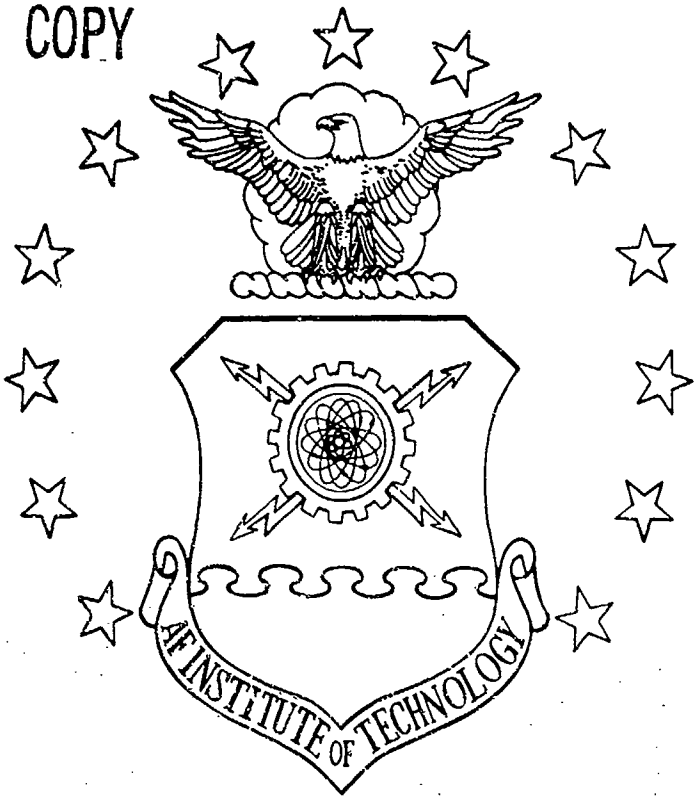

DOMESTIC TRANSPORTATION IN WORLD WAR II: LESSONS LEARNED

THESIS

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The opinions and conclusions in this paper are those of the author and are not intended to represent the official position of the DOD, USAF, or any other government agency.

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THESIS

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List of Acronyms and Abbreviations

AAF.....Army Air Forces

AAR.....Association of American Railroads

ATA.....Air Transport Association

ATC.....Air Transport Command

BMWT.....British Ministry of War Transport

CAA.....Civil Aeronautics Administration

CAB.....Civil Aeronautics Board

CL.....Carload

CTC.....Centralized Traffic Control

DOD.....Department of Defense

ICC.....Interstate Commerce Commission

IMP.....Industrial Mobilization Plan

JCS.....Joint Chiefs of Staff

LCL.....Less than carload

LTL.....Less than truckload

MSC.....Military Sealift Command

MTMC.....Military Traffic Management Command

NATS.....Naval Air Transport Service

NDAC.....National Defense Advisory Commission

ODT.....Office of Defense Transportation

OEM.....Office of Emergency Management

OPA.....Office of Price Administration

OPM.....Office of Production Management

OWM.....Office of War Mobilization

PAW.....Petroleum Administration for War

SFAW.....Solid Fuels Administration for War

TL.....Truckload

WPB.....War Production Board

WRB.....War Resources Board

WSA.....War Shipping Administration

WWI.....World War One

WWII.....World War Two

Abstract

The conduct of extended warfare by the United States anywhere on the globe is dependent on the ability of the American industrial base to support it. Such support is in turn dependent on the support of American transportation. In recent years the potential for an extended conventional war has increased. This has consequently increased the need to make adequate plans for domestic transportation support of such a contingency. The objective of this research was to examine government management of domestic freight transportation in World War Two and to draw from that examination any principles apparently applicable and helpful to current transportation planners.

This research encompassed a literature review resulting in a description of the development of the five modes of domestic freight transportation until 1941, a brief examination of the conduct of the industrial mobilization supporting American participation in World War Two, and an extensive examination of the management of domestic freight transportation by the Federal Government during the war.

The successes and failures of government management of domestic freight transportation in World War Two were subjected to an analysis which revealed a series of lessons apparently applicable to current planning for a similar contemporary contingency.

DOMESTIC TRANSPORTATION IN WORLD WAR II: LESSONS LEARNED

I. *Introduction*

Background and Justification

The assumptions underlying this research were that national transportation resources represent a critical resource to effective operation of the economy in peace and war; that those resources have recently undergone changes meaningful to planning for wartime industrial mobilization; that changing world conditions have heightened the importance of planning for such a wartime mobilization; and that the lessons offered by the history of American industrial mobilization during World War II (WWII) may be profitably applied as a framework within which to evaluate the potential impact on mobilization of the current state of national transportation resources. This section more fully develops each of these themes.

Transportation plays a vital role in the maintenance of commerce and in military and other government operations. This concept has been widely recognized and is reflected in America by such actions as the regulation and deregulation of many forms of commercial transport in striving to ensure their availability at reasonable price to the entire population, including the commercial, governmental, and military sectors. Transportation provides time and place utility to goods by placing them where, and when, they are needed. Conversely, lack of

adequate transportation can reduce or eliminate the effective utility of an item by making it unavailable where and when it is needed. This has dollar value to commercial institutions and readiness and sustainability value to government and military institutions.

In an industrialized society transportation consists of a variety of modes including domestic and international air; surface modes including rail and highway motor transport; water modes including international and domestic ocean transport, and inland waterway carriage; and a final mode, often overlooked, pipeline transport of various products. The terms "airlift" and "sealift" are commonly used to refer to air and ocean transportation in support of military forces, and are so used here. Each mode may have operational segments by commercial providers, by government agencies outside the military, and by military organizations.

As noted, the value of transportation is not applicable only to the peaceful commerce of a society. Transport's contribution is vital to military operations with the effective waging of war being of utmost importance although we cannot discount its consequence to peacetime activities. Using a simplified example to illustrate, a nation might raise the best trained and equipped army the world has ever seen yet have the effort be utterly in vain, with their national cause crashing into dust, if that army cannot be brought to the place and at the time it is needed to meet and defeat the enemy.

Neither is transportation's role restricted to direct support of troops in the field. During the course of a conflict, the direct material support of the effort requires the engagement, at some level, of the economy of the nation at war. That engagement is directly

related to the material demands of the conflict in relation to the size of the economy involved. A nation's transportation system, then, is required not only to carry finished goods from factories and warehouses to troops in the field. It is also required to transport raw materials to factories, prospective soldiers to training camps, workers to jobs producing war materials, and to support the entire range of other functions necessary to support the war economy of the nation fielding an armed force.

As with most of the remainder of the industrial base, transportation has a dual role in war. Not only must it produce in direct support of the war; it must also continue to provide time and place utility to goods and services required for the continued operation of the economy. To the degree it fails in either role, the nation's application of armed force is hampered, limited, or, at the very least, redirected from the tactical or strategic actions towards which it might be optimally directed. Complete study of transportation in wartime must, therefore, include both these roles.

If a study of wartime transportation focuses specifically on the United States and its ability to marshal its forces and its industry, that study must necessarily include private sources of transport, those sources neither directly owned by nor controlled by the military or other government bodies. The Department of Defense (DOD), through its individual service components, maintains a sizable transport capacity of its own, especially in airlift and sealift. However, the largest part of the DOD's transportation requirements in war and peace, both now and historically, have been met through purchase of the service from private concerns (30:28-9).

Transportation in support of the general economy has been virtually all privately provided by individual citizens or by commercial firms at all times. It should be noted, however, that governments at all levels make considerable contributions through the provision of financial and/or political support to major portions of the total transportation system. Examples include funding for highways upon which private operators move, subsidies to ship operators, and the historic regulation of railroads meant to ensure both their financial viability and their availability to the public.

This reliance on the private sector for transportation services is in counterpoint to many other industrialized countries in which governments have elected for more direct roles, in many cases full ownership and operation of certain modes, most commonly rail. It further implies, also in counterpoint to other societies, that what transportation develops --and how-- in America is largely at the command of market forces that governments at all levels choose not to unduly control or influence.

Because the DOD draws so heavily on private sources for its transportation needs, the developed state of those sources when an emergency develops or a war starts determines, to large extent, what the military services will have available to them with which to transport their forces and materials and what the economy has available to it to support the national war effort.

Relatedly, because the structure and capabilities of the American transportation system are largely determined through free market forces without regard to wartime mobilization needs, and because those forces are most commonly driven by the requirements of a peacetime economy

(because the nation is most commonly at peace), the national transportation resources which can be brought to bear in support of war are largely shaped by the requirements of the peacetime economy. Resources so shaped are unlikely to meet wartime needs in quantity or capacity.

The unfettered free market is unexcelled as a societal arrangement that disciplines productive labor towards efficiently meeting all, and only, those demands for which the public is willing to pay. In times of peace, the level of transportation capacity required to efficiently support the national economy and military training, and thus what the market will naturally gravitate toward producing, is not adequate to support the vastly greater demands of war. Without continuing government demand, that is willingness to pay, for the maintenance of transportation capacity required to support wartime requirements, that capacity will obey the dictates of the market to either disappear or not be created in the first place.

Moving from the domain of theory to that of practicality, there has been great concern expressed by many over at least the past ten years that, indeed, the capability of the American transportation industries to support the military readiness of the nation has greatly diminished. That concern has been most vocally expressed regarding the existing abilities, or inabilities, to effectively transport military forces to a theater of war and materially support them once there. Perhaps the most eloquent and complete of those expressions of concern was provided by the President's Commission on Merchant Marine and Defence, established by the Congress in 1984. Its mandate, in brief, was to study the state of the American maritime industry and its

supporting industries in relation to their ability to support national military readiness, and to recommend governmental and private actions required to overcome identified shortfalls (30:5).

The Commission's findings were that the availability of American merchant shipping, merchant seamen, and the capacity of supporting industries were insufficient to meet any but the smallest military deployments, let alone a protracted global war (30:1-2). For instance, the active U.S. flag merchant fleet in 1986 consisted of fewer than 370 ships, a decline of over 1700 from a fleet that included 2,114 ships in 1947 (30:11). Between 1970 and 1986, the number of American merchant seamen dropped from over 69,000 to under 29,000, and the positions on American ships open to them from 34,000 to 11,000 (30:12). The Commission cited a "virtual cessation of commercial ship construction in the United States" as a major contributor to the closing of 76 shipyards and ship repair facilities just between 1982 and 1986 (30:13).

Earlier study had revealed similar, though lesser, shortfalls in airlift capacity required to support military objectives. A result of that work was the establishment of a national goal of maintaining contingency airlift capacity available to the DOD of 66 million ton-miles (one ton of cargo carried one mile) per day. By 1988, DOD programs directed to meet that goal had reached 69 percent of the desired capacity (7:39).

Impetus for studies of sealift and airlift required for direct support of military action had been provided by the results of Joint Chiefs of Staff (JCS) exercise "Nifty Nugget" in 1978. Those results were dismal. Simulated mobilization and deployment of 400,000 troops to Europe produced an utter failure of the transportation system. Both

planning and capacity were found so inadequate to the task the exercise was terminated early (7:38).

More peripheral, but no less critical, components of the transportation system have reflected flaws in terms of military readiness similar to those components directly involved in hauling goods. For instance, as late as 1986 it was reported that the U.S. Coast Guard, the Navy's Military Sealift Command (MSC), and the Army's Military Traffic Management Command (MTMC), had each developed plans for civilian seaport support of a military contingency without either "...reference to each other or port authorities" (26:61). It was further noted that "port readiness has never been an element of a major mobilization exercise..." (26:68), a state of affairs which obviously leaves the capacity and capability of a critical transportation component in some doubt.

Similarly, the state of America's transportation infrastructure, including such things as highways, bridges, urban mass transit systems, airports, and air traffic control systems, are sufficiently degraded that their ability to support the intensive use accompanying mobilization for war is, at best, suspect. The February 1988 report to Congress of the National Council on Public Works Improvement included a finding that "...the quality of America's infrastructure is barely adequate to fulfill current requirements..." (33:1). Specifically, it reported finding inadequacies in availability of urban mass transit systems and in maintenance of existing systems. Other problems attributed to urban mass transit were declining productivity, poor system planning, increasing difficulty in attracting ridership, and increasing reliance on foreign suppliers. As an example of that

reliance, it found there are currently no American-owned firms building transit rail cars (33:6,25). The Council cited the ills of American aviation infrastructure as a generalized congestion of the system resulting from construction of new facilities inadequate to keep pace with traffic growth, and a need to upgrade an aging air traffic control system (33:6).

The condition of America's highway system was reflected in a American Society of Civil Engineers report stating that, in 1989, over 45 percent of the 571,246 bridges inventoried by the Federal Highway Administration were classified either "structurally deficient" or "functionally obsolete". Over 3,600 were closed to traffic. They further reported that over 10 percent of America's paved roads were in poor or very poor condition, and 51.8 percent were only fair (2). Thus, almost two thirds of the nation's highways in 1989 were in need of repair.

As with most transportation related shortfalls, those manifested in its infrastructure can be laid to inadequate investment. As a percentage of all government spending, investment in infrastructure shrunk from almost twenty percent in 1950 to under seven percent in 1984 (33: 8). That the system is adequate even for current use reflects the current consumption of past investment. As the Secretary of the New Mexico Department of Highways is quoted as saying, "We're spending our inheritance" (33:1).

Two purely domestic transportation modes, motor carriers and railroads, have since the early 1980s undergone striking changes which could affect their ability to efficiently support mobilization. These changes have largely resulted from federal government movement away from

tight economic regulation of these industries. Federal regulation of railroads began in the 1880s, and of motor carriers in the 1930s. For most of the time from those points forward to 1980, regulation had as its overall goal assurance of availability of transportation to the public at reasonable prices. One method used to accomplish that goal was the imposition of relatively strict controls both on exit from the industry of firms engaged in rail or motor transport and on abandonment of service to areas and along routes served. Those controls, along with other regulatory rules, had the effect of maintaining a large degree of excess capacity in those industries with excess capacity defined as resources in excess of those required to maintain service in the most efficient way.

Reforms in regulation of these industries as implemented by the Motor Carrier, and Staggers Rail, Acts of 1980 included a drastic reduction in controls on industry exit and on route abandonment. With maximum profits largely the only determinant of continued service, service to areas which provide marginal income for the firm is less attractive and, as stated, relatively easily abandoned. Abandonment of service is most notable in the railroad industry. Between 1980 and 1986 there was a 15 percent decline in miles of railroad trackage operational, a 22 percent decline in locomotive ownership, and a 17 percent drop in ownership of railroad cars of all types (31:3). These declines in absolute capacity are not necessarily bad. From a macroeconomic viewpoint, and with a goal of efficient operation of a peacetime economy, they are often cited as positive. Certainly, they have been among the factors which resulted in the railroad industry being "...in a better financial condition than it has been in decades"

(22:56), after years of weak financial performance. While a healthier rail industry would seem able to contribute more to mobilization capability than a weak one, the declines noted in resources currently devoted to rail capacity equally seem to detract from capability. As earlier stated, the industrial capacity which most efficiently supports a peacetime economy does not include excess capacity to cover the increased demands of wartime support.

Transformations in the motor carrier industry resulting from deregulation are less easily given a thumbnail assessment. In the less-than-truckload (LTL) segment of the market, consisting of "...carriers handling small lots of cargo within a network of terminals" (31:5), increased competitive pressures resulted in a marked decline in the number of carriers. A quarter of what were the largest 100 LTL carriers in 1979 ceased operations between 1980 and 1988. In the same period, a total of 3,500 carriers went out of business (31:6-7). Truckload (TL) carriers, in contrast, saw increases in entrants. The TL segment includes thousands of carriers operating truck fleets ranging in size from very small to those numbering in the hundreds. Because these carriers do not depend on a system of terminals as LTL carriers do, industry entrance and exit is relatively unburdened by financial hurdles. Many firms enter and leave the market yearly. The price and service flexibility of these TL carriers proved attractive to many shippers who have consequently diverted much of their traffic from LTL to TL shippers (31:7-9).

Changes in the motor carrier industry have apparent meaning for mobilization planning. To the degree that industry departure of LTL firms represents a net loss of either equipment or terminal capacity, it

would seem that capacity available for mobilization is hurt. No less significant is the potential meaning of the explosive growth in the number of small TL carriers. Rapid changes in composition of this segment would seem to make mobilization planning difficult because the capacity base upon which to plan constantly changes. Complications could also accompany any mobilization as the number of individual carriers upon which the mobilization would depend is so much larger than that experienced in the disciplined market resulting from regulation. It seems self-evident that the task of Federal direction and coordination of the mobilization activities of commercial transportation firms would be easier if fewer, rather than more, firms required that direction and coordination. In contrast, the trend in the TL segment of the motor carrier industry since deregulation is toward increasing numbers of firms.

While much of the preceding has focused on freight transportation, the capacity and structure of the passenger transportation network is also of mobilization concern. Perhaps the most notable occurrences in this arena are the primacy that commercial air and automobile travel have assumed since approximately 1950.

The intercity passenger rail system operated by Amtrack is only a pale reflection of the capacity existing earlier in the century. The much reduced Amtrack system can only continue operations with government subsidies covering one third of its costs (31:5).

The intercity bus system, like the motor freight industry, has undergone changes resulting from deregulation. Competition with the deregulated airlines, and eased barriers to industry entrance and exit,

have produced a smaller full service intercity network fed by many new local carriers of small size (31:10).

As with other transportation modes, these changes in surface passenger transportation capacity apparently present implications for mobilization. Declines in absolute capacity, such as in the railroad passenger segment, decrease the base upon which a mobilization would depend. Increases in the numbers of carriers, such as in the passenger bus industry, would likely complicate mobilization management.

A concern more obvious in passenger travel than freight is that the shifts in traffic modes have been to those which are less fuel efficient per passenger mile than those they replace. In times of peace that distinction may be of minor importance because supplies of energy are relatively abundant. In a prolonged war such energy abundance cannot be assumed owing either to probable disruptions in supply or diversions away from civilian use. In the event of petroleum shortages, peacetime shifts in transportation capacity from more to less fuel efficient modes could make themselves felt as bottlenecks in the process of mobilization.

None of the identified or potential concerns discussed necessarily represent absolute barriers to effectively supporting wartime mobilization of the national economy. They do, however, illustrate that transportation is an ongoing and changing area of study for mobilization.

Changing international political conditions highlight the importance of studying the ability of the national economy to support mobilization.

Starting in the 1950s and for many years thereafter, heavy American reliance on nuclear arms for strategic defence resulted in assumptions of large-scale war scenarios that followed a pattern of rapid termination after escalation to an exchange of strategic nuclear weapons (27:34,36). Industrial mobilization is not an issue in such a war since hostilities would be concluded before a transformation of military potential into actual forces could be achieved.

Since the late 1970s, in contrast, more attention has been devoted to the possibility of American involvement in prolonged conventional conflict of global scope. One impetus for this increased interest was the achievement of nuclear parity by the Soviet Union (27:35-6). That parity essentially decreased the likely use of strategic nuclear weapons by raising the probability that any use would be met with a retaliation in kind. Consequently increased was the probability that a war between superpowers would be fought with conventional weapons, and would be thus prolonged.

Apparently profound changes underway in the Soviet Union and in its military policies, if realized, may well further increase the probability of conventional conflict, at least in Europe. A reduction of the threat of a monolithic Soviet empire probably reduces the threat of a bilateral superpower confrontation. It does not, however, necessarily decrease potential sources of hostilities. On the contrary, to the degree that Soviet and American involvement with, or control over, smaller European states has held their lesser rivalries in check, Soviet and American disengagement from those states allows their differences to again surface. As one writer has noted, two world wars have been fought in Europe this century, neither of which had Soviet

communism as its central issue (17:20). Even after almost 40 years of exemplary West German performance as a member of the North Atlantic Treaty Organization (NATO), the prospect of a reunited Germany raises concern with its European neighbors. Even before such a reunification has taken place, the Chancellor of West Germany raised the issue of German dissatisfaction with the Polish-German border set after WWII (37). The multitude of potential conflicts led French President Francois Mitterrand in November 1989 to express fear that the evolving new order may well result in a return to European political conditions that prevailed prior to World War I (WWI), characterized by continuous feuding between a large number of national players (14).

