# THE TRAFFIC ENGINEER AND WAR PRODUCTION TRANSPORTATION

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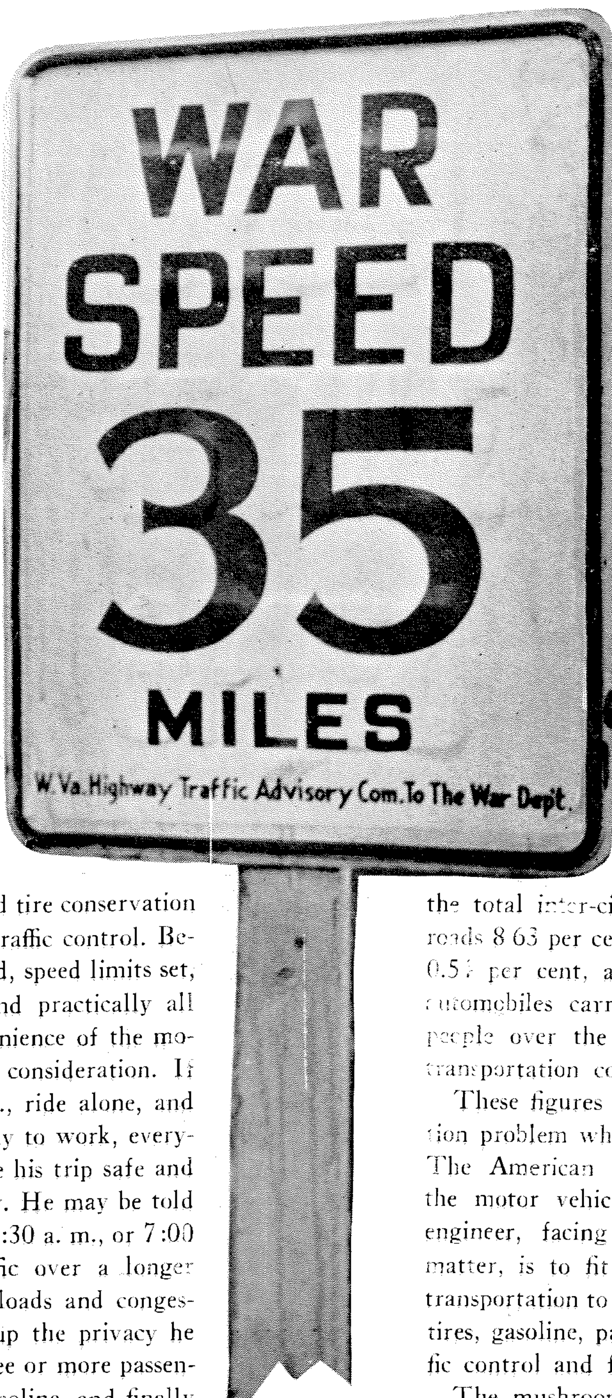
The entry of the United States into World War II has presented traffic engineers with the greatest challenge in the history of their profession. This war is basically a struggle to keep transportation lanes open and functioning efficiently, so that our army and our allies will be kept supplied with the vital essentials of war. To enable our forces to get there "the fustest with the mostest", they must have adequate and swift transportation in the theater of war operations, but must be supplied regularly and speedily from the home base also. Raw materials must be carried to the factories without delay, and the finished products must be transported away without delay. War workers must get to work safely and on time. It is the traffic engineers' job in this country to see that we do not fail on this end, that war production is not hampered by inefficiencies and congestion in our transportation system.




The traffic engineer is faced with new problems. Since 95 per cent of the world's crude rubber supply is in the hands of the Axis, steps have been taken toward tire conservation that have revised many concepts of traffic control. Before Pearl Harbor, signals were timed, speed limits set, hours of work and shopping set, and practically all traffic controls adjusted to the convenience of the motorist. His desires were given first consideration. If he wanted to go to work at 8 a. m., ride alone, and drive at 50 miles per hour on the way to work, everything was done to suit him and make his trip safe and convenient. All this has changed now. He may be told now that he must report to work at 7:30 a. m., or 7:00 a. m., in order to spread the traffic over a longer period and thus cut down on peak loads and congestion; he is told that he must give up the privacy he has been accustomed to, and find three or more passengers, or else OPA won't give him gasoline, and finally he's told that he must drive much slower than was the custom previously. In the eastern states he can't drive at all for pleasure.

