport and training planes etc had risen to 70 or 80 percent since the beginning of the year
(previously it had been proportionally equal). Taking one hundred as figure at beginning of war, figure for middle of 1944 was 360. (Comment. All types). Production of 'engineless' planes would next year be 2000 a month. (Item) Finally, (Comment. Japanese summing up) articles the production of which had definitely been impaired are ball bearings and oil, and an increase in car production had been hampered.1