As the world political environment evolves, so must (and inevitably will) American strategy and forces. The current trends certainly indicate that conventional forces will assume increasing importance. Also indicated are an increased potential for conflict, which may well include a large-scale and long-term commitment of American forces with its attendant reliance on industrial (including transportation) mobilization.

Although risk may be rising, and along with it a need for increased spending for military forces, it is virtually certain that American defense expenditures will decline, and probably precipitously, in the near future. The well publicized changes in the Soviet Union have made a threat less apparent to the American public, and with its apparent shrinking goes an equal decrease in support for military spending (5:41-2; 17:19).

It is something of an unavoidable paradox that the same forces creating a need for heightened investment in defense related

transportation resources are at the same time apparently eroding support for raising and maintaining them. Assuming both a drawdown in American forces positioned overseas, and that America will continue to hold a strategic interest in maintaining peace overseas, supporting that interest will require the transportation resources necessary to move American forces to a point of conflict. Such resources will also be needed to support the industrial mobilization required to sustain our forces in a prolonged fight. Peacetime transportation capacity, however, is ill-equipped to support rapid mobilization without some financial intervention to support maintenance of excess capacity expressly designed to accommodate surge requirements. Financially supporting such surge requirements essentially constitutes an expenditure for defense that must compete for funding with all other defense requirements; a task made more difficult in times of overall shrinking defense budgets.

Compounding the difficulty of competing for part of a shrinking store of money is a history of defense transportation needs being weak competitors in relation to other defense needs. Factors leading to that position include the great expense of transportation assets (such as ships and aircraft) and a weak constituency. One writer explained a cause of the weak constituency as follows:

> The services most dependent upon strategic lift, the Army and the Marine Corps, must rely on the Navy and the Air Force for the provision of adequate mobility assets. The latter services are understandably reluctant to devote scarce procurement funds to the acquisition of ships and aircraft peripheral to their own missions. (18:10)

Proposed government expenditures to sustain reserve capacity in commercial transportation industries would likely face not only the

stated hurdles, but also an aroused opposition from industry competitors suspicious of government support to their rivals, and from those arguing in principle against government involvement in free markets. In any case, the likelihood of building reserve transportation surge capacity seems low absent a credible threat of sufficient immediacy to make the need for funding such capacity clear both to the public and to senior military officials.

This research was undertaken with the assumption that existing American transportation assets are either unable or of questionable ability to support wartime mobilization. A further assumption was that the currently evolving world political environment is likely to result in increased emphasis on preparedness for conventional warfare, including increased requirements for transportation assets supporting defense up to those needed to mobilize the national economy for war. Political support for procuring those assets, however, is likely to decrease. The resulting assumption is that transportation assets adequate to support wartime mobilization are unlikely to exist at least at the beginning of a conflict in which they are needed.

In the absence of adequate resources to meet all mobilization needs, management of existing transportation assets to ensure their most effective use, and the rapid creation of new assets, would be vital to the effective support of the war effort. Achieving either of those goals in a timely way would be dependent on some level of effective pre-mobilization planning. To the extent that planning allows greater use of existing assets than would otherwise be obtained, or shortens the time required to call forth new capacity, it serves as a replacement of sorts for capacity not existing at the commencement of hostilities.

Given the likelihood of continuing extensive shortfalls in transportation capacity, the planning function assumes great importance.

Many tools are available to those responsible for such mobilization planning. One of the most important is an understanding of the lessons derived from experience with similar situations. The longest and most extensive recent industrial mobilization for war in American experience occurred just before and during WWII: the period of 1939 through 1945. The exact extent of involvement of the American economy in directly supporting the war effort is open to some interpretation. There is broad agreement that, while the involvement was not total, it was large. The figure of 45 percent of the American gross national product (GNP) devoted to war production is perhaps typical of those usually cited (21:63), and is precise enough for purposes of demonstrating the broad magnitude of industrial involvement in the war. As significant as the proportion of the economy then devoted to war production was the explosive growth in the entire economy. The increased production stimulated by the war drove the American GNP to 130 percent growth between 1939 and 1945 (1:139).

This marked increase of the economy drove an accompanying increase in demand for transportation services and other assets to support itself. Demand for transportation assets and services to support purely military objectives had to be met from capacity diverted from civilian uses. This was from a capacity base which was in uncertain condition at the start of the war owing to the effects of the Great Depression. Effective management of the resulting shortages of transportation capacity played an important part in assuring an Allied war victory by facilitating America's assuming the role of arsenal of democracy.

The magnitude of the industrial effort supporting the war ensured that it has been of interest to researchers. The elapsed time since the war's end has seen a plethora of historical accounts of the conduct of the mobilization. The volume of the research conducted, in fact, complicates the practicality of its most effective use by current defense transportation planners. Just the time required to gain a firm grasp of the lessons available in the study of the WWII experience, not to mention the skill required to sort truth out of the distractions of erroneous conclusions, works against the effective application of the knowledge available. The intent of this research was to remedy that situation with respect to the management of domestic wartime transportation.

General Issue

An understanding of the lessons offered by effective and ineffective government management of American transportation resources in World War II can provide one useful tool to those involved in planning for any similar current contingencies.

Problem Statement

The purpose of this work was to examine the history of governmental management of American domestic transportation in the period 1939-1945 and to identify lessons learned from that management in a form useful to contemporary defense transportation planners.

Investigative Questions

The following investigative questions guided the conduct of this research.

1. What was the state of American transportation capacity in the period just prior to WWII, 1935-1939?

2. What shortfalls in domestic transportation capacity versus demand were experienced during WWII, 1939-1945?

3. How was government management of transportation, and transportation-related, industries applied to address shortfalls in wartime domestic transportation capacity?

4. What lessons for current planners can be drawn from the effectiveness of wartime management of transportation?

Scope and Limitations

The great volume and variety of transportation produced and consumed in an industrialized society made consideration of all transportation impractical for this research. Attention was rather focused on domestic commercial transportation of freight in all major modes. International capability was appraised in the water and air modes only as it affected domestic capability, and transportation provided by government agencies themselves considered only as it affected commercial providers. Also as a means of focusing the research, study of government management of wartime transportation issues was largely restricted to Federal government actions. It was further restricted primarily to management of relatively broad programs, as opposed to more detailed operational management. As with those stated before, each of these restrictions was broadened as appropriate

to gain an understanding of a particularly critical problem of a more general nature.

Methodology

The research problem was addressed through identification of actions taken and lessons learned during WWII as revealed by extensive literature review. The literature review was undertaken using the resources of several academic libraries, documents acquired through the Defense Technical Information Center, and various Government publications.

Identification of lessons learned was achieved by evaluating the history of wartime transportation management revealed in the literature review while taking into consideration the conclusions of previous similar research.

Summary

This chapter presented an overview of the importance of transportation to the national economy and the importance of the national economy to the support of military forces in war. It continued with a discussion of some current issues which raise doubt about the current ability of American transportation resources to support a prolonged large scale war, and which suggest planning for such support has taken on increased importance. It was asserted that current planning for wartime support operations may be enhanced in effectiveness when undertaken with a solid understanding of the success or failure of

similar operations carried out in World War II. Finally, the methodology of the research was discussed.

Chapter II is a report of the review of literature concerning the use and management of domestic transportation in WWII, including the conclusions about it by previous researchers. Chapter III is a report of the lessons learned derived from this research. Chapter IV presents conclusions and recommendations for further study.

II. *Literature Review*

This chapter is a review of the literature concerning the management of American domestic transportation during WWII. It opens with a brief discussion of the development of American transportation prior to WWII, continues with a description of the pertinent details of the overall national industrial mobilization during the war, follows with an in-depth examination of wartime transportation management, and closes with an enumeration of conclusions reached about the experience by some other researchers.

Transportation Development

Managing transportation in wartime presupposes some level of transportation capability existing at war's start. Understanding WWII transportation management therefore requires a knowledge of the nature and structure of American transportation assets in place prior to American entry into the war. The purpose of this section is to briefly describe those assets as they existed in 1941. The emphasis is on describing what types of transportation were available, how the individual industries were structured, and what forms of peacetime governmental control existed. The description is structured around a study of the historical development of each mode of transportation, presented generally in the chronological order in which they developed in America. This method of presentation was chosen on the assumption that various events occurring in the development of transportation would have important implications for the shape of wartime management.

Studying American transportation development in general requires consideration be given to three important forces. These are geography, technology, and politics.

The sheer size of the American nation, and the diversity of its geography, were important factors in determining what transportation developed. Pegrum stated "the continental United States probably presents the most complex transportation problems faced by any country in the world" (20:71). Geography was an important determinant of the types of transport developed and their routings. Physical features provided obstacles to be overcome and presented opportunities to be exploited. Population concentrations were both a cause and result of transportation provided to them (20:92-3).

Transportation development was also inextricably linked to technological development, and many technological developments were in turn tied to others. Sampson and Farris presented the example of large scale rail movement requiring the development of steam engines and steel rail. They further noted motor transportation requiring improved roads and efficient engines, with engines in turn requiring advances in petroleum technology (25:18). In some cases existing technology was harnessed to transportation purposes; in others technology was developed to address transportation problems. In either case the rate of transportation's advance has been linked to that of technology.

Political forces were also instrumental in determining the shape of American transportation development. Lieb noted that "because of the importance of transportation in the realization of governmental goals, it has always attracted considerable political attention" (19:7). He asserts as proof the development of an extensive history of government

promotion and regulation of transportation (19:7-8). Pegrum, in contrast, denied that political considerations played a significant role in determining the route structure of the transport system. He stated that most decisions have been purely "economic" (20:77).

Supporting each, and central to understanding American transportation, is the notion that the major agents of transportation development in this country have been private rather than public. As Lieb noted and as is obvious in the following discussion, governmental actions at several times have played critical roles in shaping the development of transportation. They have done so, however, primarily by facilitating and/or directing the course of actions taken by private enterprises. Pegrum is correct in his assertion that many decisions were based on private economic considerations. In the broader sense, however, the fact that an aspect of public life as important as transportation was largely left to be shaped by private interests is in itself a key political consideration. One concrete effect of these political considerations was that wartime management of transportation required marshalling the efforts of a wide and diverse body of private transportation providers to further the overall national cause.

Development of Water Transportation. Domestic water transportation includes movement on inland waterways --including rivers and the Great Lakes-- and upon the oceans. The latter is divided into coastwise and intercoastal transportation. Coastwise transportation refers to movement between ports on a single coast, or between Atlantic and Gulf ports. Intercoastal transportation refers to movement between ports on the Pacific Ocean and Atlantic and/or Gulf ports (13:32).

Water transportation was the first developed in America. American roads were few and underdeveloped in the 1700s and early 1800s. Overland movement from Philadelphia to New York took three days (25:18-9). It was easier and cheaper to bring a ton of cargo to Philadelphia from Europe than it was to move it by land 70 miles from Lancaster, Pennsylvania (20:47).

In response, an active trade grew up centered on coastwise transportation and on movement on the many rivers and bays of the East Coast. As late as 1818, two-thirds of the crops raised in the Piedmont region and requiring transport to market were grown within five miles of a river; the remaining one-third were grown within ten miles of a river (25:19-20). Movement of traffic down the Mississippi River to the Gulf of Mexico was so heavy that by 1817 New Orleans was the world's fourth most important seaport (25:20). Traffic movement upstream on all rivers, however, was scant owing to the lack of adequate mechanical power with which to propel it (20:47).

The development of shallow-draft steamboats and their introduction into scheduled river service in the early 1800s allowed easy upstream movement. In response, river traffic movement expanded greatly and remained important until the 1860s. Similarly, coastwise and intercoastal shipping were important until the later development of transcontinental railroads (20:46,49; 25:20).

Inland waterways were further exploited through development of a system of canals. These made movement along rivers easier and connected inland waterways to the ocean. Some short canals were constructed in the late 1700s to go around river rapids. The first canal of major significance, however, was the Erie Canal, completed in 1825. It

connected Lake Erie with the Hudson River, allowing easy movement of goods from the American interior to the Atlantic at New York City at rates far below those for land movement. Originally funded by the State of New York as a public works project, its commercial success was reflected in the fact that it paid for itself with tolls collected in seven years (20:49; 25:23).

Spurred by the success of the Erie Canal, other states funded construction of canals to connect their rivers or ocean coasts with the Great Lakes. Over 4,000 miles of canals were built before 1850, most of them as state projects. None were as commercially successful as the Erie, however, and their weak economic performance in turn weakened the financial condition of the states sponsoring them. The Financial Panic of 1837 caused many states to default on bonds issued to finance canals and significantly slowed their continued construction (20:49; 25:24).

While canals were "...marvels of their time" and occupied the position of dominant transportation mode through the end of the Civil War, they suffered from several major weaknesses (25:24). Their susceptibility to freezing made them unusable for portions of the year. Restricted as they are to water courses, they provided a transportation system of limited flexibility. In addition, most of them ran in a north-south direction while the growth of the country (and thus its need for transportation) was predominantly westward (25:25). The railroads were largely immune to those weaknesses and their development robbed inland waterways of much of their traffic base. As traffic was diverted to railroads the fortunes of the waterways fell. By the 1930s more than half of the canal milage originally developed had been abandoned. By

1900 it was almost completely gone. Steamboat traffic declined after the 1850s, virtually disappearing by 1875 (19:86; 20:49).

Canal construction enjoyed a revival in the early part of the 1900s. This was partly the result of interest in developing a low cost shipping alternative to the railroads, and partly an outgrowth of an interest in flood control and natural resource conservation (13:34; 20:57-8). In 1903 New York funded the improvement of the Erie Canal into the New York State Barge Canal (20:58). Congress established within the War Department a Board of Engineers for Rivers and Harbors to evaluate and promote waterway development, and appropriated funds for development (20:58). One estimate of the Federal funds expended on waterway development placed that figure at more than $213 million between 1900 and 1940. New waterway development spurred an increase in traffic. By the 1930s, 15 percent of freight traffic moved on river waterways (19:87).

The Great Lakes constituted a tremendous transportation resource to be exploited. Transportation use of the Great Lakes was facilitated by construction of a series of canals and locks which made their use as a system feasible. Some construction of this type had been undertaken as early as 1829. Completion of the Soo Locks at Sault Sainte Marie in 1855 allowed the beginning of significant traffic over the Lakes. Widening of the river channel connecting Lakes Huron and Erie, combined with the opening of the Soo Locks, effectively opened a "natural channel spanning a third of the continent." Further canal work around the St. Lawrence River and Niagara Falls in the early years of the 1900s opened the Lakes to some shallow draft ocean vessels (25:35).

The extent and type of Federal Government involvement in waterway transportation explains to a large degree the structure of the industry. While several important projects —notably the Erie Canal— promoting waterway transport were undertaken as private ventures, the Federal Government was responsible for funding and guiding the bulk of development. The waters of American rivers have historically been treated as a national asset, and the maintenance of them as transportation resources treated as a federal responsibility. Similar support has been given to ocean harbors. The U.S. Government began funding for harbor improvement in 1789, continued in the early 1800s, and since 1866 made appropriations for waterway improvement almost every year (19:85; 25:35).

Free use of the federally maintained waterways was "a definite principle of national policy" from 1882 on (13:30). One effect of this policy was to relieve waterborne carriers of the need to cover an important portion of the cost of providing service, that is, maintenance of the way. As a result the capital investment required for industry entrance was quite low and the industry was consequently made up of a large number of firms of various sizes (13:29; 19:91).

While government promotion and support of water transportation was extensive, government control was much less so. The Federal Government set maritime safety regulations which were enforced by a federal agency, namely the Coast Guard and its predecessors (19:91). Cabotage laws restricting trade between U.S. ports to American ships were instituted in the Navigation Act of 1817. While this certainly was one form of control, it primarily was a form of protection for American shipping interests (13:38). Federal economic regulation of maritime carriers, a

fact of life for the railroads since 1887, was not applied until 1940. The legislation instituting that regulation, however, was so crafted that it applied to only about 10 percent of all water traffic (19:87,91).

In summation, the domestic water transportation available to the United States at the start of WWII encompassed several routes and types of service providers. It included well-developed trade routes over the Great Lakes with connections to ocean ports; barge shipment on an extensive series of river systems and canals, also with connections to ocean ports; and well-developed ports on all three coasts. Carriers were numerous, heterogeneous, and accustomed to only a minimal level of government control.

Development of Highway Transportation. Intercity highway development in the U.S. was initiated after waterway development but much of its significant early progress occurred simultaneously. Early road development was slow owing to the roughness of the American terrain and the consequent need for large investments of capital and labor in road building. Most roads were only slightly improved Indian trails. Some of the first improved roads were developed in the 1770s connecting large cities along the East Coast as a means of facilitating postal traffic. Beginning in the 1790s and progressing into the early 1800s, a number of private concerns successfully built and operated improved toll roads connecting important points (25:21-2).

The high cost of highway construction made it difficult for private firms to finance large-scale projects. Recognizing this, Congress in 1797 appropriated funds for construction of a road connecting the East Coast with the western frontier. Known as the

National Pike, it was envisioned as stretching from Cumberland, Maryland to St. Louis, Missouri. Approximately $6.8 million was appropriated for its construction through 1838, vice $1.6 million for all other roads. By 1818 it had been completed to Wheeling, West Virginia. Construction continued but the National Pike was never completed to its intended terminus at St. Louis. The constitutionality of federal spending on internal improvements became an issue after the election as president of Andraw Jackson in 1832. In the face of this issue, construction of the Pike ended at Vandalia, Illinois in 1838 (25:22).

Interest in road construction declined after termination of the National Pike project. Some states funded minimal work, but increased completion from railroads and canals made highways relatively unattractive. Further, the failure of many toll roads slowed new construction of them (13:25; 25:22).

Interest in highway construction didn't revive until the 1890s. Three major groups were responsible for this revival. They were the railroads, farmers, and bicyclists. Railroads were interested in developing feeder lines into their own systems. Farmers wanted efficient farm-to-market transport. Bicyclists wanted improved surfaces on which to ride. Increasing automobile usage also provided an early impetus to development and became, according to Pegrum, the single largest one (20:59; 25:30).

Progress on road construction in this period was slow, steady, and uncoordinated. Most of the work was undertaken by state and local governments acting individually. The Congress had established an Office of Public Road Inquiry in the Department of Agriculture in 1893, but it produced no large federal aid or guidance. By 1915, 45 states had

established highway aid measures, 40 had founded state highway departments, and 24 had created state highway systems. The states' ability to finance such large projects was limited, however, and little road milage had been improved (25:30-1).

Indicative of the condition of the nation's roads at the time was the experience of the Goodyear Tire Company in 1917. Attempting to demonstrate the feasibility of intercity truck transportation, Goodyear employees drove a then-modern truck the 770 miles from Akron, Ohio to Boston and back over the best roads available. It took over 18 days to reach Boston on the first leg. The return trip was somewhat quicker. The entire round trip required 28 days and consumed 28 tires. In 1918, a similar run was made from Boston to San Francisco. While crossing Wyoming on that attempt 36 of the 56 wooden bridges the truck was obliged to go over gave way under the vehicle's weight (16:121-3).

In 1916 the Federal Government recognized a requirement for its involvement in road construction and first became involved in a significant way. Congress at that time appropriated $75 million for a five-year project of highway improvement. Most importantly, it established in legislation the system of federal aid which was to endure thereafter. Its provided for state ownership, construction, and maintenance of highways; federal sharing of construction costs based on population, area, and milage; and the establishment of state highway departments to "...coordinate, engineer, designate, and contract for highway improvements" (25:31).

The 1916 legislation was followed and expanded five years later by the Federal Highway Act of 1921. It continued the aid system previously established and provided a method of concentrating that aid to ensure

its best use. It made the Secretary of Agriculture responsible for designating roads to be included in a system of primary national interstate highways. The system was limited to seven percent (later raised to eight) of all state highway milage. During the approximate same time, the individual states widely began to levy taxes on gasoline to finance highway construction and improvement. The net effect of these actions was to greatly accelerate the availability of improved roads (13:26; 19:56; 20:59; 25:31).