The motorist's convenience is no longer a factor. Today the traffic engineer works on the basis of economy of operation of essential transportation and elimination of all non-essential transportation. During the past thirty years, the American people have built their way of life around the private automobile. Today we possess 29,000,000 passenger autos, 4,900,000 trucks and nearly 146,000 buses of all types, plus nearly 29,000 surface trolley cars. Forty-three per cent of our population living in rural areas is almost entirely dependent on private automobiles for transportation. Over 54,0000 communities are without railroad service, and some 2,300 towns do not have any means of mass transportation whatever. Each year we traveled an estimated 500 billion passenger miles by all forms of common carrier. The private automobile has become the most important means of moving about in cities.

Between cities, the private auto has carried most of the load too. A study of the Interstate Commerce Commission made in 1939 showed that private cars account for 85.44 per cent of the total inter-city travel in the United States, railroads 8.63 per cent, buses 5.15 per cent, water carriers 0.5[illegible] per cent, and air carriers 0.25 per cent. Thus automobiles carried five and a half times as many people over the country as all the other means of transportation combined.

These figures illustrate the share of the transportation problem which must be accorded the private car. The American economic system is dependent upon the motor vehicle. The challenge facing the traffic engineer, facing the whole United States for that matter, is to fit the rapidly increasing demands for transportation to the diminishing supply of automobiles, tires, gasoline, parts, and men and materials for traffic control and facilities.

The mushroom growth of industrial and military establishments has produced marked changes in the traffic patterns, which had been more or less stable in the past, both as to space and time distributions. The traffic engineer has been faced with a mighty task of re-adjusting traffic control, construction, and maintenance of facilities to the new conditions. In some areas this has been done by making studies to determine the 10 per cent of the total road system which is carrying the largest percentage of war production traffic, and concentrating available funds and manpower on this important 10 per cent. The increase in twenty-four hour operation of industries has caused traffic to flow at times never before experienced, requiring additional controls and safeguards. These changes have occurred in the face of shortages of signs, signals, construction materials, and manpower; consequently the traffic engineer has found it necessary to resurvey all existing traffic control facilities and manpower allocations on traffic control and enforcement to make transfers of these materials and men to places where they are more essential. This has not meant undertaking extensive area-wide traffic surveys, the "shotgun" approach. Time is short and manpower too scarce for such grandiose treatment. Rather it has meant the "rifle" approach; selecting the war production routes, and concentrating attention on these vital arterials, pulling signals and other equipment off other routes to be used where they will aid war traffic the best.

Passenger transportation may be divided into two main categories, private and public. Let us first examine the new problems affecting private passenger transportation.

The sudden growth of great war production plants and military installations has created access road problems of unprecedented magnitude. Countless industries already situated in urban or business districts, having secured war contracts, have expanded employment, drawing thousands of pedestrians and automobiles where there were only hundreds formerly, imposing heavy loads and congestion on city streets unable to accommodate the increased demand. Also there has been the access road problems brought about by the construction of giant plants in outlying districts, though here there has been the chance to design and construct adequate facilities to accommodate the expected loads. Realizing the great importance of keeping war traffic rolling on these routes, Congress has appropriated $150,000,000 for the construction and improvement of access roads to military and naval reservations; to defense industries and defense industry sites, and to sources of raw materials.

Working on these problems have been local city and state traffic engineers, assisting the plants and the communities in their joint interests. Several larger plants, such as the Glenn L. Martin bomber plant in Baltimore, employ their own traffic engineers. An idea of the size of this industry may be illustrated by the fact that today the company has some 44 acres of parking lots.

Where a factory is situated in a built-up area, there are generally only one or two main routes carrying the war worker traffic. Therefore, the sudden expansion generally congests the existing routes at the times of shift changes, and steps must be taken to increase the capacity of these or to provide alternate routes to carry the added traffic.

One of the major causes of congestion is frequently found to be curb parking. On a 40-foot roadway, for instance, the elimination of parking would just double the capacity. By making a traffic check of the existing volume and estimating the probable increase due to war worker traffic, (or the actual demand, if the route is now congested and unable to carry the load) the engineer judges whether it is possible to increase the capacity of the route to a point where it will carry the demand, or expected load. With well regulated cross-traffic, at intervals of a mile or so apart, a route should carry about 1,000 vehicles per lane per hour.

Other methods of improving the capacity of the access route which are usually employed include provision of a traffic signal system, timed for progressive flow, installation of special turning restrictions to reduce delay from left-hand turns, use of lane markings to reduce "weaving" and turning from the wrong lane, or physical changes such as the widening or inter-connecting of certain street lengths to form a continuous through route.

In some cases the engineer has had to attract motorists to alternate routes to spread the load by the simple expedient of making the extra routes more attractive than previously. In some cases, the alternate routes have been made "one-way"; one to, and another away from the plant. Or the answer may lie simply in making the extra routes "through streets" by providing stop signs on the side streets, and directing the traffic to use these newly-made thoroughfares. Some industries have distributed route maps to their employees, calling attention to available alternate routes which have been made more attractive.

With the provision of adequate access facilities, goes hand in hand the problem of terminal facilities. Too often, elaborate plans are made for getting the workers to the plant, and little thought is given to the proper design and location of storage space. One actual case in particular illustrates this point; where it was found that no time at all was wasted in driving to a plant employing 16,000, but each employee, on the average, consumed one half hour in getting into the parking lot and parking his car. This congestion at the lots represented a waste of thousands of manhours daily besides constituting a real danger in the event of an emergency, such as fire, sabotage, or air raid.

The error of putting the parking lot across an important street or road from the plant entrance should be avoided. If it is absolutely necessary to locate the lot in such a manner, it is to the factory's own advantage to see that overpasses or tunnels are provided for pedestrian traffic, safe-guarding their own employees, while not disrupting traffic flowing past the plant entrance. Modern principles of parking lot design incorporate the following elements:

1. Separate entrances and exits.
2. One-way flow within the lot.
3. No conflicts or crossing of paths at entrances or exits.
4. Drivers assigned to specific stalls, convenient to their entrances and exits.
5. Location of lots around the plant according to the origin of traffic, to prevent cross traffic congestion.

Of equal importance to the problems of design and construction of facilities to handle the great war production traffic loads, is the program of conservation of vital transportation facilities. The drastic shortages of critical materials, particularly the almost complete loss of our rubber supply, has made it necessary

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of Perth, with the family of the local American consul, also bound for home. It proved impossible for me to reach the eastern Australian coast in time to sail with them, by returning army transport.

By now rail passenger traffic was congested beyond hope. After numerous frustrated attempts to obtain passage by ship to eastern Australian ports, another of our staff and I succeeded in arranging for passage with the captain of a freighter under charter to the U. S. Army. With little faith in her scheduled sailing, we climbed aboard. If she failed to sail, well, we could always go ashore again.

To our amazement, within 24 hours we cleared the harbor and joined a convoy with about eight other transport vessels and an escort of a half dozen small naval vessels. The second day out the convoy suddenly began to zigzag more violently in its course and two of the escort vessels instantly became involved in a frantic search for some mysterious undersea creature, raising huge geysers with their depth charges. At length they rejoined the convoy. No report was ever heard as to the success or failure of their hunt. The third day out our ship pulled out ahead of the convoy, limited in speed to the 8-knot pace of its slowest vessel. Our ship reached Melbourne four days later, alone.

There we beheld, with great relief, signs of mobilized order. Comparative calm and grim determination were beginning to grip the Australian effort. We booked passage on a returning U. S. Army transport due to sail for home about four days after our arrival. She sailed exactly on the hour announced something over 24 hours in advance.