The onset of the Depression in the 1930s considerably slowed much of national life but it paradoxically further speeded highway development. Road construction and improvement was heavily funded as a means to provide work to the unemployed. Most of the work undertaken was aimed at highway improvement, rather than system expansion. The federally funded system was expanded to include farm-to-market roads less heavily travelled than those previously funded. That funding made possible the first large-scale building of improved roads ever experienced in many areas. In 1934 extensions of the system into urban areas were also made eligible for aid (13:26; 19:56; 25:31,337,443).

As in the case of waterway transport, provision of essentially free way encouraged many to enter the business of highway transportation. The costs of entry were quite low, and there were few political restrictions. The intercity motor carrier business began in earnest after the end of WWI and continued to grow. The low capital requirements of industry entry made it especially attractive to the unemployed during the Depression and many small firms commenced business then (25:31). Largely as the result of the greatly increased trucking business and the competition it posed to established forms of

transportation, Sampson and Farris termed the 1930s "...perhaps the period of greatest change for transportation during the twentieth century" (25:337).

One result of the increased participation in the motor carrier industry was pressure to extend federal economic regulation to it. Railroad interests wanted to protect themselves from having to compete as regulated carriers against unregulated truckers. Larger trucking firms were interested in protecting themselves against competition from small (often one man) firms willing to work at or below cost. Some states had taken the lead in attempting to regulate motor carriage. Their actions regarding licensing and safety requirements were largely successful. Their economic regulation was much less so, mostly because much trucking was interstate in character and individual states legally could only regulate traffic moving totally within their borders.

Federal regulation of interstate motor carriage was implemented with the passage of the Motor Carrier Act of 1935. Much of the regulation was very similar to that previously applied to railroads. It encompassed political controls on industry entry, rate setting, and conditions of service. It also recognized the wide variety of types of carriers engaged in interstate motor carriage and exempted from regulation a large number of them, notably those engaged in hauling agricultural products. While new entries into the industry were controlled, carriers already in were allowed to continue operation (19:56; 25:339-45).

At the beginning of WWII America enjoyed a well-developed domestic highway system that had just recently undergone a long period of expansion and improvement. There were over 4.5 million registered

freight carrying trucks operating over it (4:228). Highways and trucks both were valuable and important transportation resources. The existing mechanisms for managing them were, however, slim. This was largely because of the wide variety of carrier types and sizes in existence. Federal economic regulation had been expanded to trucking but it was relatively new and exempted a large percentage of trucks from control (4:228). As will be explained later, this was to be of great significance to wartime management.

Development of Railroad Transportation. Following the development of steam locomotives in England, the first American railroad --the Baltimore and Ohio-- commenced operation in 1830 (20:51). Thereafter rail development was so fast and of such importance that Pegrum termed it "..probably the most significant and far-reaching...transport improvement in the history of mankind... ." (20:50). Growth of total U.S. rail milage was rapid, from 23 miles in 1830 to over 30,000 miles in 1860. Most of the development until the 1850s was in short lines serving small regions. There were many separate lines but a common operating gauge had been established based on the requirements of the first imported English locomotives (20:51; 25:27).

Until 1853 the longest single rail system was only 135 miles long (20:51). By 1860, however, several systems had joined the East Coast to the Mississippi River, and the eastern part of the country enjoyed a "substantial network" of rails (25:27).

The Civil War induced a general increase in the pace of business and an accompanying speed-up in railroad development. The first transcontinental rail link to the West Coast was started during the Civil War. The Federal Government encouraged the construction as a war

project and provided some financial aid. The line was completed in 1869 (20:51; 25:28).

Rail line expansion again accelerated in the 1870s and '80s. Some of the growth was as an effect of the consolidation of small independent lines into large rail systems. The Pennsylvania Railroad, for example, absorbed almost 600 other lines just in the 1880s. Total rail milage in the U.S. more than tripled between 1870 and 1890 (19:38; 20:53).

After the mid-1890s the rate of growth slowed considerably. By 1900 the basic U.S. rail system as it was to develop was in place. The railroads had become the dominant mode of intercity transport in the country, a position they were to maintain until the 1920s brought in the beginnings of competition from highway carriers. Rail milage continued to expand until approximately 1916 largely as the result of branch line construction to improve service on existing main lines (13:5-6; 19:36; 20:51; 25:29).

It is notable that, even at its most completely developed state, the American railroad industry did not have a single firm which provided service coast-to-coast completely within its own system. What are referred to as "transcontinental" railroads are those which serve the West Coast from origins only as far east as the Midwest. One effect of this was to require railroads to develop a complex system of traffic and car interchange agreements to provide transcontinental service. Carrying these out entailed a large degree of wastage most evident in the milage accumulated in shuttling empty rail cars back to their owning lines (19:38-9; 20:53).

Development of the railroads, as opposed to the other modes previously mentioned, was largely financed by private capital. The

government's choice to refrain from large-scale financing of the rails was partly due to continuing questions about the constitutionality of the federal involvement in public works projects. The railroads' need to raise large amounts of capital to build and maintain way shaped an industry much different in appearance than those involved in water or highway carriage. Rather than many small firms, railroad transportation was carried out by a relatively small number of large firms (19:38; 25:29).

While governments at all levels provided little in the way of direct aid to railroad development, a great deal was provided in more indirect promotion. Numerous state and local governments provided the railroads with such inducements as free land, tax exemptions, and loan guarantees in attempts to secure rail service for themselves. Perhaps the largest promotion of all was carried out by the Federal Government in its program of land grants to the railroads between 1850 and 1871. Under this program, the Federal Government encouraged railroads to expand westward by giving them public land along the railroad right-of-way. The railroads were given alternate sections of land out to a distance of six miles on either side of their tracks. Approximately 75 of these grants were made. Sampson places their total size at 179 million acres and accounting for almost 10 percent of the total area of the country; Pegrum states they totalled 131 million acres. In either case, they were sizable (20:55; 25:28,442).

Despite such indirect government aid the reliance of railroads on private financing and their subjection to great competition resulted in their chronically weak financial positions. As early as the 1870s industry overexpansion and excess capacity had placed many roads in

financial jeopardy. This was compounded by frequent financial misbehavior by those involved in the railroad industry (20:55-6).

One result of the financial pressure on railroads was the institution by them of rate systems that widely discriminated between shippers based on their degree of dependence on the railroads. Following from that practice was political pressure on governments to financially regulate the railroads. After some largely unsuccessful state experimentation with regulation, Congress set up a comprehensive interstate system in the 1887 Act to Regulate Commerce (25:314-8).

The 1887 act mandated that the railroads set rates that were "just and reasonable", prohibited price discrimination, enforced railroad competition by prohibiting cooperative arrangements of various types among the railroads, and established the Interstate Commerce Commission (ICC) to administer the act (25:319-20).

The Act to Regulate Commerce was strengthened by a series of other legislation in the early 1900s so that, by 1911, regulation was complete and extensive. The ICC unabashedly took on the role as protector of shippers' interests. Most requests for rate increases were denied regardless of the requirements of the railroads. As one result, railroad companies representing almost 10 percent of the nations trackage were in receivership by 1916 (19:215-6;25:324).

Another result of vigorous regulation was that railroads were forced to defer maintenance and equipment upgrades. As a consequence of this they were ill-equipped to handle the press of traffic that accompanied the dramatic business upturn in WWI. This was especially apparent after American entry into the war in April 1917. To overcome equipment, and other, shortfalls the railroads were nationalized in

December 1917 and operated under federal control through WWI and into 1920 (19:216).

The next evolution in railroad regulation was embodied in the Transportation Act of 1920. This was legislation which returned control of the railroads to their private owners while modifying regulation to attempt to ensure the health of the rail industry. The scope of regulation was tightened to include controls on industry entrance and exit and the ICC's rate-making power was expanded to include the authority to set minimum as well as maximum rates. In essence, the thrust of regulation thereafter was to protect shippers while at the same time assuring a fair return to the railroads (19:217-221; 20:293-5).

While some improvement in railroad financial performance was achieved in the 1920s, those gains were wiped out by the onset of the Depression. Between 1929 and 1933 railroad revenues declined over 50 percent and drove 75 of the largest railroads into receivership. It was feared that continued poor returns would drive all railroads into bankruptcy (19:227; 20:300).

In response to those fears Congress passed the Emergency Transportation Act of 1933. This legislation was intended to promote cooperation between the railroads and to eliminate wasteful duplication of services. It set up an Office of Federal Coordinator of Transportation to facilitate that cooperation and to aid railroad reorganization attempts. The 1933 act proved ineffective, and the Transportation Coordinator's position was abolished in 1936 (19:227-8; 25:336).

In 1940, just before America's entry into WWII, her rail system possessed just over 233,000 miles of track extensively spread over virtually the entire country. Total trackage had declined somewhat from the all-time peak of 264,000 miles but the railroads were still the country's "...most important freight-carrying agency" (4:20; 20:51; 25:27).

It was obvious that maintaining solid control of the railroads would be important to effective wartime transportation management. Luckily the structure of the industry was such that management could be easily asserted. There were a relatively few number of firms providing a relatively homogenous mix of services, and virtually all had long experience in dealing with government regulation.

Development of Pipeline Transportation. Pipeline transportation began in the oil fields of Pennsylvania. Pegrum places its origin in 1872; Lieb and Sampson and Farris stated it started in 1865. It was originally developed to provide an alternative to the expensive wagon transportation originally used to move oil from the fields to refineries and distribution points (19:79; 20:62; 25:36).

The first major pipeline, stretching 110 miles, was built in 1879 to move Pennsylvania oil from the field to a connection with the Reading Railroad for onward transit to New York City (20:62). Most early pipelines, both before and after that one, were much shorter and were used primarily as gathering systems within oil fields. This was partly the result of inadequately advanced pipeline technology. It was also partly due to the railroads' frequent refusal to allow passage of pipelines under their tracks (19:79; 25:37).

Profitability of the lines was initially high and attracted many new entrants into the industry. The consequent intense competition drove many into bankruptcy. Oil companies were quick to buy out the bankrupts with the result that pipelines came largely under their control (19:79).

The Standard Oil Trust was particularly active and aggressive in acquiring pipeline. In the 1880s and beyond it acquired much new line, blocked construction of competing lines, and built many new lines itself (13:88). Pegrum stated that by 1900 the Standard Oil Trust controlled over 40,000 miles of pipeline versus 550 for the next largest operator. Harmon states that the entire pipeline network at the turn of the century encompassed only "...approximately 18,000 miles" (13:51), but concurred that Standard Oil controlled most of it (13:88).

As pipeline technology advanced longer lines were built. Many connected oil fields in Pennsylvania to the Atlantic Coast and the Great Lakes region. The greatest growth in pipeline construction occurred in the early 1900s as the growth in automobile use spurred increased demand for oil and large well fields in the Southwest were developed to satisfy the demand (13:51; 20:62).

Also as a result of technology improvements pipelines were able to move beyond their original role of transporting crude petroleum. Improved welding techniques cut leakage and allowed construction of the first refined product line in 1930. The development of lightweight pipe of high tensile strength was followed by the beginning of large-scale development of natural gas pipelines in 1931 (13:55; 19:80; 25:37).

There was minimal government involvement with the development of pipeline transport. Virtually all were developed by private capital

with their only government assistance the allowance of right-of-way on some Federal property. Harmon cites the estimated value of those allowances between 1900 and 1940 at just over $76,000. Most lines were owned and operated by individual oil companies or oil company combinations, although some few were independently operated (13:98; 20:62).

Somewhat paradoxically, given their ownership patterns, pipelines had been regulated by the ICC as common carriers since 1906. At least two factors were behind this. First, the extreme monopoly power that the Standard Oil Trust had wielded over oil prices, partly as a result of its virtual total control over pipeline transport, had driven calls for federal regulation. Second, while pipelines primarily moved the products of their owner-operators, they also moved some oil owned by others (13:50,88; 25:71,322).

The form of pipeline regulation was much the same as that applied to railroads except that industry entrance and exit was not controlled (19:82). After the imposition of federal regulation, oil company pipeline owners continued to use a variety of schemes to place competing shippers at a disadvantage. The extent of those schemes was such that Harmon termed the effectiveness of early regulation "debatable" (13:89). He asserted that effective regulation only followed aggressive ICC action after 1934 to determine and set fair shipping rates (13:89-90). Similarly, Pegrum concluded that the status of oil pipelines as common carriers was sufficiently ambiguous as to make their effective regulation problematic (20:364-5).

At the beginning of WWII the American pipeline system consisted of approximately 118,000 miles of line. That total was composed of "about"

65,000 miles of long-distance crude trunk line, 53,000 miles of gathering line, and 9,000 miles of product line (13:51). Most of it was of less than 10 inches in diameter (19:80). It was largely owned and operated by a relatively small group of firms. Those firms had many years of experience in operating under some form of government regulation. However effective or ineffective that regulation was, it allowed them some familiarity with government controls prior to the onset of wartime management.

Development of Air Transportation. Transportation by powered aircraft was the latest mode to emerge in America and the one which received the greatest level of government involvement. The pace and direction of air transportation development was intimately linked to federal efforts to promote and guide it. This is especially true in the case of air freight transportation. The high cost of air shipment made one special form of government freight --air mail-- the traffic staple of early air carriers.

Powered flight was first achieved in 1903. Harmon placed establishment of the first scheduled air transportation service in 1914. World War I provided an impetus to more rapid aircraft development and to the training of many pilots. Its end allowed the release to peaceful public use of many of the aircraft and pilots produced. Many surplus aircraft were sold to individual private pilots, and many of them used the planes to start small commercial operations (13:57; 19:104; 25:33).

The Federal Government, in the meantime, was developing the process of moving air mail. Harmon stated the first experiment with air mail service occurred in 1911. Other authors place it, alternately, in 1916 and 1918 (13:57; 20:337; 25:33). Some air mail was moved between

New York City and Washington in 1918, first in Army aircraft and later in Post Office planes. In 1919 the first regular air mail service between those points was instituted. The first transcontinental air mail service was started in 1919. By 1924 it was expanded to provide day and night service (20:61,337;25:33).

Movement of air mail prior to 1925 was undertaken by government employees in government aircraft. The Kelly Act of 1925 authorized the Post Office to contract with commercial carriers for air mail movement. By 1927 all air mail was being carried by commercial firms under contract (25:33).

The Kelly Act also required that the carriers working under contract "provide facilities for passengers" (20:61). This was an important step in developing a more secure traffic base for the commercial carriers. Air transportation was seen as something of an oddity. Air mail contracts provided the revenue which carriers needed to operate while they expanded their markets. Sampson and Farris noted "most airline companies were highly subsidized by air mail contracts and were in the mail business more than any other" (25:34).

Pegrum characterized early Federal interest in commercial aviation as concerned with promotion, navigation, and safety (20:336). The Kelly Act was promotion. The Air Commerce Act of 1926 was more concerned with navigation and safety, although its structure also had a promotional effect. It created a Bureau of Air Commerce to establish and maintain all necessary air navigation and safety facilities, except airports, for the aviation industry. The act also authorized the establishment of air safety regulations for carriers. The Bureau of Air Commerce used that authority to establish safety rules and standards as well as to begin

the inspection and licensing of pilots and aircraft (25:349). The act had the effect of promoting commercial aviation by its establishment of the principle of free government provision of airway maintenance. This relieved carriers of a significant cost of doing business (20:61).

The McNary-Watres Act of 1930 was further, and more blatantly, promotional. It changed the basis for computation of air mail contract payments so that air mail effectively paid the entire basic costs of aircraft operation. Any additional traffic carried essentially represented revenue generated without cost (25:349-50).

McNary-Watres also allowed the Postmaster-General to award contracts selectively and without competitive bidding. This provision allowed contracts to be more directly used as carrier subsidies and to be used to shape the airline system. As a result of implementation of its provisions many airline routes were consolidated and a route system of trunk and feeder lines were established (13:58; 19:237).

Greatly increased federal funding for airports also started in the early 1930s. The Air Commerce Act of 1926 had prohibited federal funding of airports but the onset of the Depression changed that policy. Like road building, construction of airports was undertaken as a public works program to provide work to the unemployed. After 1933 federal financing became the primary source of airport construction funds (20:338).

The first government economic regulation, vice promotion, of aviation came with the Air Mail Act of 1934. This legislation was enacted as the result of suspected illegal collusion between Post Office and airline officials in negotiating air mail contracts. All air mail contracts were cancelled for a brief period in 1934 and the Army hauled

the mail. When contracts were re-instituted under the Air Mail Act the ICC was allowed to set rates and to prevent airline mergers (19:237; 25:350).

More complete regulation was instituted under the Civil Aeronautics Act of 1938. Motivation for the legislation was provided by the near-bankruptcy of many major carriers and by a series of aviation accidents in 1936-37 which had eroded public confidence in air travel (20:337).

Many of the Act's provisions were similar in form to regulatory acts affecting other transportation modes. Airline rates and earnings were to be controlled by the government, as was entrance and exit from the industry (25:350).

Regulation of airlines was to be different, however, in many other respects. Instead of making any existing body responsible for regulation two new agencies were created. The Civil Aeronautics Authority --renamed the Civil Aeronautics Board (CAB) in 1940-- was established to administer economic regulation. The Civil Aeronautics Administration (CAA) was established to take over from the old Bureau of Air Commerce the responsibility of maintaining the airways and enforcing safety regulations. Lieb attributed the decision to set up new agencies to Congressional beliefs that air transportation was different enough from other modes to warrant a new agency and that the then-current responsibilities of the ICC were already broad enough (19:238,240; 25:350,352).

The 1938 act also included a number of promotional provisions that were unique to air transportation regulation. It directed that economic regulation be used in large measure to encourage the further development

of commercial transportation and protect it from destructive competition. Among other of these provisions it formally allowed federal aid to airport development and authorized the CAA to develop a comprehensive plan for airport construction and development (20:61; 25:348-9).

Civil aviation at the start of WWII was a relatively small industry which was still maturing. As compared to other transportation modes it carried only minimal traffic, much less than one percent of the total of either freight or passengers (24:33-4). It was heavily dependent upon government for revenue traffic, provision of services, and protection from competition. Because its services were unique for their speed, however, it represented a very significant potential contributor to the mix of wartime transportation resources. Further, the almost inextricable intertwining of civil aviation with the federal government made executives in this industry well adapted to government controls.

1939-41 Transportation Development. The period between the onset of WWII and America's entry into it was significant to transportation for at least two reasons. First, it included passage of a major piece of federal transportation legislation. Second, some early institutions of transportation control during the period were important to later wartime management.

The Transportation Act of 1940 was passed following over two years of hearings on the status of the domestic transportation. As a result of these hearings the Congress concluded significant problems existed, especially within the water and rail carrier industries. As a result, it used the 1940 Act to initiate economic regulation of water carriers

and to modify regulation of the railroads. These, and other, of the 1940 Act's specific provisions were important as time went on. In the short term they were largely overcome by events with the onset of war. What was more significant was that the Transportation Act of 1940 stated, for the first time, a national transportation policy. That policy, in brief, was to develop, coordinate, and preserve a national transportation system composed of all of the several modes. The particular advantages of each industry were to be preserved by structuring regulation in such a way as to promote those advantages (19:241,244; 25:355-6).

There was no indication in the literature that wartime transportation management was specifically guided by the 1940 declaration of policy but the experience of WWII proved the wisdom of that policy. As is extensively discussed later, each transportation mode made significant contributions to the wartime effort.

Industrial activity supporting WWII started before the U.S. became a belligerent. Some of this was in support of America's own rearmament, some provided material to countries already in the war. As the volume of export traffic grew, and as the potential for American involvement into the war increased, some early control of war-related transportation evolved.

The system of transportation controls instituted prior to 1941 was largely the product of planning after WWI. As has been mentioned, in WWI the government had had to assume operation of the railroads in order support the war. The lessons of that experience had been used to make plans to avert repeating it.

Before the nationalization of the rails in WWI the flow of wartime traffic had caused "virtually paralyzing" congestion in the system (24:73). Factors contributing to the congestion included

> ...extraordinary grain shipments in late 1917, Fuel Administration ineptitude that had delayed the shipment of coal into the fall and winter, severe weather, and mismanagement at the terminals, which prevented the timely unloading and return to service of scarce freight cars. (1:104)

Failure to establish coordinated direction produced

> ...terrific jamming of the freight terminals at East Coast ports which backlogged freight cars as far as Harrisburg, Pennsylvania and Albany, New York. (8:163)

Freight cars arrived at the ports much faster than they could be unloaded. At one point in December 1917 almost 70,000 carloads or carload-equivalents of freight were being held waiting for unloading at the ports or on rail sidings along mainlines behind them. The ports normally held a five-to-seven day supply of cargo with which to load ships. At the peak of the congestion a supply of ninety or more days' worth was held (24:74).

The WWI Railroad War Board, consisting of a group of railroad presidents, attempted and failed to control the problem. There were several causes for their failure. The individual railroads resisted rerouting traffic because it might cause them some loss of revenue. The Department of Justice refused to waive anti-trust law provisions that prohibited the cooperative efforts by the railroads that efficient operations required. Various government departments "...issued priority orders indiscriminately..." to port-bound traffic, and the railroads "...were not in a position to question the relative priority of these orders" (34:294). Further, movement of freight to the ports was not

coordinated with the availability of shipping space for it. Freight moving under priority required complex sorting at the ports, further adding to the congestion (24:74).

The WWI railroad problem was only solved by government taking over the rail system. Among the actions finally solving the problem were raising rates, unifying terminals, forcing shippers to efficiently load cars, and pooling railroad maintenance facilities (1:104-5).

After the "bitter experience" (24:75) of WWI, and with the greater freedom of cooperative action allowed the railroads under the Transportation Act of 1920, plans were developed by Army, Navy, and railroad officials to deal with transportation in any future war emergency. Fundamental to those plans were the notions that there should be no "general system of priority in transport" and that railroad freight movement had to be coordinated with the port capacity and the availability of shipping space (24:76).

The plan, as finally developed by the Association of American Railroads (AAR), was put into effect in November 1939 as traffic to Europe increased significantly. It encompassed appointment by the AAR of a Manager of Port Traffic to regulate the flow of commercial traffic to and through the ports. The Port Manager monitored the levels and status of traffic at the ports, and controlled the flow of traffic into them to match their capacity. Control of inward flow was maintained by requiring shippers to secure shipment permits from the Port Manager before their cargoes would be accepted for rail movement to a port. Cargo flow through the ports was maintained by requiring shippers applying for permits to show proof that they had confirmed steamship space reserved for their cargo (24:77-8).

In May 1941 the Army established a control system to regulate the movement of its own export cargo as well as that it procured for others under Lend-Lease. Its goals and mechanisms were similar to those of the AAR's system except that the Office of the Quartermaster General, rather than the Manager of Port Traffic, issued movement permits to shippers (24:79; 32:29).

Industrial Mobilization in World War II

Just as the status of transportation assets shaped their management in WWII, that management was itself shaped by the industrial mobilization in which it occurred. This section is a discussion of America's WWII industrial mobilization. It is not intended to be --and is not— an exhaustive study of the mobilization. Rather, it provides a background of sufficient detail in which to appreciate the course of wartime management of transportation.

One cardinal characteristic of America's industrial support of the war effort was its immensity. Peppers characterized WWII as "a war of mechanized mass" (21:84). Supporting the technological complexity of warfare captured in that characterization demanded a large and continuing stream of goods from the national industrial base. Provisions went not only to American forces but also to those of the Allies. As President Roosevelt had wished in 1940 the U.S. became the "arsenal of democracy" (21:20).

A number of statistics establish the degree to which American industrial output grew during the war. Between 1940 and 1945 the total U. S. labor force (including the armed forces) grew from 55.1 million to 67.5 million. The military services accounted for a peak of over 12

million of that total, up from about 300,000 in 1940. Even after such an extensive levy to the military, however, the civilian work force grew by 600,000 over the same period. Much of this can be explained by a dramatic drop in national unemployment; some by the entry into the labor market of new workers. In any case, the pertinent fact is that the WWII American economy included (and required) many more workers than before the war (23:5-46,47).

The growth in the number of people working produced an even larger growth in the total national output of goods and services. Between 1939 and 1945 the U.S. gross national product rose from $90.5 billion to $211.9 billion. All federal spending, including defense, went from $8.9 billion to $95.2 billion. As these figures indicate, not all of the increased production was accounted for by increased military needs. The portion of national output devoted to consumer spending also increased considerably. Abrahamson pointed out that civilian consumption of very many goods rose during the war. He stated "Americans fought their second world conflict out of increased production" rather than solely by diverting resources to the military (1:139-40).

The output of individual industries reflected the widespread effects of war production. Aircraft production in 1944 was over 28 times higher than in 1939, explosives output was 20 times higher, and ship production was 17 times higher. Other, more mundane, products such as furniture, industrial chemicals, and pig iron showed less dramatic --but significant-- increases (1:149; 23:5-16). During WWII American industry produced (among other items) over 900 warships of various types, 5,600 merchant ships, 310,000 aircraft, 88,000 tanks, 12.5 million rifles and carbines, over 800,000 2.5 ton trucks, and 40 billion

rounds of small arms ammunition. One author also specified the production of "2 atomic bombs", the small total of them obscuring the amount of industrial capacity that went into their production (1:137; 10:78; 15:486-9).

Marshalling American industrial potential to meet the demands of war required a system of governmental controls more comprehensive than any before imposed on the American public. The nation's entire economy, not just its industrial capacity, was directed to winning the war (36:7). The Federal Government

> told businessmen what they could produce, the prices they would charge, and the profit they might make. Federal agencies not only drafted part of the labor force into the armed forces --an action never before commenced in peacetime-- but helped, and sometimes coerced, workers to find essential wartime jobs and eventually limited the hourly wage they might earn. Federal authorities also controlled essential raw materials, rationed scarce consumer goods, and set the prices retailers might charge. (1:132)

The control system as fully evolved was administered by a number of Federal agencies created "to control specific industries or to manage an entire sector of economic activity" (1:147). After May 1943 the activities of the individual agencies were coordinated by yet another "superagency" (1:148). All were designed as temporary agencies meant only to meet the needs of war.

The control scheme that was imposed on the economy was not instituted as a complete plan at a single blow. Vawter characterized its development as a "...hit or miss, evolutionary development of organizations and controls which, in the long run, directed our economy toward the goal of winning the war" (36:7).

The net effect of the dispersion of mobilization responsibility and the incremental approach taken to imposing controls was that the

system often was —or appeared to be— insufficiently controlled and coordinated.

Plans for a more tidy-appearing set of comprehensive controls to be imposed as a single package had been developed by the Army and Navy Munitions Board in the 1930s and published in a series of Industrial Mobilization Plans (IMP). The IMPs were developed based on lessons learned in WWI. They envisioned the creation of a strong central economic managerial agency which would report directly to the President and be supported by a series of agencies and committees to carry out its policies. The system was to be implemented on the appropriate declaration of emergency by the President (10:49-50; 12:31-2).

These plans were never instituted. One of their major strengths, the provision of a comprehensive set of controls to be initiated all at once, proved to also be one of its serious flaws. The IMPs, because they failed "to plan for pre-war preparations short of total mobilization" (23:2-8) had "...very little relevance" in the context of the situation as it actually developed (23:6-18).

The slow development of American participation in WWII did not lend itself to the one-time immediate imposition of wartime economic controls. There was significant concern about German and Japanese intentions in some quarters before war was a reality but a political consensus that would support broad American participation emerged only after the attack on Pearl Harbor. Until that time isolationist sentiment was strong (35:1-3) and preparations for war were hampered by suspicions that the President "...secretly sought to maneuver the nation into another useless European conflict" (1:166).

Pre-war mobilization efforts paralleled the incremental development of the scope of the emergency. Before American forces were attacked and Congress subsequently granted the President sweeping powers to manage the economy mobilization efforts were forced to rely on "voluntary compliance, emergency powers derived from old statutes, or questionable assertions of (Presidential) authority" (1:166).

In August 1939 President Roosevelt established a War Resources Board (WRB) "to study and report on" the 1939 version of the IMP. The WRB recommended a modified version of the IMP for implementation without appointment of the strong central director. Its recommendations were rejected by the President, quite probably because their implementation was not politically feasible at the time (1:133; 10:57; 23:6-6,7,18,19; 35:33).

After the European war took a series of bad turns for the Allies in early 1940 the President took more aggressive action to spur mobilization preparations. In May 1940 he revived the National Defense Advisory Commission (NDAC) of the Council of National Defense which had originally been established in 1916. Because that agency was already in existence its use did not require Congressional approval. It included seven members, each of whom was concerned with a specific aspect of the economy. The President also created a new agency, the Office of Emergency Management (OEM) to serve as his link with the work of the NDAC (1:134; 10:59).

The NDAC had no formally-appointed leader. Vatter characterized it as "...a chair-less, salary-less, almost appropriation-less apparatus for advising on coordination of the whole defense effort" (35:34). It had no formal authority, depending instead on "...the prestige of the

Presidency and the prominent ...men appointed to..." it to carry out its work (35:34).

As the press of domestic and military orders became heavy later in 1940 the NDAC proved ineffective. It was replaced in January 1941 by a new agency, the Office of Production Management (OPM). The OPM's focus was concentrated on stimulating production and breaking logjams in resource procurement. Although it "...moved industrial mobilization further along than had the NDAC" it, too, lacked statutory authority for its directives. As military demands on industrial capacity became yet heavier, especially after American entry into the war, the voluntary actions on which the OPM relied became inadequate to effectively control industry (1:135; 10:74-5).

In the aftermath of American entry into the war the President created the War Production Board (WPB) to replace the OPM. It was given a single chairman and a broad charter to direct wartime production. Also created, both before and after Pearl Harbor, were a number of individual agencies responsible for control of specific commodities and functions of the economy (1:135-6). The WPB was successful in curtailing nonessential civilian production so that more capacity could be directed to filling military orders. It developed a Production Requirements Plan and Controlled Materials Plan to control production and the use of scarce materials. These constituted "...a fairly satisfactory system for controlling industrial production" (1:136).

The WPB failed as an agency to centrally coordinate the entire economy. Abrahamson summarized the WPB's shortcomings as follows:

> It emphasized control of defense production when the entire economy --civilian and military-- required direction. It left most procurement to the military services, which led to poor

> coordination with civilian and Allied needs and little advance planning. It took a voluntaristic approach to business, emphasizing profit incentives rather than coerced central direction. It allowed such important aspects of industrial mobilization as petroleum, rubber, prices, and manpower to escape its authority and fall under the direction of independent agencies. Its Production Requirements Plan and Controlled Materials Plan controlled only a few scarce materials and imposed an overwhelming paperwork burden on smaller manufacturers. (1:137)

Especially crippling was the WPB's inability to effectively coordinate the activities of the independent agencies. The WPB was "theoretically" superior to them but their chairmen regarded WPB directives as essentially "second opinions" to their own decisions and "...not necessarily conclusive" (23:6-26). The resulting inefficiencies eventually made clear the need for a superagency with sufficient power to authoritatively settle disputes among agencies. Presidential and Congressional misgivings about appointing an individual whose powers would be so broad that he would essentially be an "Assistant President" (23:6-32) were overcome by necessity and, in May 1943, the Office of War Mobilization (OWM) was created. It filled the need for strong central direction to authoritatively arbitrate disagreements about resource allocation among conflicting claimants and thus effectively coordinate the national mobilization effort (1:140; 23:6-32-36).

The evolutionary and fragmented movement to strong government control of the economy and industrial mobilization has met with disdain from some researchers. Reed noted that all American mobilizations -- including that in WWII-- "..have always had an improvised quality about them, much to the frustration of mobilization planners" (23:6-36). He asserted, however, that the evolutionary and fragmented nature of control of WWII mobilization was appropriate to the political context of

the time and the evolutionary nature of the emergency itself. He further claimed that each agency which emerged as time progressed succeeded in effectively advancing mobilization efforts and failed only when new problems were exposed by the advancement (23:6-36-7). Judgements on the reasons for or appropriateness of the nature of government control of the WWII mobilization notwithstanding, it inarguably formed the milieu in which control of wartime transportation took place.

Transportation Management in World War II

The dramatically increased tempo of industrial activity supporting America's war effort would suggest a like increase in the tempo of transportation activity. Pertinent example statistics from the era bear this out. During the peak war year of 1944, American railroads carried 97 percent more ton-miles of freight than they did in 1940; freight ton-miles carried on the Atlantic and Gulf coast intracoastal waterways rose over 110 percent in the same period; railway passenger miles were up 295 percent; the number of passengers carried by intercity bus rose 116 percent; and between 1941 and 1944 taxi ridership increased 67 percent (24:31,34,248-9,265).

The stockpile of transportation resources available to handle this greatly increased workload was relatively fixed and did not grow at anywhere near the rate of demand for its use. Compared to WWI, American railroads carried the burden of WWII traffic with [illegible]000 fewer locomotives, 600,000 fewer freight cars, and 18,000 fewer passenger cars. Acting as the agent of the railroads in seeking production of equipment, the Office of Defense Transportation (ODT) asked for an

additional 311,500 freight cars, 4,159 locomotives, and 5,150 passenger cars to ensure the ability of the railroads to carry wartime traffic. Of these, they were granted only 130,826 freight cars, 2,500 locomotives and 1,977 passenger cars. Requests for additional steel rails, trucks, and busses met with similar results (34:III). The result was that wartime traffic was largely carried on equipment available at the beginning of the war.

A shortage of equipment relative to demand was only one challenge facing wartime transportation management. Equally daunting were a number of changes from peacetime traffic flow and traffic distribution by mode. Among other reasons, these were caused by enemy action and by changing patterns of commerce necessitated by internal war support activities. For instance, enemy submarine activity off the American East Coast presented a great threat to shipping. At the same time, much of the available shipping was diverted from its normal peacetime routing to support of America's forces and her allies overseas. The combined effect was to halt, in large measure, the coastwise and intercoastal hauling that normally carried a large bulk of freight between American East Coast ports. The traffic thus diverted became the responsibility of inland carriers, primarily the railroads (34:IV).

As another example, many new industries and military bases were established in areas of the country which had previously generated little freight or passenger traffic demand. This complicated the task of transportation management by causing new, or increased, demand in areas which were poorly served with resources such as rail lines with which to meet the greater needs (34:17).

The primary tasks of domestic wartime transportation management, then, were largely to stretch what resources did exist to achieve their most efficient usage and to ensure that transportation shortfalls were allocated so the traffic most important to the war effort was serviced with the capacity in being.

Functions of the Office of Defense Transportation. The Office of Defense Transportation was created in late December 1941 as the executive agency most responsible for the efficient management of domestic wartime transportation. Its charter, as defined in Executive Order 8989 which created it, was to:

> Coordinate the transportation policies and activities of the several Federal agencies and private transportation groups in effecting such adjustments in the domestic transportation systems of the Nation as the successful prosecution of the war may require. (34:1)

Among the specific duties with which it was charged were these:

> (1) Coordinate the transportation policies and activities of the federal agencies and private transportation groups as the successful prosecution of the war may require;
> (2) Compile and analyze estimates of the requirements to be imposed upon existing transport facilities by the needs of the war effort; determine the adequacy of such facilities to accommodate the increased volume of wartime traffic; develop measures designed to secure maximum use of existing transport facilities and equipment, and in this connection, advise the Supply Priorities and Allocation Board as to the estimated requirements and recommended allocation of materials and equipment necessary for the provision of adequate domestic transport service;
> (3) Coordinate and direct domestic traffic movements in order to prevent congestion and assure the expeditious movement of men, materials and supplies to the point of need;
> (4) In connection with the United States Maritime Commission and other appropriate agencies, coordinate domestic traffic movements with ocean shipping in order to avoid congestion at port areas;
> (5) Survey and ascertain present and anticipated storage and warehousing requirements, and encourage the provision of increased storage facilities;
> (6) Represent the defense interest of the government in negotiating rates with domestic carriers and in advising the

> appropriate governmental agencies with respect to the necessity for rate adjustments caused by the effects of the defense program;
> (7) Report to the President with respect to the progress made in carrying out the order. (24:8-9)

In carrying out these responsibilities, the first ODT director, Joseph B. Eastman, established the principle of voluntary cooperation as paramount to ODT operations while reserving government mandate only for situations truly requiring it. His purpose was summarized in a statement he made soon after assuming office:

> I shall endeavor...to make full use of the collaboration and cooperation of other departments and agencies of the Government and of private transportation groups...and I have every confidence that I shall receive whole-hearted cooperation from all these sources. (34:2)

Mr. Eastman further determined that the ODT would embark on a course of action which would make the best usage of existing agencies and procedures rather than attempting re-creation of a framework of system control. He stated "I shall try not to duplicate work which is being done effectively, nor to interfere where interference is unnecessary" (34:2).

There were numerous organizations with which to collaborate and coordinate to achieve effective operation of the transport system. While the ODT was established as the principal wartime government agency responsible for domestic transportation, other agencies and groups maintained significant transport responsibilities throughout the war. Rose notes that the ODT was "...only the first of many" groups concerned with transport (24:2). As the enumeration of the ODT's prime responsibilities makes clear, its job was largely one of coordination of the actions of a number of players. Some of those groups had existed pre-war; others, principally governmental, were created solely to deal

with the wartime emergency. In either case, their interests and functions were to significantly affect how, and through whom, the ODT was to carry out its responsibilities.

Organizations Affecting Wartime Transportation. The Interstate Commerce Commission, while primarily concerned with the economic regulation of the interstate operations of virtually all surface transportation providers, also maintained the authority for more specific direction of carrier operations in times of emergency. Its Bureau of Service kept a force of agents in the field reporting on prevailing traffic conditions on the railroads. These reports provided the background information upon which the ICC based emergency operational directions to the carriers. The Bureau of Service was also active in promoting the safe transport of explosives on the rails. The ICC's Bureau of Motor Carriers, created as a result of broadened ICC authority granted by the Second War Powers Act of 1942, performed much the same functions in relation to the trucking industry as the Bureau of Service did for the rails (24:3-5).

Rose noted the authority of the ICC is so broad that with certain modifications to provide wartime relief of restrictions on activity normally outside its responsibilities it could well have performed the same function as the ODT, thus removing the need for a new agency (24:5-6). He speculated that this was not done because the ICC "...functioned essentially as a quasi-judicial body and could not perform effectively the promotional and administrative duties considered crucial for a war agency", and because "it was felt that a new agency under the leadership of a single director would operate more aggressively than the eleven-man Commission" (24:6).

The War Production Board affected transportation through its roles both as a representative of shippers' interests and as a supplier to the transportation industry. On behalf of shippers, the WPB had responsibility for assigning transport priorities to various materials. The ODT was, in turn, directed to "...be governed as to the relative importance of deliveries" by these priorities (24:16). The WPB as a supplier also had a profound effect on transportation through its power to regulate the amount of scarce materials devoted to various manufactures. Under its Controlled Materials Plan, the WPB controlled the quantity of new transportation assets available to the industries involved. The ODT acted as the agent of the separate carriers in this matter, consolidating their projected requirements and submitting them to the WPB (24:16-18).

The War Shipping Administration (WSA) had authority over "...the control and operation of all United States merchant shipping", with the exception of that owned by the military services and that operated solely in coastwise service (3:83). This included the "...operation, purchase, charter, requisition, and use" of merchant ships (3: 84). Part of its responsibility was to allocate shipping space to specific traffic and to direct traffic to specific ships and ports. Domestic transportation was significantly affected by the consequent demand for inland transportation of goods and people to meet sailing schedules.

The Office of Price Administration (OPA), through its rationing of tires and gasoline, significantly affected the type and quantity of motor transport available during the war. Further, it indirectly affected transportation through its intervention in transportation rate

setting hearings before the ICC and various state public utilities commissions (24:18-19).

The Petroleum Administration for War (PAW) affected transportation much as the WPB did, both as a shipper and a supplier. As a shipper, it dictated to the ODT "..the quantity and kind of petroleum to be shipped and received..." (24:19). As a supplier, it was responsible for determining, based in part on ODT estimates of need, the total amount of petroleum to be devoted to civilian transportation uses. Further, it was granted approval authority over the construction or extension of pipelines, and authority over their operation as it concerned the type, quantity, and direction of flow of the petroleum products transported in them (24:20-21).