We sailed a course obviously designed to circumvent the farthest wanderings of the Jap submarines, far, far off the normal steamer track. The ship was designed for 21 knots maximum speed. We averaged nearly 25 knots, making the trip to San Francisco in 19 days. Speed is the essence of safety from submarine attack; our peace was undisturbed.

My wife had arrived without mishap a month earlier. San Francisco seemed a very excellent place to be.

## THE TRAFFIC ENGINEER . . . .

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to take extreme conservation measures to avoid an absolute breakdown in our transportation system. Mileage is now rationed by gasoline restrictions, and the nation-wide top speed limit set at 35 m.p.h., while in the 17 eastern states, all pleasure driving is prohibited.

Normally we in this country used about 650,000 tons of rubber per year; 220,000 tons for auto tires, 240,000 tons for truck and bus tires, and the remainder for other purposes. Thus we consumed about 460,000 tons per year for tires. At the turn of the year, we had 578,000 tons of crude rubber on hand, according to the Baruch Committee report. We could expect only about 53,000 tons more from other sources until 1944, making a total of 631,000 tons available till that date. But the expected military demand alone is 842,000 tons! Before we start we are confronted by a shortage of 211,000 tons by January 1, 1944. This shortage will have to be met before any synthetic stock can be made available for civilian use. It appears that if the scheduled construction of synthetic rubber plants is attained, some relief will be felt by the middle of 1944, but under no circumstances will there be sufficient rubber available before that time to meet the demand.

It is evident that strict conservation of tires is the only means of preventing a collapse in our transportation system. President Franklin D. Roosevelt informs us, "The demands of war on our national resources make it imperative that unessential travel be eliminated for the duration."

In every industry over 100 employees, OPA has made it mandatory that a labor-management transportation committee be set up, to promote group riding among the employees, and to certify to certain requirements which an applicant for supplemental gasoline rations must meet. If an employee needs additional gasoline (above the "A" allotment) or tires, to allow him to drive his car to and from work, he must carry 3 or more passengers regularly, or prove that it is impossible to carry passengers because of irregular hours of work, or absence of fellow employees living near him. His plant transportation committee

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certifies to the local rationing board as to the accuracy of his statements, and that there is no alternative transportation available, such as bus or rail, if the car-owner cannot obtain a car-load of employees. Most plant transportation committees carry out an organized transportation plan, whereby all employees are registered by zone of residence (using a zoned map) and efforts are made to teams of employees, assigned to one car, or perhaps to several alternately used cars.

By means of car-occupancy counts at the times of major shift change, the average number of persons per-car is obtained, which serves as a guide to the effectiveness of the local ride-sharing program. Before Pearl Harbor, the usual count showed an average occupancy of 1.5 to 2.0 persons per-car. Today, many plants have raised their average to above 4, through systematic effort. Many times employees are switched from one shift to another in order to team them up with others.

Realizing that the program of conservation of private automobiles should include non-war workers, many cities have set up central "ride-sharing bureaus" where business district employees can team up in ride-sharing groups, or swap rides to and from work. The OCD has been responsible for similar set-ups in residential areas for teaming up the housewives and others going to town for shopping. Other organizations have set up similar plans for salesmen and church goers.

Naturally, the element of traffic safety is a major factor in the transportation conservation program. Organizations like the National Safety Council and the National Conservation Bureau are devoting their resources toward "off-the-job" accident prevention, which in 1942 took a toll of 29,000 workers' lives in the U. S., 16,000 of which were a result of traffic accidents. Not only are war workers laid up or lost for good, but the loss of automobiles, tires and parts cannot be replaced. The manpower needed to mend broken automobiles is really manpower diverted from vital war production, and should better be expended on building airplanes and guns.