The Solid Fuels Administration for War (SFAW) affected transportation through its concern with one of the largest sources of transport workload --coal. The SFAW provided to the ODT and the various carriers annual projections of coal requiring transport and established shipment priorities for coal users. These actions allowed some planning of transport allocation to cover the requirement (24:20-21).

The War Department very significantly affected transportation operations through its role as perhaps the single largest shipper during the war. Its Chief of Transportation assumed the attitude that the regulations of the ODT were "...essential to the war effort and should be supported by the Army". At the same time, however, the Chief of Transportation's end-of-war report cites an agreement reached between the Army and the ODT arranging for submission of ODT regulations for "clearance" by the Chief of Transportation prior to their being placed in effect. If those regulations would present difficulties to the Army

transportation operations the "ODT was requested to make an exception of military traffic" (32:19). No reference to such an agreement was found in other sources.

The War Department created an extensive and complex organization of its own, ultimately creating a Transportation Corps, to coordinate and expedite the movement of Army traffic. Its operations ranged from placement of personnel at traffic gateways to expedite Army movements to operation of individual railroads which otherwise would have been idled by strikes (32:19). It also included close coordination with carriers to provide effective service to War Department shipments (24:21-24).

The Navy Department, as would be expected, also played an important role as a major shipper of material. In contrast to the War Department, however, the Navy's domestic freight traffic was much less tightly controlled. Ballantine extensively documented the general diffusion of control of Navy logistics activity throughout its Bureaus, Districts, and Commands in WWII. He stated:

> In general the pattern of regional logistic activity was one of many separate autonomies over which district organization had almost ceased to exercise any influence. The resultant in terms of logistic effort was increased overhead, waste of personnel and material, and, worst of all, the impossibility of carrying out the policies and programs of the central command, even to the limited extent that comprehensive direction was supplied by the Navy Department. (3:146)

As one example of the results of that diffusion, Ballantine cited the case of the Commandant of the Third Naval District in New York being forced to "consult the New York Telephone Company for complete information" when he was asked to list all the activities, including those responsible for some aspect of logistics, within his command.

Seventy-seven agencies previously unknown to the Commandant but under his control were thus identified (3:145).

As would be expected from their decentralized logistics system, the Navy played little role in the central control of domestic transportation. Rose states that the Navy "...at no time integrated its activities with the general plan to control exports" (24:83) and that the ODT, WSA, and the Army "found it difficult to obtain information concerning" Navy traffic (24:94). Ballantine stated that the Navy moved to a more centralized control of transport only under threat by the ODT to strip it of some controlling authority over its own traffic (3:221).

The Car Service Division of the Association of American Railroads represented in war, as it did in peace, the organization effecting the smooth flow throughout the national rail system of cars owned by the many individual railroads and shippers. The conditions of the war, however, required that the Car Service Division's operating priorities change. While in peace its primary goal was to return cars to their owners as quickly as possible, in war the goal was to achieve the greatest possible use of the limited quantity of railroad cars available. In pursuit of that goal, the Car Service Division agents normally assigned to the field to enforce its own orders often during the war "...served as agents of the ICC and the ODT in the administration of orders issued by those agencies" (24:25-28).

Shippers Advisory Boards were created before WWII by the Car Service Division to communicate to it shipper requirements for rail cars. These boards consisted of major freight shippers and receivers. During the war they expanded their activities to include promotion of transport equipment conservation. In addition to their normal

functions, these boards also served as a source of information to the ODT regarding local transportation conditions and as a tool through which to communicate ODT policies to shippers (24:28).

Control of Wartime Transportation. The following is a discussion of the control of domestic transportation in WWII as it was exercised in freight transport. It is largely centered around the control exercised in each of the major transportation modes although some overlapping is inevitable owing to the interrelationships of one mode with another.

Railroad Freight Traffic. The share of total domestic freight traffic moving by rail versus other modes had steadily declined since approximately 1920. However, the position rail maintained in 1941 as by far the single largest carrier of domestic intercity freight traffic made its effective management critical to successful support of the war effort. The following table demonstrates the primacy of rail transport in WWII, and its growing importance throughout the period.

TABLE 1

PERCENTAGE DISTRIBUTION OF INTERCITY FREIGHT TRAFFIC BY MODE AND YEAR

YEAR	RAIL	HIGHWAY	INLAND WATERWAY	PIPELINE	AIR
1940	63.36	8.36	18.38	9.9	<.01
1941	64.72	8.5	17.59	9.19	<.01
1942	71.08	5.36	15.29	8.27	<.01
1943	72.79	4.6	12.91	9.69	.01
1944	70.19	4.45	12.87	12.48	.01
1945	68.9	5.33	13.14	12.62	.01

(24:33)

Rose described the critical task of controlling wartime rail traffic as so large, and the margin of error so slim, that "disaster seemed always just around the corner" (24:36). The ODT's activities in management of the railroads largely concerned maintaining the flow of traffic throughout the rail system, and with achieving the greatest possible use of rail cars. The programs undertaken to achieve these goals fell into three broad areas. These were the Traffic Channels Plan, which called for monitoring and directing traffic in the rail system to anticipate and relieve bottlenecks; diversion and rerouting of traffic among the various railroads to prevent bottlenecks in traffic flow and to promote efficient use of the rails; and the promotion of heavier loading of freight cars (24:49).

The Traffic Channels Plan required the Class I railroads to submit daily reports to the ODT for selected gateways and operating divisions containing information such as numbers of trains dispatched, number received, number of cars loaded, total cars dispatched, and total cars awaiting movement (24:50; 34:17). Individual railroads collected such reports from their respective operating divisions and transmitted the consolidated result to the ODT in Washington. Initially, these reports were transmitted by air mail. After late 1942, however, they were sent by telegraph and ODT personnel were then able to complete their analysis of the condition of the system for the preceding day by 5:30 P.M. of the day the report was received (24:50; 34:17). The ODT analysis consisted of a summarization of traffic data for all railroads and plotting this data onto a map. The data so summarized and plotted was then studied to reveal current or threatened "congestion, sluggishness, or other irregularities...", so action could be directed to the problem (34:50-

51). A daily memorandum summarizing the findings of the analysis was prepared and distributed within the ODT, to other Government agencies, and to the Association of American Railroads.

The reporting requirements of the Traffic Channels Plan were scaled back somewhat, both in scope and reporting frequency, as the war ground on and experience revealed what was and wasn't critical. In June 1942, 121 Class I railroads submitted reports. By the end of the war, this number had decreased to 32 (34:18). The reports themselves had shrunk from an original eight separate items to just three (34:17-18). While the official ODT history discounts the role of the railroads in reducing requirements, Rose noted that many carriers found the reporting "burdensome and unnecessary", and "not worth the effort required to make them" owing to the time lapse between receipt of the report and any action to address the problems revealed (24:51). Perhaps revealing in the same vein, the ODT history describes the plan as "purely voluntary" for the railroads on one page (34:17) while on the next it refers to reports which railroads were "required" to submit (34:18).

The program of traffic diversion and rerouting was called into being largely to address the issues surrounding railroad shipping conditions in the western part of the country. Before the war traffic through this area was relatively slight and moved largely in an eastward direction. The demand at west coast ports for material supporting the Pacific war reversed the peacetime flow. Monthly railroad ton-miles carried in the region rose over 91 percent between 1941 and 1945 (24:51-52; 34:21). At the beginning of the war, the largely expanded traffic base was unevenly allocated among the railroads, with the southern and central transcontinental roads overburdened and the northern ones

underused (24:52). The resulting congestion of the overutilized lines threatened the overall smooth flow of traffic to the west.

The railroads themselves addressed the problem of the greatly increased traffic load on limited western rail capacity by expanding the installation of centralized traffic control (CTC) on many of their single track lines. Centralized traffic control, in essence, was a system of electrically automating train dispatching and control. It eliminated many of the inefficiencies of manual switching and train signalling (11:13-14). The installation of CTC on western lines allowed much greater use of them than they would otherwise have been able to bear. Rose stated that had CTC not been installed on the western rail lines, handling their wartime traffic burden "would surely have proved intolerable" (24:277). Installations of CTC line rose from 2,163 in 1941 to almost 6,500 in 1945 (24:45).

The carriers also possessed the requisite knowledge of the traffic flow and the capacity to permit themselves to work out for themselves a system of traffic rerouting and diversion which would evenly spread demand over the several lines. However, it was unrealistic to expect them to do so. First, despite the national emergency, anti-trust laws stayed in effect so that any such collective action of the railroads could be construed as collusion in restraint of trade and open them to legal action by the Justice Department (24:53). Second, the railroads continued to operate as private, profit-making enterprises which could hardly be expected to voluntarily divert to their competitors a significant portion of their business.

As a consequence, the DOT and the Interstate Commerce Commission (ICC) acted jointly to appoint a common agent to reroute and divert

traffic to even demand over the transcontinental railroads (34:22). The agent appointed, Mr. W. F. Kirk, was a railroad executive recommended by the Association of American Railroads. He received reports relating to railroad operating conditions from field agents of both the DOT and the ICC as well as the same reports transmitted under the Traffic Channels Plan (34:23). During the war, 335,000 cars of the 7,061,933 moving through the affected major gateways were diverted or rerouted to smooth the flow within the system (24:56). An exceptional achievement of rerouting was the elimination of cross-hauling of traffic between railroads at the important Salt Lake City and Ogden gateways (34:23-24). Cross-hauling is the movement of traffic in a direction lateral to its primary direction of travel between origin and destination. This practice represents a waste of railroad capacity when it is not absolutely necessary to accomplish the onward movement of traffic to its destination. Beyond diversion and rerouting, Mr. Kirk was also successful in eliminating some circuitous routing and other normal practices which wasted railroad capacity (24:55).

Normal commercial practices in the middle third of this century, as they do now, often required or encouraged less than full usage of individual rail cars. In 1939, the average freight car of 50 ton capacity was loaded with an average burden of just under 37 tons of carload (CL) freight (24:56). The average load, while accurate, understates the degree of lost capacity by including all shipped commodities. For instance, average loading of miscellaneous manufactured goods --known as merchandise commodities-- tendered for movement in LCL lots was only 5.5 tons as late as 1941 (34:11). While the resulting underutilization was of little consequence in the relative

plenty of normal circumstances, the demands of war illustrated it for what it was —waste— and raised it to an issue of great significance. Recognizing this, the ODT undertook to eliminate as much of this waste as possible through a series of directives requiring heavier loading of rail cars. ODT General Order Number 1, effective May 1, 1942, established minimum loading standards for less than carload (LCL) traffic, initially requiring carriers to load no less than six tons of LCL freight per car in May 1942. Incremental increases occurred over time until, in September 1942, the standard reached 10 tons per car. Loading standards for CL freight were established by ODT General Order Number 18 in August 1942. This order prohibited shippers from offering, or carriers from accepting, any freight car not loaded to or above the marked weight capacity of the car or not occupying "all practicable stowage space" of the car (34:15). Other provisions of these orders prohibited the movement of LCL freight in rail cars within municipalities, or between adjoining cities; prohibited holding cars at warehouses to accumulate full carloads of LCL freight; and allowed some carrier cooperative actions normally prohibited by the Interstate Commerce Act (34:12).

Those orders had the effect of increasing average LCL loading of general merchandise from the 5.5 tons of 1941 to a peak of 9.8 tons in 1942, and a rate of 9.1 tons in 1945 (34:11). Carload freight rose from an average of 37.7 tons in 1940 to a wartime peak of 41 tons in 1943 (24:57). The ODT estimated that the increased car loading made so much more car space available that it had the same effect as increasing the car stock by a peak of over 200,000 in 1943 (34:13,15).

Not all was successful with the program, however. Rose noted that railroads objected that loading requirements "obstructed the free flow" of LCL traffic, and that heavier loading required more car stops at intermediate stations to "break bulk and consolidate shipments" (24:59). Further, one of the primary goals of the plan —to divert rail traffic to trucks when such diversion was most efficient— was not realized. This was due both to the refusal of regulatory agencies to broaden the authority of railroads and to the frequent refusal of railroads to exercise such authority as they had to arrange for carriage with independent motor carriers (24:60).

Within the broad parameters of these overall plans addressing rail management, specific problems and situations required concerted action to prevent critical bottlenecks, to promote the greatest possible use of the national rail system, or both. Among these were the control of traffic through ocean ports; management of the shipment of coal, grain, and petroleum; and control of refrigerator cars.

The control of traffic through America's ocean ports was of special significance. America's forces overseas were completely dependent on the lifeline of goods carried on ocean shipping. Lend-Lease goods also provided a large workload. Getting goods onto ships for delivery overseas was dependent on the efficiency of the interface of the surface and water transportation modes at the ports. Beyond the raw ability of the ports to berth and load ships, what was required was a system providing a smooth and continuous flow of the right material to the right port at the right time for loading on the right ship.

The task was herculean. Rose noted the "volume of freight consigned to foreign destinations was of unprecedented magnitude during

the war" (24:73). The total numbers of rail cars of export cargoes handled through the ports rose steadily through the period. During both 1944 and 1945 that figure was over 300 percent higher than in the pre-war year of 1940. At the height of activity in WWI, the port of New York handled "about 750" rail cars each day. In May 1944, that port handled a daily average of 1,815. In 1918 the average number of cars unloaded daily at all North Atlantic ports was 1,140. At the peak war year of 1944 it was 2,940 (24:75-6).

The failure in WWI to successfully handle the same general problem occurring at a much smaller level of activity, as discussed earlier, raised the issue to a high level of concern. That

> bitter experience made everyone concerned with transport in World War II --carriers, government officials, and shippers-- acutely conscious of the need for maintaining a continuous flow of traffic through the ports. (24:75)

Fortunately, the lessons of the WWI experience were productively applied to avoid a repeat of the same mistakes. Rose cited those lessons as "the indiscriminate issuance of priority orders to expedite the transport of war materials" and the "failure to coordinate the inland movement of traffic to the ports" with the availability of ships at the ports on which to load it (24:74). The system designed to avoid those errors was a joint product of the Army, the ODT, and the railroads. It consisted of a set of activities that took as their major goal keeping the ports open by ensuring the right traffic flowed through them rather than allowing for the early movement of priority cargoes. These activities included allowing transport to the ports only of cargo definitely committed to a specific ship and port. Storage behind the ports was also used as a buffer to prevent overloading the port and to

prevent unnecessary ship delays by ensuring cargo was always readily available for loading.

Allocation of shipping to individual ports was originally accomplished solely by the WSA. As the war progressed, however, it became apparent that this allocation had a significant impact on the domestic inland transportation system. Further, the ability of cargoes to meet ships was itself dependent on the ability of the inland system to carry it. In 1943, the WSA recognized these interrelationships and the need to address them by forming the Port Utilization Committee.

Port Utilization Committee membership included representatives of the Army, the Navy, the ODT, the WSA and, later, the British Ministry of War Transport (BMWT). Its function was primarily to allocate ships to ports in such a way that no single port was overburdened. Meeting monthly, it compared scheduled shipping with port capacities to assign ships to ports. In making those assignments it also attempted to minimize use of inland transportation by directing ships to ports near centers of production or consumption. Also considered was the availability at the ports of any special equipment required for cargo handling, and the need to keep labor at ports busy to prevent it from migrating to other work or locations (34:36).

Transport of freight to the ports was controlled through a system of permits. Carriers were only allowed to accept for transportation to a specific port cargo accompanied by a permit authorizing that movement. The number of permits available depended on the availability of shipping space. These permits were administered through a Transportation Control Committee consisting of representatives of the agencies chiefly concerned with the traffic carried and/or controlling significant

portions of the available shipping. These agencies included the Army, the Navy, the WSA, the ODT, and the BMWT (34:35-6).

The WSA and the BMWT allocated available shipping space to government shippers. The WSA (later the Port Utilization Committee) designated the port where, and the time when, the ship would be available for loading. Using this information, the Transportation Control Committee released permits for an amount of material corresponding to the available space and notified the shipper of the space allocation. The shippers to which the space had been allocated then applied for a permit to move material to fill the allocation to the appropriate port (24:84-5; 34:37).

While the Transportation Control Committee was responsible for release of permits, the actual issuing authority was the Traffic Control Division, Office of the Chief of Transportation, Army Service Forces. Rose attributed this delegation of authority to the fact that the War Department was the only government agency that had set up an operating control function (discussed earlier) prior to the war (24:85). Even though this delegation, in retrospect, presents a picture of a somewhat untidy division of authority, it did support the ODT director's stated intention of making the best use of existing procedures and agencies.

As an exception to this general procedure, the Navy controlled its own traffic and issued its own permits (24:94; 34:40). As previously discussed, this was primarily the result of a decentralized logistics structure in that service. The availability of only limited information about the domestic traffic of a major shipping agency could have undermined the success of the control program overall. In practice,

however, the problems resulting were very limited in scope and localized to only the San Francisco area (32:32).

Commercial shippers were given permits in a different manner. They first had to obtain an export license for a shipment from the Board of Economic Warfare. They then obtained, subject to the approval of the WSA, a definite shipping space from an ocean carrier. Following these steps they could then request a permit from the AAR Manager of Port Traffic in New York City, or one of his field offices (24:85; 34:37). Later in the war this procedure was changed to make the WSA the issuing authority for commercial permits (34:38).

The ODT created a system of reports with which to monitor and control the permit system and the flow of traffic through the ports.

The P-1 report was created from data regarding permits issued. It reflected the volume of freight expected to move to the each port, the shipping agency, the receiver at the port, when the freight was expected to move, and which railroad would be carrying it. The P-1 allowed ports to anticipate workload, and provided a source of information on which to base port allocation and shipping space decisions (34:41).

The P-2 report was created with data collected from the railroads. It reflected the amount of cargo actually shipped under permit, the permit number under which it was travelling, the number of the car in which it was shipped, the shipper's name, and the date of departure. The P-2 made it possible to more accurately forecast port workload. Comparison of this report with the P-1 would also allow detection of freight travelling under bogus permits, although experience proved that the attempted use of forged permits was virtually nonexistent (24:86; 34:41).

The P-5 report reflected the arrival of traffic at a port and any subsequent movement within the port area (34:41-2).

The P-6 report was submitted every 30 days. It consisted of a report of all carloads of freight which had been on hand at the port for 30 days or more along with pertinent information about such freight (34:42).

Although theoretically effective, these reports were of limited value in practice. P-2 reports proved impractical because they were commonly not sent owing to the heavy pressure of wartime workloads under which freight agents labored. P-5 reports, for much the same reasons, were found to be often incomplete or inaccurate. The P-2 was discontinued in May 1944; the P-5 in August of the same year (24:93).

As previously indicated, storage was used and managed as a buffer to protect the smooth operation of the ports. The Army established a system of holding and reconsignment points on important rail lines within 24 hours shipment time of the major ports. The intention of the Army in creating them was to provide a workload buffer close enough to the ports that freight could be quickly called forward when needed. This system was initiated with the establishment in May 1941 of a depot at Shamokin, Pennsylvania. That depot soon proved to be both too small and too poorly served by the railroads. In July 1941, therefore, two new depots were authorized at Voorhoesville and Elmira, New York. The system eventually encompassed ten such points. The eight additional to the first two were located at Marietta, Pennsylvania; Richmond, Virginia; Montgomery, Alabama; Shreveport, Louisiana; Yermo and Lathrop, California; and Pasco and Auburn, Washington. As the locations of the points indicates, this system provided service to ports on all coasts.

Construction of the system was completed in early 1944 and it was in operation through the end of the war (32:32-3).

The holding and reconsignment points were initially conceived of as a method of controlling only property procured by the Army for itself or for Lend-Lease. Experience proved, however, that property procured by the Departments of the Treasury and Agriculture for export under Lend-Lease constituted a significant portion of the traffic passing through the ports. Those and other agencies and the Army ultimately concluded agreements allowing the use of the points for almost all traffic. This allowed the system to maintain its effectiveness as a buffer for the ports (32:34).