Traffic accidents not only affect the participants, but many times slow up production on a large scale. Last winter a collision between two cars killed two war production workers, injured two others, and obstructed traffic so seriously that some 5,000 men were late for work at a munitions plant that day. In another part of the country, accidents on a steep, narrow approach to a bridge blocked traffic several times during the winter, causing thousands of lost hours by employees in a munitions plant. These are only two examples of accidents that are slowing up production everyday, that are sabotaging the war effort just as unnecessary usage of transportation equipment and unnecessary traffic delays are doing.

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Public mass transportation (buses and street cars) is the second major division of passenger transport that the traffic engineer must assist. In normal times, mass transportation has tried to meet the customer's every desire, within reason, literally picking him up at his door step and depositing him at his convenience wherever he desires to be let off. In conforming to the average American's daily habits, in order to be on hand when and where he desired transportation, bus and street car companies have had to maintain large fleets of vehicles to carry the heavy morning loads and peak afternoon loads, while during the remainder of the day operating less than half the equipment.

The average curve of passenger load before Pearl Harbor would reach peaks between 7:30 and 8:30 a. m. and between 4 and 5 p. m. three times as high as during the other (off-peak) hours, resulting in a tremendous inefficiency in operation, caused by the necessity of maintaining the great overhead to meet the sudden peak demands for 2 or 3 hours a day where less than half the equipment was needed during the remaining 21 or 22 hours.

The mass transportation shortage problem is even more critical than that of the private car, and with the rationing of gasoline, wearing out of tires, and inability to buy new cars, many new customers are crowding the buses and street cars. Many lines show increases of 50 to 200 per cent over the load a year ago, and yet they are unable to secure additional vehicles. The office of Defense Transportation requested that 5,000 be manufactured for 1943, as the minimum necessary for meeting the expected demands. Yet the War Production Board has set the 1943 production of buses at only 1,500 for civilian use. So it is obvious that drastic measures must be taken in 1943 and 1944 to permit the existing equipment to carry the loads that must be accommodated. It is interesting to note that the 1942 output of local transit buses alone was 9,200 vehicles. In 1943 only 1,500 buses will be manufactured for all types of civilian uses.

During 1942, 1,000 war plants and 260 cities in this country staggered their working hours in order to spread the demand more evenly on mass transportation, and by spreading the demand over a longer period, automatically lower the peak loads, making it possible for existing facilities to carry greatly increased loads. "Staggered Hours" is the term applied to the process of changing the hours of starting and terminating a work shift, or an office, school, or store day, so as to reduce peak movements. Generally in cities, this has been accomplished by having retail stores close at 6 or 6:30 p. m. instead of the usual 5:30 p. m. Schools open at 9:00 a. m. instead of 8:30 a. m., and offices change according to the existing transportation demand fluctuation, to offset the peaks. Generally plants have had to start and stop earlier in the day, at say 6:30 or 7:00 a. m., and different plants have often found it necessary to stagger their hours in relation to one another so that both will not discharge employees onto the streets at the same time, or so as to cause peak demands on the bus or street car lines.

In factories contributing the major proportion of travel to a mass transportation facility or traffic route, the staggering of hours of various departments or main units has often provided the required relief. Naturally this intra-plant staggering of hours tends to hamper the group-riding program at the plant, since employees on different shifts cannot very well ride to and from work together, hence it is not so popular as inter-plant staggering, which would mean shifting the hours of every employee one way or the other at a plant.

The development of staggering hours plans has fallen into the hands of traffic engineers in most cases, and where a city or industry has not had such an engineer in their employ, state and national organizations have come to their assistance. The surveys of working hours and transportation load fluctuations requires the engineering approach to work out solutions. In most cases the engineer then has found it necessary to become a combination politician-salesman in order to secure the approval of the merchant groups, the school groups, and the industrial interests, in making the hours changes.

Elimination of 1/3 to 1/2 the usual number of bus and street car stops, shortening of lines, and elimination of jogs and detours in lines have been necessary to further conserve the mass carriers.

In regard to movement of buses and street cars, the office of Defense Transportation has issued the following: "Traffic regulations and controls have generally been operated to facilitate the movement of automobiles. During the present emergency the movement of mass transit vehicles should take precedence, and the efficient movement of such vehicles should be the major consideration in the timing of traffic control devices."