These points were composed of both covered and hard-surfaced open storage. They were used to hold cargo consigned to a port but diverted enroute owing to a lack of shipping space. They also held cargo consigned directly to the point to be retained there until called forward by an overseas command or a foreign country under Lend-Lease. Supplies held at the points were intended to remain there for 60 days or less although this was not strictly enforced (32:34).

In addition to the holding and reconsignment points which they operated themselves, the Army also contracted with the railroads for operation of 48 open railroad storage yards which served much the same purpose. The Army Transportation Corps allocated storage space within the yards and provided inspection to ensure that they were managed according to the contract terms. Forty-six of these yards were located east of the Mississippi River. While they were never all simultaneously active, usually more than 40 were open at any given time (32:35). Approximately 400,000 carloads of freight were handled at the points and

yards during the war (32:35). Rose credited the holding and reconsignment points as being "an indispensable factor in keeping the ports free from congestion" (24:89). In addition to their routine utility, the points were also critical in protecting the ports on many special occasions. For instance, during the buildup in April 1944 for the anticipated invasion of Europe, 1,500 carloads of freight which had been consigned to the ports were diverted to the holding points owing to a temporary reduction in available shipping. Over 1,000 carloads were likewise diverted in October 1944 when ship offloading delays in Europe required a slowdown in American port loadings (32:34).

Another Army innovation was the establishment of freight consolidating stations and distributing agencies. Their functions were to accumulate Army LCL shipments within a given area for consolidation into CL loads for movement to other Army posts and to the ports, and to distribute consolidated CL shipments to individual consignees at delivery. They were established at 18 separate points in the United States. They proved so successful the Navy also began using the service in 1943 (32:28)

These activities were originally intended to speed Army shipments and achieve visibility over them. In practice they also proved to have the benefit of saving the Army money as CL rates were considerably lower than LCL rates. Further, they allowed greater use of freight cars and thus achieved savings for the rail system overall (32:27-8). It is also clear that, by interposing another level of centralized traffic control between shippers and the ports, they must have contributed to keeping the ports uncongested.

Between July 1942 and August 1945, 140,000 carloads of freight were consolidated at these stations, 65 percent of it Army, the remainder Navy. Of these, over 45,000 carloads were loaded aboard refrigerator cars which otherwise would have been unproductively moved empty to new points of lading on the Pacific Coast (32:28). Further protecting the ports was a system of nine warehouse/open storage area combinations procured by the ODT and administered by the armed forces and the Lend-Lease branch of the Foreign Economic Administration. These served to collect the output of factories in the area of Ohio, Indiana, and Illinois and to hold it until final overseas destinations were determined (34:48-9).

The system of traffic control, including both permits and buffer storage, instituted to smooth railroad traffic through the ports was completely successful. At no time was port operation anywhere in the country seriously threatened by traffic congestion caused by poor shipping coordination. Rose termed the results "brilliant" as compared to the disaster experienced in WWI (24:76).

Another major challenge to railroad management in WWII was provided by the control of the movement of coal. While there are two types of coal, bituminous and anthracite, anthracite production in the U.S. amounted then to only about ten percent of bituminous production. The relatively small production of anthracite kept it from presenting significant problems for transportation. Movement of bituminous coal, however, was a problem and the remainder of this discussion concerns it (34:55).

Demand for, and production of, coal during the war rose considerably over pre-war levels. Production rose from 460.8 million

tons in 1940 to a peak of 619.6 million tons in 1944. As coal is a basic raw material used in the making of steel, the increased demand for it was partly driven by greatly increased steel production. Also increasing demand was the primacy then of coal as an energy source combined with the energy demands of greater industrial activity of the war, along with the continuing demands of household coal use (34:55).

As it is now, coal was extremely dependent upon rail transport. In the WWII period over 80 percent of the coal produced in the U.S. made at least some part of the journey from mine to consumer by rail (24:97). As a result, the ability of the railroads to handle the increased production of coal was critical to support of the industrial mobilization overall.

The three greatest problems encountered in the wartime movement of coal were (1) a forced diversion of coal transport from normal peacetime routings; (2) greater demands forced upon the important Great Lakes and ocean ports and; (3) a fixed and limited quantity of cars available to move the much increased volume of coal traffic (24:97).

Diversion of coal movement from normal peacetime routings was forced by new and rapid industrial development, primarily in the western states, outside of areas with extensive previous rail development. Another major cause of coal traffic diversion was the intensive German submarine campaign along the American Atlantic coast. A further cause was the diversion of ships from coastal service to carrying transoceanic military cargoes. The combined effect was to force significant changes in the way the coal was sent to the important New England industrial area. For example, in 1941 over 60 percent of the coal sent to New England moved through the Hampton Roads, Virginia ports. Lack of ships

and the hazards presented by submarines reduced that total to under 35 percent in 1942 and under 30 percent in 1943 (24:97-102).

Little could be done to effectively address the problems accompanying provision of transportation services to new industries. By September 1943 the WPB had recognized that the placement of new factories had significant effects upon the transportation system and that the availability of transportation was an important issue in plant location decisions. It issued a directive requiring "placement of war procurement contracts in such a way as to accomplish worthwhile savings in the use of transportation facilities." This effort, however, came late enough in the war that the pattern of industrial development was already set (29:658).

Also in 1943 the SFAW issued a directive prohibiting the movement of coal from Great Lakes ports to areas outside of Michigan, Illinois, Wisconsin, Minnesota, Iowa, Nebraska, North Dakota, South Dakota, or the Canadian Provinces bordering on the lakes. This regulation was effectively directed towards forcing industries in the northwestern states to procure their coal from sources nearer to them. It reduced, to a degree, the gross effects of the overall pattern of traffic diversion. It also was important as a measure which conserved on car usage and lightened somewhat the workload on the Great Lakes ports (34:57).

Diversion of traffic away from the Atlantic coastwise route was managed through a combination of establishing new all-rail routes to New England, the revival of some old routes, increased use of existing rail-barge combination routings through the ports of New York and Philadelphia, and increased use in New England of coal produced in

northern rather than southern mines (34:66). While these measures effectively kept the people and industries in the northeast supplied with coal, the new routings carried rates significantly higher than those charged for coal shipped through Hampton Roads. The OPA provided through regulation some price relief for those affected by the new rates (34:67).

Management of coal traffic through the Great Lakes and ocean ports presented a large challenge because of the interaction of greatly increased workload and relative shortage of rail equipment. Even in peacetime the volume of traffic moving through the ports and the uncertainty of shipping schedules coincided to make the rail/water interface a complex management task.

This was made yet more complex by coal marketing procedures that established many different classifications of coal depending on its grade, size and quality (24:106). A carload of coal is composed of a single classification. As an indication of the degree of complexity this practice introduces to the shipment process, at the port of New York as many as 750 separate classifications were in use during WWII (34:66). Further complicating the task was that loaded cars at the port had to be further segregated by destination and consignee. The possible combinations of all these factors numbered as high as 1,900 (34:62).

Since coal had to be held at the ports in carloads until full barge loads were complete and since the number of possible combinations that could make up a barge load was so large, there was a considerable burden upon the ports. Their job was to complete the complex rail yard switching necessary to efficiently manage the port. More significantly for the rail system in general was the potential effect of poor

management. How port managers handled the job affected the supply of rail cars available for use. If rail cars were detained excessively at the ports, fewer were available either to haul more coal or to haul other critical commodities —such as ores and coke— competing for use of the same cars. As was the case for export traffic moving through ocean ports, the primary goal in the case of coal was to maintain the flow through the ports (24:102-107).

The system developed to achieve that primary goal was similar at all ports, whether Great Lakes, Hampton Roads, or the more northern ports. It was based on the system developed by the AAR in the 1920s to control the Great Lakes ports. That system itself was based on one instituted in WWI. In essence that system entailed appointment of an agency to facilitate the exchange of shipment information among all parties involved with the movement of coal through the ports. It also maintained current information about traffic in the ports and its status. It further made longer range plans to handle coal projected to move through the ports (34:61-2).

At the Great Lakes ports, where the system originated, the agency was called the Coal and Ore Exchange. When similar agencies were established during the war at Hampton Roads and New York they were called, respectively, the Hampton Roads Coal Emergency Committee and the Tidewater Bituminous Committee. The Coal and Ore Exchange was in peacetime a private organization. During the war, however, its manager —as well as those of the other committees— was appointed as an agent of the ICC so as to give the force of government authority to his decisions (34:61,64-5).

The managers at the ports succeeded in keeping traffic at each flowing and reducing the time cars were held at the ports. They achieved these results by allowing movement of coal into the ports only by permits keyed to the anticipated arrival of barges on which to move it out. They further were able to maintain timely information about traffic at their port with which to manage flow. They were also successful in reducing the number of separate coal classification and consignee combinations. At the Lakes ports these were reduced from 1,900 to 1,300 and at New York from 750 to 583. This measure reduced the amount of yard switching required. The combination of these activities reduced the average time cars were held at the ports from 4.38 days to 3.31 at the lakes and from 9.2 days to 5.3 at the Hampton Roads ports (34:62-5).

Maximum efficiency in car usage for coal carriage system-wide was achieved in part by close cooperation of the ODT and the SFAW. The SFAW prepared annual plans for coal production in advance which allowed the ODT and the carriers to in turn plan their support activities (34:57).

Continuing close scrutiny of the rail system by agents of the AAR, the ICC, and the ODT revealed instances of excessive car detention allowing corrective action (24:119-120).

Further car savings were achieved by AAR-mandated reductions in the allowable number of no-bill cars. These are cars which were loaded with coal, although no buyer for it had yet been found, which were then held pending identification of a buyer. The practice of no-billing was normally conducted in peacetime as a method of maintaining continuous production at mines. In war it represented a waste of shipping capacity and thus was curtailed by the AAR on advice of the ODT. The practice

theoretically should have been unnecessary given the high overall demand for coal. As a practical matter, the numerous classifications of coal and the vagaries of both production and demand revealed it to be necessary to some extent. By the end of the war the allowable number of no-bill cars which could be held at mines had been fixed at just 25 percent of the total at each (24:120).

The SFAW contributed to the conservation of rail cars by mandating to coal producers in the vicinity of the Great Lakes that they plan their distribution to take full advantage of water movement. Further, the SFAW used authority granted it by the ICC to direct rerouting and diversion of coal in transit (34:58). This authority was primarily exercised to meet emergency situations. It is obvious it also must have conserved rail resources by shortening the time required to move coal to its ultimate destination and eliminating unnecessary cross-hauls and back-hauls.

The movement of grain might seem so routine and prosaic it certainly could not offer any substantial problem to the rail system. In fact, that movement was so troublesome during WWII Rose stated it "...undoubtedly occasioned greater and more persistent difficulties to the railroads than any other task they assumed" (24:125).

In large measure, the fact that grain movement became a problem was a consequence of the great expansion in the output of American farms during the war. In 1939, the total U.S. grain crop was 4,819,333,000 bushels. It peaked in 1942 at 6,348,244,000 bushels. In 1942, 1944, and 1945, U.S. grain output was higher than at any other previous time in American history (24:125-6). Representative crop statistics are presented in table 2.

TABLE 2

AMERICAN GRAIN PRODUCTION, SELECTED CROPS, 1939-1945

YEAR	WHEAT OUTPUT (Bushels)	CORN OUTPUT (Bushels)
1939	741,000,000	2,581,000,000
1940	815,000,000	2,457,000,000
1941	942,000,000	2,652,000,000
1942	969,000,000	3,069,000,000
1943	844,000,000	2,966,000,000
1944	1,060,000,000	3,088,000,000
1945	1,108,000,000	2,869,000,000

(1:138)

While corn constituted, by far, a larger crop than wheat, transportation of wheat presented the chief problems with grain transport. That was because only approximately 20 percent of the corn crop was shipped out of the county in which it was grown but 75 percent of the wheat crop, in contrast, was shipped out of its originating county (24:125).

As with the rail movement of other commodities, the major wartime problem with wheat movement was to continue a smooth and orderly flow of goods from producer to ultimate consumer. The difficulty of the problem was compounded by the fact that even in peacetime the transport of grain to its markets, most of which was by rail, constituted annually for the railroads "the greatest single job of boxcar distribution throughout the year" (34:74). This was so because there are numerous grain producing areas in the U.S. and widely divergent grain markets. Crops grown in the different areas mature at generally different times, allowing the railroads some flexibility in car distribution. Often, however, the

harvests would overlap which multiplied an already difficult task (34:73).

In peace or war, grain harvested must be moved to market on a stock of cars that is fixed at the time of the harvest. With the relatively stable and predictable demand for car use in peace this task was manageable. Carriers began setting aside cars (primarily boxcars during that period) for grain transport prior to the harvests coming in. By contrast, in WWII not only did grain requiring shipment increase in volume so, too, did the volume of all other goods competing for use of the same cars. This eliminated the carriers' ability to build pre-harvest stocks of empty boxcars (34:74-5).

A further complication was that the supply of boxcars remained relatively fixed not only during the period of a single harvest, but throughout WWII. While grain carriage alone on class I railroads rose 41 percent between 1939 to 1945, the boxcar supply rose only 5.4 percent (24:138). This was complicated yet more by the requirement for grain to be shipped in boxcars of the highest grade, both leakproof and uncontaminated by substances which would make them unacceptable for grain shipment. The number of such cars available decreased through deterioration as the war progressed because of hard use, deferred maintenance, and inadequate replacement (24:138-9; 34:73).

Storage was not available as an option with which to maximize the use of transport facilities. The greatly increased crops ensured that, by 1941, "almost every practicable commercial storage facility was in full use" (34:70). Rather than a potential solution, storage became part of the transport problem.

The storage problem was lessened by 1943, shifting the greater burden of grain movement onto the rails. Starting in 1941, the Department of Agriculture in many areas formed committees of all groups interested in the grain trade, including carriers. These committees were successful in fully identifying grain storage capability. Working through the AAR representatives, embargoes (temporary prohibitions on rail traffic into an area) were used to prevent traffic bottlenecks at particular markets and storage points. The committees also instituted a system of permits which required shippers to certify to carriers that grain tendered for shipment was intended for sale, not storage. This measure was required to prevent unnecessary detention of boxcars awaiting unloading at destination points (34:70-1).

The reach of the permit system was extended to the entire nation in 1942 through ICC Service Order 80. This was promulgated on advice of the ODT and the Department of Agriculture as a result of rail carrier concerns that their car distribution activities under the permit system would be judged illegal under the Interstate Commerce Act (34:70-1). It encompassed a more formalized permit system. Committees were established to control permits. Their decisions were instituted by an agent of the ICC, usually someone with broad experience in the grain trade. No grain movement was allowed without a permit granted by the ICC agent (34:72).

There were two major effects of these actions. The use of all grain storage facilities was maximized because traffic into them was centrally controlled to achieve national, rather than private, interests. Second, the efficiency of boxcar usage was increased by

eliminating unnecessary car detention at congested storage facilities (34:72).

While the storage problem yielded to a significant degree to efforts to solve it, the problem of car shortages persisted throughout the war. Some relief was found by using unconventional car types for grain shipment. For instance, from 1943 through the end of the war the ICC allowed refrigerator cars on normally empty backhauls to the Pacific Coast to be used to haul grain (34:73). While this was a helpful measure, it offered no great relief. Moving grain was a pressure on the railroads that remained "relentless" (24:141).

A number of measures were used to combat the continuing shortages. The AAR's Car Service Division issued orders directing the return of boxcars operating on eastern railroads to their western railroad owners prior to harvests. The Car Service Division and the ICC increased charges both to railroads for per diem operation of boxcars owned by other rail lines and to shippers for demurrage; the time that a railroad car is held beyond that allowed for loading or unloading. Restrictions were placed on the use of American railroad cars either in Canada or Mexico, or carrying foreign traffic through the U.S. (34:74-5,77).

As one method of determining where savings in car usage could be achieved, and implementing those measures, the ODT and the ICC in concert formed a committee of those most knowledgeable of the grain trade. It was composed of 22 members representing, or drawn from, such agencies the ODT, the ICC, and grain milling and traffic associations. Its charge was to identify wasteful grain transport practices and to resolve them, through voluntary cooperation wherever possible (34:77-8).

The committee was successful in identifying and eliminating 10,052 circuitous routes. Also identified were practices which contributed to excessive backhauls and crosshauls. Many were eliminated through voluntary action, although ICC service orders were also used. Much of the committee's success may be attributed to the clear understanding it developed among all concerned that measures taken to increase the capacity of the system in wartime would not be considered precedents for similar peacetime operation. This understanding was critical because many of these measures had the effect of reducing what shippers saw as service provided by the carriers (24:157-164).

Dissatisfaction among grain shippers with the distribution of rail cars was widespread. Many felt that ODT, AAR, and ICC policies encouraged retention of boxcars in the east rather than the return to their owning roads to handle the western grain harvests. In some cases this may have been true. In any event, while American grain crops successfully moved, controversy regarding the equity of government actions taken to make it do so remained even after the war (24:147-152).

One instance in particular reveals both the delicacy of the government's task in balancing competing interests in wartime management of the economy and the potential for conflict even between government agencies working to achieve the same overall goals. It sparked "what was perhaps the most spirited controversy regarding transport during the war" (34:76).

In 1943 the Department of Agriculture and the War Food Administration determined that a large purchase of Canadian wheat would be required to supplement American production. Through the WPB, they

insisted that American rail cars be used to carry this wheat "even at the cost of diverting cars from American shippers" (24:155). The WPB in turn directed the ODT to ensure the necessary cars were furnished. At the time this order was issued American grain storage facilities were full and farmers were constantly looking for increased transport to move grain to market (24:155-6).

Officials of the ODT, the ICC, and the AAR were all opposed to the use of American rail cars for this purpose based upon their belief that American wheat should have instead been used. The ODT was, however, bound to follow the directives of the WPB and the other agencies, in turn, bound to follow those of the ODT. As opposed to the voluntary cooperation that marked much of transportation management during the war, cars were furnished for shipment of the Canadian wheat only when "promulgation of an order was imminent" (34:77). Interagency wrangling can only have slowed disposition of the matter. Later Senate hearings further explored the issue with the result, as Rose noted, that

> all views were thoroughly aired, in the American tradition; the food authorities and a few of the transport officials who had shown a disposition to leave food issues to those who knew most about them were roundly abused, also in the American tradition; and the Canadian wheat was imported. (24:156)

While grain movement provided the greatest single recurring problem to the railroads, the movement of petroleum to the East Coast constituted "easily the most difficult task in the entire field of wartime domestic transport" (24:179), and its handling "the most spectacular performance" (24:175).

The genesis of the petroleum movement problem was much the same as that for coal. The German blockade of the American east coast, and the withdrawal of ships from the route, forced the diversion of traffic away

from a principal method of supply. During just the four month period of February through May 1942, German submarines sank 50 American tankers (24:181). They also forced tankers everywhere to move in convoys for protection, thus reducing their possible speed and requiring more tankers to be used to maintain deliveries (24:182).

The shape of the coal and oil problems were similar. The degree of the problem was much more pronounced with oil, however, as its dependence on the sea route was much greater. Ninety-five percent or more of the oil consumed on the east coast had, prior to 1941, been provided by sea from the Gulf coast (24:180; 34:185). The dramatic shift in oil distribution patterns in this critical area is revealed in the following table.

TABLE 3

METHOD OF OIL SUPPLY TO THE NORTHEAST U.S., 1941-1945
(By mode as percent of total supplied)

YEAR	BARGE	PIPELINE	RAIL	OCEAN TANKER
1941	1.8	3.5	2.3	92.4
1942	5.9	9.9	51.6	32.6
1943	7.0	19.2	61.2	12.6
1944	7.5	38.7	37.7	16.1
1945	7.0	40.4	27.8	24.8

(34:185)

The final solution involved extension of pipeline service into the east, which will be discussed in more detail in a later section. Initially, however, as indicated in the figures above, the rails were called upon to address the dramatic loss in ocean-borne petroleum supply capability. The commonly encountered problem of inadequate car availability was compounded in the case of petroleum transport by the

fact that, by the time of WWII, rail transport of oil had come to be obsolete (24:182). Of the approximately 145,000 tank cars left in the American inventory, "many were rusting on sidings or being used for storage" and averaged more than 18 years old (34:185). While their disuse made them available, their advanced age made it questionable whether they would stand up to hard, continuous use.