Thus traffic engineers are hard at work devising ways and means of curtailing service to the minimum essential, and speeding up the schedules through congested areas by giving the "breaks" to the mass carrier wherever possible.

Today, the bus rider finds that he has to walk a couple of blocks to the bus stop, where formerly he was picked up at his door step. His hours of work have probably been changed, to lessen the peak load on the buses, and yet today he probably has to stand up since the buses are filled to overflowing as never before. But the bus rider and the motorist today are finding out what a luxury transportation has been in the past, and they are beginning to be glad to find standing room in a bus or a seat in a car full of war workers.

What can the traffic engineer expect for the future?

There is the certainty of great increases in urban and suburban travel. Public and private aviation will mushroom almost unbelievably, probably superceding much of our pre-war long-distance motor vehicle and train trips, where time-saving is important and cost is not too much a factor. But the use of the motor vehicle for short trips will be an essential part of our transportation network. The average length of motor vehicle trips has been 15 miles, and will probably continue to be about that. It is generally agreed that planes will not supercede cars for short trips! So folks will still need cars.

Federal funds will aid construction of parkways and freeways, functioning as arteries for the great masses of motor traffic that will flow into and out of cities, and between cities not too far apart.

The traffic engineer will continue to function as a Highway Transport "Operations" Engineer, a field the importance of which has long been recognized by the railroads, and which is rapidly coming into its own in highway transportation. His field of operation will continue to cover the subject: (1) geometric highway design, (2) road surface characteristics, (3) terminals—their location, design and operation, (4) methods of securing efficient highway transportation, (including accident prevention and public education), (5) vehicle performance, (6) traffic capacity, speed, composition and other characteristics of the traffic stream, (7) driver characteristics and driver behavior, (8) methods of supervision and control of both vehicular and pedestrian traffic, (9) the use of relationships of metropolitan highway transportation systems to other transportation facilities and to city planning, and (10) highway transport economics.

The traffic engineering profession, in meeting the challenge offered by the war production transportation problem, is undergoing a broadening influence which cannot fail to benefit the engineer, as he works more closely with public groups in staggered hours and tire conservation programs and with industrial groups in solving their transportation problems.

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# THE CAMOUFLAGE PROGRAM

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of a bombardier who had been ordered to bomb a large gas holder. After making a thorough study of the maps of the area, he and his pilot made their flight but could not find the target. They circled and tried again, but again were unable to find it. Then they returned to the base and new photographs were taken of the area. Minute study of these photographs finally indicated that a square platform had been erected on top of the tank, so that instead of a round object and its shadow for which the bombardier was looking, there now existed a square structure and its shadow. On the next trip the bombardier hit the target.

The painting of large, flat factory roofs or large ground areas such as landing fields to simulate the surrounding area, can be done with surprising success. Streets are continued, by painting, up the walls and over the roofs of structures or across the runways. Sometimes, in order to get the proper texture, it is essential that shavings or similar material be imbedded in the paint. This is especially true where simulated turf is painted on the runways. Houses or other small buildings are simulated by areas of light and dark, the dark portion acting as the shadow, painted directly on the "tone down" background color. They should be made to appear like other buildings in the neighborhood.

Because of the change in character of foliage with the seasons, it is essential that the backgrounds, or "tone down" color be changed with the seasons. Also, the paints used are generally somewhat darker than the colors in the surrounding territory because they tend to fade.

In this stage of camouflage, it is impossible to do much with the automobile parking lot. The protective concealment of parked cars is one of the most difficult problems we have because of the many reflective surfaces that a car presents. It has been suggested that cars could be painted a dull tone similar to that used in buildings, but as long as they have many glass surfaces present, this seems of little use. If room is available, cars can be dispersed; trees and shrubs planted to hide them, and the area painted to conform to the adjacent areas. This will usually double the area now used, but it is probably cheaper than using the third stage of camouflage. Perhaps the rubber