A pre-war test of the ability to supply to the Atlantic coast by rail came in the spring of 1941 when 75 ocean tankers were pulled off the Gulf-to-east coast run and loaned to the British. At that time the Transport Division of the Office of Emergency Management (forerunners of the ODT and the WPB) organized a Tank Car Service Executive Committee to investigate "the efficiency of use of tank cars" and to monitor their management (24:183). This committee was composed of representative of the railroads, tank car owners and lessees, and petroleum shippers (24:183). Under this semi-centralized management, 20,000 tank cars were used to supply oil to the east. By October of 1941 the average daily flow of tank cars into the area had risen from 50 to 600. In November 1941 the tankers loaned to the British were returned and the effort ended (24:180-1; 34:135).

American entry into the war in December 1941 was quickly followed by German submarine action to blockade the east coast. This called forth the reestablishment of extensive movement of petroleum by rail to the east.

Immediate steps to deal with the emergency were handled by coordination through the AAR's Car Service Division, the office of the Petroleum Coordinator for National Defense (a forerunner of the PAW), and the Petroleum Industry Tank Car Sub-Committee The last group was

established by the Petroleum Coordinator to provide a single industry body to address the problem (24:184-5). These early steps included pressing idle tank cars into service and freeing tank cars for east coast service by replacing them with tank trucks, barges, or pipeline wherever possible (34:186).

Actions by the ODT in early 1942 were limited to requesting an increase of 20,000 cars in the tank car fleet. That request was denied by the WPB. As the ODT matured as an agency and as it became ever more clear the problem would continue large, the ODT exercised a more active role. In May 1942 the ODT issued its General Order Number 7. This order established under the ODT a nationwide system of tank car control. Government shipments (chiefly military) were exempt from ODT supervision (24:184). Its primary intention was to achieve the greatest possible use of the tank car fleet, and to direct its use to the area of greatest need. A number of steps were taken to ensure that the greatest possible number of tank cars were devoted to service to the east coast.

As it had been found that one tank truck in continuous use could do the same work as up to 25 tank cars in congested urban areas, General Order Number 7 required ODT permission for any tank car shipment of less than 100 (later extended to 200) miles. This had the effect of shifting local transport duties onto tank trucks and freed about 18,000 tank cars for long-haul deliveries (34:186).

As many tank cars as could be were freed from the movement of commodities other than petroleum, such as chemicals and packing house byproducts. Ultimately 25,700 tank cars of the total national stock were devoted to hauling these other commodities (34:185-6).

Shippers and carriers were required to submit daily reports reflecting tank car usage. The ICC and the AAR furnished similar daily reports. These allowed identification and correction of any unnecessary tank car use or delay (34:186).

Through coordination with the PAW and the Department of Justice, oil shipments to the east were directed to large central terminals rather than more widely separated smaller terminals. This had the effect of reducing unproductive car turnaround time at destination (34:186).

Tank cars in the aging fleet inevitably broke down under hard use. To prevent long, unproductive movement of disabled cars the DOT directed that cars needing repair be sent to the closest repair facility without regard to ownership either of the car or the facility (34:186).

These steps assured the best possible supply of tank cars for oil movement. The next step was to assure their most efficient use. This was accomplished through the symbol train system.

In essence, the symbol train system encompassed the use of trains of up to 60 to 70 cars in length. Assembled and filled at a central location near oil production areas, they were then dispatched as dedicated units over railway mainlines to central reception terminals in the east. Efficiency was achieved by avoiding slowdowns while passing through local switching yards or the breakup of the train to serve intermediate customers (34:187).

Symbol trains took their name from the alphanumeric labels, or "symbols", which were assigned to them by the railroads to track their movement. Each moved over a specified route designated by the DOT on the advice of the AAR, shippers, receivers, and oil industry

representatives. A unique symbol was assigned to each train depending on its direction of movement, date of shipment, and route of travel. Further, symbol trains moved according to predetermined schedules. This allowed the ODT and the AAR to maintain visibility over, and control of, both individual symbol trains and the rail movement of petroleum as a whole (24:185; 34:187).

The use of symbol trains considerably speeded the flow of oil. Between 1939 and 1941 tank cars moved an average of approximately 50 miles per day. In 1942 this rose to 106 miles, and in 1943 to 128 miles. Some railroads achieved over 200 miles per car per day. Railroad workers accepted the concept so enthusiastically that "general restrictions had to be placed prohibiting oil train speed above 40 miles per hour." By 1943 symbol trains were responsible for 90 percent of the petroleum rail traffic to the east (34:187).

The use of symbol trains was extended to include their origination at Norris City, Illinois when the "Big Inch" pipeline (which will be discussed in greater detail later) was completed to that city in February, 1943. In addition to the earlier features, symbol train movement out of Norris City incorporated the use of car pooling. Rather than having to devote some or all of a train to cars belonging to separate oil companies, eight oil companies pooled 10,000 tank cars devoted to movement over this route. This eliminated the need for extensive car switching at either origin or destination (24:188).

The flow of oil through Norris City started with its movement from Texas by pipeline. At Norris City it was stored in one of the 1,280,000 barrel tanks built for this purpose. Trains of 75 car length were filled at the tanks and dispatched to the east through Mt. Carmel,

Illinois at 52 minute intervals. Empty cars returned to Mt. Carmel where they were inspected, removed from service if necessary, and repaired if necessary and possible. Seventy-five empties at a time were then hauled from Mt. Carmel to Norris City, with the engine performing that haul carrying back to Mt. Carmel a newly loaded symbol train beginning its journey (24:188-9).

The Norris City symbol trains were enormously successful in promoting efficient use of tank cars. Symbol trains operating out of Norris City achieved complete east coast delivery turnaround times of 10 days versus the 18 day times for trains originating on the Gulf coast. The service continued until just after extension of the "Big Inch" to the east coast was completed in August 1943 (24:189).

Although of a lesser absolute magnitude than the problem of oil supply to the east, movement of oil to the Pacific coast constituted another significant challenge to the railroads. Although the west coast was normally self-sufficient in oil, the heavier industrial and, especially, military demands of the war outstripped its production capacity. The shortfall was largely made up from production in the Texas oil fields.

In addition to the problems encountered in eastward oil movement, trains going to the west had to overcome other problems. As previously noted, the west was less well served with rail lines than the east. Those lines in existence were already hard pressed to adequately handle the volume of other war shipments. Further, oil (as well as all other traffic) moving to the west had to traverse the Rocky Mountains as opposed to the easy and gentle terrain over which eastbound traffic

flowed. The result of this requirement was a greater demand for motive power to move the same quantity of goods.

Despite the greater handicaps, oil movement to the Pacific states was successfully supported using the symbol train system originated in eastward movement. A peak of over 17,000 tank cars were pooled to support this movement. Tank car movement of oil to the west rose from 9,500 barrels per day in 1942 to 165,000 daily in June 1945 (24:197).

Management of refrigerator cars engendered concern during WWII for several reasons. As with virtually all other traffic during the war, shipment of perishable foods increased (34:27). The increased traffic went not only for war needs but also to support the rising standard of living which came to Americans in the increased prosperity of WWII. Also as with other traffic, wartime conditions forced the shipping of perishables to undergo a change from usual peacetime distribution patterns. Whereas the motor carrier share of this traffic had risen from approximately 16 percent of the total in 1929 to 44 percent in 1936, the war forced that share back into the range of 15 percent by 1943 where it stayed through the remainder of the war. Declining revenue traffic had encouraged an accompanying decline in the stock of rail cars. The war forced increased traffic back onto the contracted ability of the rails to carry it. Further changing distribution patterns was the large relocation of populations to new war industries and new military posts (24:167-8).

Other arguments for close management of refrigerator cars came from their ownership patterns. Most other types of rail cars were owned by the railroads themselves and operated generally as a single nationwide pool through the auspices of the Car Service Division of the

AAR. Refrigerator cars, in contrast, were largely owned by private car lines. Although those lines were themselves often owned by railroads, they were operated as separate entities interested in providing service only to a specific group of shippers usually located in specific geographical regions (34:28). Whether the companies were owned by carriers or not, the major concern of the car owners was for rapid return of their equipment to their home producing area for reloading once the cars had been used to deliver a load to consumers. This private concern of the owners took precedence for them over any efficiencies which could be gained in finding a load to prevent an empty backhaul (24:167).

These ownership patterns and interests led to a number of wasteful practices. In one instance, refrigerator cars were habitually used to ship potatoes from Maine to Florida and returned empty to Maine. At the same time, refrigerator cars from different lines were loaded with Florida produce and similar goods from California for movement to New England and subsequent empty return to their home territory (24:28). While these practices were allowable in peacetime, the demands on wartime railroad equipment, both refrigerator cars and motive power, made such flagrant waste unacceptable.

The obvious solution to the wasted capacity problem was to manage refrigerator cars as a national pool, regardless of ownership, to achieve the greatest efficiency of use. Instituting such a plan, however, proved initially troublesome for the ODT. A combination of what apparently were private owner concerns with government management and a desire of some government agencies to protect their peacetime prerogatives delayed ODT action.

In March 1942 the ODT proposed a plan that encompassed tight control of refrigerator cars under a single manager appointed by a board composed of car line representatives and chaired by an ODT official. When this plan was presented to a conference of car owners, they presented a counter-proposal which provided significantly less control of cars and eliminated ODT representation —let alone chairmanship— of the controlling board. When that counter-proposal was not accepted by the ODT, the AAR unilaterally formed an organization for control of refrigerator cars under its Car Service Division. That organization resembled the original ODT plan in its operation, but contained no ODT representation. When this plan was amended to include ODT representation and to strengthen central control the ODT agreed to its implementation.

Before the amended AAR plan could be put into effect the Department of Justice weighed into the fray with the opinion that, because it had been drafted by the railroads and car owners acting in concert, the plan constituted an illegal violation of the antitrust laws. The AAR plan was abandoned, and the ODT drafted an order implementing its original plan.

Circulation of the draft to other concerned government agencies resulted in its review by the ICC. The ICC Chairman took that opportunity to question the power of the ODT to make such an order over the existing statutory authority of the ICC to control car service. Only after a series of conferences between ODT and ICC authorities was the matter resolved. In its final form as implemented, the plan required the ODT to certify to the ICC the need for certain car controls, and "suggest" to it that it issue the appropriate directives

under its emergency car service authority (34:28-9). Only in November 1942 did any plan reach the implementation stage (24:170).

The plan for control of refrigerator cars as directed by ICC Service Order Number 95 appointed the manager of the Car Service Division's newly-created Refrigerator Car Section as an agent of the ICC. He was to set up, on approval of the ICC, an advisory group consisting of representatives of the ODT, the ICC, the AAR, the railroad industry, and the car lines (34:30). He was further authorized and directed

> ...to supervise, coordinate, and direct the distribution of all refrigerator cars according to the needs of the various loading areas and with due regard to economy in their use and ...without regard to ownership... . (34:30)

Rose stated the manager was only rarely forced to use his authority as an ICC agent because voluntary cooperation most often was adequate to meet pooling requirements. He also characterized the result of the central control finally achieved under this manager, combined with ICC service orders suggested by the ODT, as successful in reducing empty milage. This is borne out by ODT figures reflecting between 10 and 20 percent fewer empty refrigerator car miles carried in the 1943-1945 period than in 1942 (24:171; 34:33).

Motor Freight Traffic. As discussed earlier, the motor carriers' share of wartime traffic show marked declines in the war years. The total intercity freight they hauled also declined, but to a lesser extent. Both figures reached their highest points in history to that time in 1941. Between 1942 and 1945 the motor carriers' share of traffic ranged from approximately 52 to 63 percent of the 1941 peak. The absolute quantity of traffic they handled, however, ranged between

approximately 74 and 87 percent of their 1941 total. This demonstrates the performance of the motor carriers continued to play a significant part in the nation's commerce and thus in the course of industrial mobilization (34:299).

The general challenges faced in the national management of motor carriers were essentially the same as those faced in managing the other transportation modes. Those challenges were to reduce (or eliminate) waste and to promote efficiency. Achieving those goals, however, called for a different set of approaches owing to differences in industry structure.

Fully utilizing the motor carrier resource presented a wealth of problems not encountered in railroad management. Highway transportation equipment wore out faster than rail equipment and could not be replaced at the pre-war levels during the war. While the truck fleet aged during the war and consequently required greater maintenance, the supply of spare parts with which to maintain it dwindled as a consequence of greater military demands on the supplier industries. Nationwide rationing of fuel and rubber was most strongly felt in this transportation mode. The diffuse nature of the motor carrier industry made it difficult to institute a national system of control to address these, and other, problems.

Of all these problems perhaps the greatest, both from the standpoint of the difficulty it presented to government management and of its criticality to solving the others, was in achieving control over the motor carriers. As Rose noted, "the atomistic organization of the motor transport industry presented an almost insurmountable barrier to effective centralized control" (24:215).

The first complicating factor in the structure of the industry is the variety of types of carriage provided by motor carriers. Then and now, those included common carriage, contract carriage, and private carriage.

Common carriage is provided by those holding themselves out to haul goods for the general public for compensation. Contract carriage is also provided for compensation, but not to the general public. It is provided only according to terms of specific contracts worked out by shippers and carriers. Private carriage is carried out to promote and support another business in which the firm or individual is primarily engaged. It is not conducted for others for compensation (28:28-33).

The sheer quantity of existing motor carriers also presented a management challenge. As opposed to 121 major rail operators --all common carriers--which the ODT had to bring under its direction (34:17), there were over 2.75 million separate motor carriers in 1944. Approximately 95 percent of them operated a single truck. About 1.6 million trucks were engaged in farm work, and other private carriers operated approximately 1.1 million trucks. Only 630,000 were operated by commercial common carriers (34:101,112). Even ascertaining the total quantity of trucks and carriers available to be managed in the national effort was a problem. The figures presented here were obtained by the ODT as a result of it gaining "...more detailed information concerning motor carrier operations than ever before available" (24:215).

A further complication was provided in the fact that only a minority of all carriers were accustomed at all to any meaningful government regulation of their transportation business. While the ICC's authority had been broadened to cover interstate motor carriers in the

1930s and individual states regulated intrastate carriers, their authority only extended to carriers engaged in compensated hauling. It did not cover that great majority of carriers which the ODT proposed to manage during the war (34:101).

As one measure of the difficulty of the task, the ODT was required to devote many more personnel to motor carrier management than to any other single area. At its peak in 1944 this entailed 3,750 ODT employees devoted to motor carrier operations, out of 4,917 total, working out of 142 offices nationwide (24:12).

To bring this mass of differing carriers under its management the ODT issued General Order ODT Number 21 in September 1942. It covered every commercial vehicle in the United States, including ..."virtually all trucks, busses, taxicabs, and similar motor conveyances" (34:111). It required that the commercial vehicle owners obtain from the ODT a Certificate of War Necessity to continue operation during the war. A Certificate of War Necessity established for a commercial vehicle its maximum allowable annual milage, its minimum allowable load, and its gasoline allowance. Its purpose was to ensure commercial motor vehicle operations were

> (1) confined to those necessary to the war effort or to the maintenance of essential civilian economy; (2) conducted in a manner to assure maximum utilization of commercial motor vehicles, and (3) conducted in a manner to conserve rubber and other critical materials... . (34:111)

Enforcement of the program was achieved through rationing the scarce materials which the carriers required to continue operation. These were primarily gasoline and rubber but also included new vehicles and spare parts. No commercial carrier could legally obtain fuel, tires, inner tubes, or spare parts except upon presentation to the

seller of a valid certificate for the vehicle. Operators were required to show they were conserving rubber through frequent tire inspections and other practices and conforming to all other ODT instructions. Failure to conform could be met with either denial of new tires or inner tubes, or revocation of the certificate (34:112).

While the program is relatively easy to describe, it was very difficult to institute. To get the program off the ground, the ODT hired R.L. Polk and Company of Detroit, "an experienced automotive directory firm" (24:219;34:112). That company prepared a list of all registered owners of commercial vehicles in the U.S., of which there were over 3.7 million, accounting for about 5,000,000 vehicles (24:219). In October 1942, they mailed to those owners copies of ODT General Order 21, applications for certificates, and instructions for filling out the applications (34:112).

Certificate applications required the owner to state

> his type of business, purpose for which the vehicle was used, area of operations, nature of the services rendered, number of vehicles owned or leased, miles operated quarterly and annually, number of trips made quarterly, average load per trip, capacity of vehicle, load factor, that is, the ratio of average load to capacity of the vehicle, steps taken to conserve tires and equipment in compliance with Office of Defense Transportation orders, and other data. (34:113)

Upon receipt of the completed applications, ODT personnel determined the vehicle's allowable load, milage, and gasoline ration. This process, called tailoring, in essence consisted of reducing the requirements stated on the application "on the assumption that the claims included nonessential services." The completed certificate was then returned to the vehicle owner (24:219).

The ODT had originally intended that all applications be returned and certificates issued prior to November 15, 1942, when national gasoline rationing was to be started. On that date, however, only about two-thirds of the applications had been returned so the deadline was extended to December 1, 1942. Radio and press announcements encouraged operators to apply for certificates. By mid-December, "the bulk, but by no means all, of the operators...had received certificates" (24:221; 34:115).

Much of the delay can be attributed to the complexity of the applications. Many operators were not in the habit of keeping the detailed records required to provide the information requested. There were many questions asked of the ODT by puzzled carriers. About 50 percent of the applications submitted were incomplete (24:220).

Difficulties with the issuance of certificates provided an impetus for the ODT to greatly expand its field staff. ODT representatives went to 500 cities and towns to assist owners in completing applications and to help with appeals for correction of gasoline allocations insufficient to support essential operations. In addition, the help of the County War Boards --established by the Department of Agriculture to coordinate farm activities-- was obtained to complete applications for farm vehicles (24:220-1; 34:133).

A system of review and appeals was set up allowing changes in the allowances granted by the certificates. Carriers could appeal as insufficient the gasoline or milage allotments granted them. The ODT district offices, meanwhile, were engaged in trying to identify and reduce excessive allowances. By the end of 1943 "virtually all" of the

certificates originally granted had been reviewed on the initiative of one group or the other (24:222).

A system of reports by carriers was required by the ODT to enforce the certificate program. Initially, these included weekly reporting of

> number of trips, miles operated, out-bound and in-bound loads, gallons of fuel used, new, recapped, and retreaded tires, and dates of tire inspection. (34:117)

Monthly reporting of idle vehicle time was also required. Reporting requirements were progressively simplified over time until, in September 1944, reports were eliminated for all but a few large operators (34:117-8). While it is unmentioned in the literature, it can be assumed these reports represented a large administrative burden to the great majority of operators unused to either extensive record keeping or government regulation.

Having achieved control over truck transportation through Certificates of War Necessity, the ODT established specific programs to achieve greatest efficiency. These were principally aimed at three primary groups: long distance common carriers, local carriers, and contract and private carriers.

Long distance common carriers, defined as those engaged in operations over more than 25 miles, were governed by ODT General Order Number 3. This order included provisions intended to eliminate waste, establish loading and operating requirements, provide for the interchange of traffic between carriers, restrict the establishment of new service, substitute rail for truck service, and allow some joint business activities normally prohibited by anti-trust laws (34:103).

Elimination of waste was addressed through directions to carriers to adjust their routings to eliminate duplicate or parallel services to

the same points. The use of circuitous routing, defined in the order as a route between two points exceeding by more than 10 percent the most direct highway route available, was also extensively limited. Also established were standards which required trucks to be fully loaded up to their rated capacity (34:103-4).

Movement of empty or partially loaded trucks was only allowed under very restricted circumstances. These covered situations in which truckers were not able to find a full load for trips returning to their starting point. The interchange of traffic between carriers was promoted and required to facilitate obtaining full loads (34:103-4).

The ODT authorized the establishment of joint information offices to help truckers obtain full loads. These offices served as clearinghouses for traffic awaiting shipment and for trucks requiring loads. If truckers were unsuccessful in finding a load on their own they were to check for cargo availability with a joint information office if one was available, or with other carriers if one was not. If all these steps failed, the trucker was to attempt to lease his truck to a carrier which had a load for it (34:127).

Individual joint information offices were initially established in 78 cities. As initially conceived they were set up and financed by two or more carriers subject to approval by the ODT. Early experience showed that these carrier-operated offices were unsuccessful, primarily because of the time and expense involved in setting them up and because of carrier fears that registering either freight or equipment with them would reveal trade secrets (24:227-8; 34:128).

As a result of the early failures, the ODT reorganized the joint information office program in March 1944. After that time, the function

was performed by the ODT through its 142 field offices rather than by carriers or carrier groups. The program was also made more stringent. Carriers were required to register both available freight and vehicles with available loading space. Under ODT direction the program was more successful, saving an estimated 100,000,000 vehicle miles annually (24:228-9).

Restrictions on extension of motor carrier service were required when the inability to replace worn out trucks made itself felt as the war ground on. Whereas common carriers previously had to obtain permission of either the ICC or state authorities to inaugurate new service, the permission of the ODT was also required after October 1943. ODT requirements for permission for new service were much more restrictive than those applied by the ICC or the state regulatory agencies. Traditional regulation of new service was based on findings of "public convenience and necessity", usually meaning that the new service would not provide competition destructive to the industry. The ODT's permission for new services was granted required that they

> (1) were necessary to the war effort or the maintenance of essential civilian economy; (2) could not be performed at all by any existing means of transportation; or, were needed for the war effort and were shown to be more expeditious; (3) did not merely add to the pleasure or convenience of civilians but contributed in important degree to the war effort; and (4) could be furnished without detriment caused by additional use of critical materials or manpower. (34:104)

Substituting rail for truck service allowed a shifting of the traffic burden from the hard-pressed motor carriers onto the relatively better-off rail system. When the ODT certified that such service over a specific route would conserve trucking facilities and not adversely affect those of the rails, and when shippers did not specify that their shipments go over the road, motor carriers were allowed to divert

traffic originally consigned to them to the railroads. This practice not only conserved motor carrier equipment, it also was profitable for trucking companies. This was because they could consolidate LCL shipments into CL lots, thus obtaining low rates from the railroads, and simultaneously charge their shippers at the higher motor carrier rates (34:105).

Joint action plans were a method of encouraging more efficient truck utilization. They did this by allowing two or more carriers to adopt plans for joint operations when their joint action would eliminate waste by cutting out duplicate services. Such plans were voluntary arrangements among carriers, and were initiated either as the result of ODT promotion or by the carriers themselves. Among the actions allowed shippers under joint actions plans were alternating or coordinating schedules, exchanging shipments of property, pooling traffic and/or revenues, and jointly operating equipment or terminals (24:225; 34:121).

Business activities such as those allowed under joint action plans normally were prohibited by anti-trust laws because they had the effect of reducing competition within the industry. The Congress provided protection of these activities from the laws during WWII by the passage of the Small Business Mobilization Act. Even with such protection, the ODT and the Department of Justice were careful to point out that joint action plans were legal and valid only so long as they were drafted and operated primarily to conserve transportation resources rather than to gain unfair competitive advantages. Further protection was provided by the requirement for approval of plans by the ODT headquarters. This was normally granted only after review and approval by the ICC, although

that step was neither absolutely required nor always taken (24:226; 34:122).

Over 3,900 joint action plans were instituted. They were especially effective in reducing inefficient private carrier operations, most notably within the coal industry. The ODT history estimated annual savings of "about 452,000,000 vehicle miles" from them. Rose cited over 220 million miles saved per year (24:225; 34:126).

Management efforts to promote efficiency in local carrier operations took the form of both voluntary and mandatory measures. Voluntary measures included publicizing to the general public the effect on transportation of their individual actions, and seeking their help in conservation. "Housewives of the country" were asked to conserve on local delivery transportation by spacing out their shopping to cut down on the number of trips required and to carry purchases home themselves. People were asked to have their home coal deliveries made during the summer, when transport was easier, rather than during the winter (34:106).

Mandatory measures, directed towards carriers, were incorporated in ODT General Order Number 6A. Much of local transport was composed of carriers providing what could be considered, in wartime, wasteful "luxury services" (24:2[illegible]0-1). The ODT's regulation of local transport was designed to eliminate them. In addition to the promotion of joint action plans and restrictions on extension of service, General Order 6A prohibited local carriers from making

> (a) Any collection or delivery during any calendar day, the order for which has been received after 3 p.m. during such day;

(b) Any collection or delivery without ascertaining, prior to the operation of a truck for such purpose, that it may be completed;
(c) Any call with a motor truck except for the purpose of collecting or delivering property or servicing, maintaining or repairing a truck; or
(d) More than one collection during any calendar day from any one point, nor more than one delivery during any calendar day to any point from any one point. (34:107)

Private and contract carriers were addressed by ODT General Order Number 17. While many of its provisions were similar to those affecting common carriers, including those promoting joint action and controlling service extensions, they were in general more restrictive (34:108).

Private and contract operators were required to reduce their total milage operated by 25 percent from their 1941 levels. They were required to eliminate a wide variety of special deliveries and other unnecessary services. This category of carriers was also held to a standard of truck loading higher than that imposed on common carriers. While the latter were allowed to operate empty or partially loaded trucks if they had made diligent efforts to secure a load, private and contract carriers were required to always operate their trucks loaded to full capacity over a "considerable portion" of their routes (34:108).

General Order 17 was made yet more restrictive in early 1943 when shortages of fuel became especially acute. Carriers governed by it were required to develop formal delivery routes "which were neither duplicating nor overlapping", and to maintain maps showing those routes. The order established a maximum number of weekly deliveries for a wide variety of commodity types, and carriers were prohibited from making more deliveries than that number. Sunday deliveries of all but a few commodities were banned outright. To force shoppers to carry their purchases home, retail deliveries of packages below "60 inches in

combined length and girth or less than 5 pounds in weight" were prohibited (34:109).

Vehicles used on farms and operated by individual farmers represented an important exemption to these regulations of private and contract carriage, and a large challenge to the overall effective management of national transportation resources.

Control of farm vehicles took on importance for several reasons. Their continued operation was essential because they represented the primary means of transport of agricultural products from the farm to initial marketing points. This importance was enhanced during the war by the record crops of all kinds produced during the period, and the importance of those crops to the Allied war effort.

In addition to their role in the distribution of farm products, farm trucks were also important in carrying supplies to farms. Farmers "customarily" used their own transport to haul tools, feed, fertilizer and so on from town to the farm (24:233).

Controlling farm vehicles was also important because they formed a large percentage of the national vehicle stock. During WWII there were "approximately 1,650,000" of them (34:131), accounting for 35 percent of all trucks and constituting the "largest group of commercial vehicles" in the nation (24:231). It was obvious that asserting a convincing control of commercial vehicles nationally required control of agricultural transportation.

The task of control was made more difficult by the nature of farm vehicle ownership. The 1,650,000 farm vehicles were owned by "almost that many operators" (34:131). In peacetime those private operators were not subject to Government regulation of their transportation

operations and were therefore "unfamiliar with the restrictions and techniques of regulation" (34:131). Assuming control was thus hampered by the need to regulate a large number of individual operators whose ability to cooperate was limited by their ignorance of the techniques of any controlling system.

Control of farm vehicles was achieved by the ODT through the extension of the Certificate of War Necessity program to cover them; by encouragement of community vehicle pooling; and by setting up Industry Transportation Advisory Committees.

Bringing such a broadly distributed group of operators under the Certificate of War Necessity program was especially difficult. To achieve that goal the ODT sought, and gained, the cooperation of the Department of Agriculture. In July 1941 the Secretary of Agriculture had set up War Boards in every one of the over 3,000 agricultural counties in the country to assist with implementing Department of Agriculture war programs. In October 1942, at the request of the ODT, the Department of Agriculture established within each of those county boards a County Farm Transportation Committee. They were composed of representatives of farmers, farm truck operators, and farm equipment suppliers (34:133; 24:235).

The County Farm Transportation Committees publicized to farmers the requirement for Certificates of War Necessity and helped them to fill out applications for them. The help they provided was especially important because farmers usually did not keep the comprehensive records required to provide information requested in the applications. In place of exact figures farmers were allowed to give estimates which the committees provided "indispensable" help with calculating (24:235).

Committees were also active in the process of appealing milage and gasoline allowances deemed inadequate by farmers. County committees received, reviewed, and made recommendations on the appeals before passing them on to ODT District Offices for action. Because of the importance of farm transport generally, farmers were "invited and encouraged" to appeal certificate allowances, and "special efforts" were made to ensure that their transportation needs were met (24:235).

Community pooling of vehicles was envisioned as a way of conserving vehicle resources by encouraging joint use of vehicles by several farmers. It was undertaken as a voluntary program and largely promoted through the county committees. It was explained in "press releases, radio shorts, and meetings" as "just another name for neighborly cooperation...to make cars and trucks last longer..." (34:134).

In order to achieve yet more conservation of agricultural transport, the ODT --after consultation with Department of Agriculture and truck operators-- initiated the Industry Transportation Advisory Committee program in October 1942. Committees were groups of food producers, carriers, and processors concerned with the movement of particular commodities within specified geographical areas. Those commodities included dairy products, livestock, poultry, fruits, vegetables, cotton, and several others. Committees were selected by industry representatives, and approved by the ODT.

The committees were charged with acquiring information about the transportation practices involved in the movement of their commodity, and to design plans --subject to ODT approval-- to eliminate waste such as duplicate or overlapping routes, crosshauling, and so on

(24:237,239). To the degree that plans required joint action participants were protected from anti-trust prosecution by the Small Business Mobilization Act, discussed earlier (34:135).

By 1944 there were 672 dairy industry committees, over 2,200 livestock industry committees and sub-committees, and over 600 committees and sub-committees organized around various other commodities. Dairy committees alone had produced over 500 approved conservation plans (24:238-9).

In addition to specific programs designed to conserve the resources of the several types of motor carriers, the ODT was active in addressing problems common to motor transport in general. These included shortages (whether real or induced) in rubber, fuel, new vehicles, and spare parts. Also addressed were differing state laws that effectively constituted barriers to interstate highway movement.

The shortages of rubber and gasoline experienced during the war were intertwined. Real shortages of fuel were largely limited to the eastern seaboard and to the early part of the war. By July 1942 the OPA had instituted a gasoline rationing system in that area that effectively allocated the available supply (24:211-2).

Rubber supplies were less assured. Japanese entry into the war left "90 percent of our sources of crude rubber...in Axis hands; supplies from another 7 percent...were uncertain" (8:94). In September 1942 a special committee which had been set up to study the rubber supply problem recommended a list of actions to address the critical shortage. Among these were a system of tire conservation and nationwide gasoline rationing to limit vehicle usage (8:94). National gasoline rationing to conserve rubber became effective in December 1942 (24:212).

The ODT was extensively involved with the national system of fuel and tire rationing which finally emerged. It served as the claimant agency for rubber and fuel required to support civilian transportation needs. In this capacity, it certified to the allocating agencies the quantities of each commodity required to continue essential services by the entire civilian transportation system. After gasoline and tires had been allocated out of total production to support civilian requirements, the OPA administered its rationing to individual users (34:205-6). Fuel was rationed to commercial users based on allowances established by the ODT in Certificates of War Necessity. Tires for commercial users, and both fuel and tires for non-commercial users, were rationed without direct ODT involvement and solely based on OPA guidelines (24:210,213).

While the ODT was not normally closely associated with the final step of tire rationing early in the war, it became more so after August 1944. At that time the tire shortage had become especially acute, most particularly in the larger sizes needed for commercial trucks. In response the OPA established 132 Emergency Tire Panels which received requests for tires of larger sizes. The ODT provided advisory personnel to these panels (24:210).

Supplying tires for civilian use "was fraught with great uncertainty throughout the war" (34:207). As would be expected, tires for military uses had first call on the nation's limited production. "About 85 per cent" of civilian trucks qualified for tire replacements, as did almost all busses (24:210). Wartime production of commercial size tires was not greatly below pre-war levels. Meeting military and essential civilian requirements required "a huge diminution in the output of passenger car tires", as evidenced in the drop in their annual

output from "approximately 33,000,000" in the 1939-1941 period to 2,664,904 in 1942 (24:204-5).

Even given the relatively stable supply of commercial tires during the war, heavier use meant that the supply of tires for civilian use was "inadequate (24:211). Faulty distribution also made tire supply problematic. By 1944 stocks were "practically exhausted" (34:207). Many trucks were being run without spare tires. In the last third of the year an average of 5,500 commercial vehicles were inoperative at any one time for want of tires (34:207).

The ODT provided assistance to carriers in finding tires unavailable in their local area. In January 1944 the ODT established a formalized procedure for referring tire requests which it could not help to the Office of Rubber Director. That office in turn referred requests to manufacturers' committees for help in locating the tires (24:210-1).

One method implemented to conserve both fuel and rubber was the imposition of a national speed limit. This was initiated in March 1942 with a letter from the President to the 48 state governors asking that they establish and enforce a 40 mile per hour (mph) speed limit within their states. Recognizing that it didn't have the personnel necessary to enforce any speed limit, the ODT chose at that time not to mandate any general limit. In September 1942, however, the ODT --in response to a recommendation of the Rubber Survey Committee-- issued a general order establishing a 35 mph national speed limit (34:171-2).

The results of these efforts were mixed. In response to the President's original letter, 11 governors set their state speed limits at 40 mph. In the other 37 states the governors did not have the statutory power to set speed limits themselves. Many of them, however,

took such actions as issuing proclamations urging citizens to adhere to a 40 mph limit. Surveys of traffic speed between May and October 1942 revealed a drop in average vehicle speed from 47.1 mph to 42.3 (34:171).

Officials of the ODT had reservations about the need for, and efficacy of, a 35 mph speed limit. Such a limit was set, as previously noted, only as an outgrowth of the work of the Rubber Survey Committee. The ODT Director indicated that he "did not know where the ...Committee got the idea of a 35-mile speed limit", and felt that its imposition would significantly cut into transportation resource capacity (34:172). The ODT set the speed limit, however, to publicly support the work of the Committee and to reinforce in the public mind the real need for rubber conservation (34:172).

Ironically, later ODT studies established that a 35 mph speed limit for heavy trucks resulted in greater rubber usage than a 40 mph limit would have. This was because adhering to a 35 mph limit required more braking and down-shifting. The 35 mph limit was not rescinded, however. It was felt raising the 35 mph limit, already widely disregarded by the public, would only encourage even greater speeds (34:173).

Enforcement of the limit was haphazard, at best. Violators, once identified, could be punished with cutbacks or elimination of fuel or tire rations, or with revocation of Certificates of War Necessity. Identification of violators was, however, difficult. In many states, local traffic enforcement agencies did not report speeders to ODT or OPA authorities at all. In other states reporting was only partial. In yet others, reports was numerous. Rationing action, however, could only be taken if a conviction was obtained in a local court, and local courts

would not convict for speeds above 35 mph unless they were also above the state maximum (34:174).

Surveys during the war revealed that at no time did even half the traffic observed stay within the 35 mph speed limit. Average truck speed ranged between 35.1 and 39.4 mph. Average speed for all traffic was between 37.8 and 42.3 mph. While adherence to the national speed limit was not great, the speed of all traffic was considerably below that observed prior to the ODT regulation. The speed limit was lifted in August 1945, days after the Japanese surrender (34:174-5).

Management of the allocation of new vehicles was required for two primary reasons. First, there was no construction of new vehicles for civilian use during a large part of the war. Second, the aging of the national vehicle fleet under hard wartime use required that what new vehicles did exist be efficiently distributed to those users most needing them.

Production of all civilian trucks was discontinued by the WPB by March 1942. Production of heavy trucks was not re-instituted until May 1943; of medium trucks until January 1944; and of light trucks until January 1945. Average annual demand for trucks between 1936 and 1940 was "approximately" 550,000. In the entire period of 1942-1945, a total of 544,079 new trucks went to civilian use (24:200-01).

The average age of trucks in 1941 was 5.6 years old. In 1946 it was 8.7 years. Just over eight percent of trucks were ten years old or older in 1941. Thirty-five percent of them were in 1946 (24:202).

Control over allocation of new vehicles was achieved by halting their unimpeded sale to the general public and establishing a permit system for their transfer.

All sales of new trucks was frozen between January 1942 and March 9, 1942. When sales were resumed, it was from a pool of previously unsold vehicles held for release to the public. It contained 97,000 trucks, representing just 37 percent of the ODT request for commercial trucks for 1942 alone (34:200).

Transfer of a truck to a new owner required the buyer to present a Certificate of Transfer. These were initially issued by the WPB upon recommendation of the ODT. The ODT was bound, in making recommendations, to follow classes of priority usage established by WPB Conservation Order M-100. Five classes were established encompassing --in descending order-- vehicles used in connection with the military or for public health and safety; those used primarily to directly further the war effort; vehicles used primarily in indirect support of the war effort; vehicles used for other unspecified transport; and those used for non-essential transportation not connected to the war effort (34:200). In 1944, responsibility for issuing certificates to civilian buyers was transferred to the ODT. In exercising that responsibility, the ODT continued to follow the same usage priorities originally laid down by the WPB (24:201).

The task of reviewing applications was relatively straightforward; however, it required a field organization to adequately service the widely distributed applicants. When the program was initiated the ODT did not have such a force in the field. From program inception until July 1944, therefore, the ODT relied on field personnel of the ICC's Bureau of Motor Carriers to carry out the function. Those personnel received and initially reviewed applications, then passed them on to ODT

headquarters in Washington. Final approval recommendations were made there (34:201).

Although some trucks from new production started to reach the civilian market in 1943, their numbers were never large enough to meet all demands. Over 593,000 Certificates of Transfer were issued to ration new trucks from the program's inception until its demise in November 1945 (34:202,204).

A number of factors contributed to making the supply of truck repair parts a problem during the war. The aging of the truck fleet and inability to replace old equipment raised the demand for repair parts. So did the more intense usage of trucks, their heavier loading, and the increasing use of "unskilled drivers and mechanics" (24:205).

At the same time as demand for parts was increasing, supply tightened. Factors leading to decreased supplies included widespread scrapping of used vehicle parts in scrap steel drives; WPB limitations on the amount of critical materials which could be devoted to making new parts (34:210); diversion of manufacturing capacity from spare parts to other, more profitable, war work; and the military's practice of "swooping down upon materials and parts originally designated for civilians and taking them for their own use" (24:205).

The government program instituted to conserve and control the supply of repair parts was largely "voluntary and educational" (24:205), although it did have some obligatory provisions.

The ODT established within its field offices a group of maintenance specialists. In addition to other duties, these groups worked with WPB personnel to help individual vehicle operators locate and procure scarce repair parts. They were also instrumental in

convincing the WPB to ultimately restrict the scrapping of used vehicle parts. These were "the main sources of supply for very old vehicles", and their stock had been greatly decimated by scrap drives in 1942 (34:212).

In cooperation with Society of Automotive Engineers, the ODT formed a wide system of volunteer Maintenance Advisory Committees in individual communities. In addition to other duties, these committees advised maintenance personnel on efficient shop practices and helped to locate repair parts (34:209).

The WPB in 1942 issued a series of orders designed to encourage manufacturers to build repair parts, but did not establish a material priority for them high enough to cause any improvement in the supply situation. At the end of 1942, the ODT --vice the Office of Civilian Supply of the WPB-- became the claimant agency for materials for automotive repair parts, and priorities for those materials were made the highest awarded to civilian goods (34:211). The ODT history noted that "improvement in the situation was quickly manifest", but spare part supplies continued as a problem (34:211). Real improvement only began after the middle of 1944 when restrictions on the availability of scarce material became less severe and ODT field agents were granted the power to upgrade priorities for emergency repair parts. At the same time, the WPB and industry recognized ODT-upgraded emergency requirements as sufficiently important to obtain parts to fill them "directly from military production, if necessary" (34:211).

Inadequate supplies of repair parts remained a problem throughout the war. ODT statistics revealed continuing levels of trucks out of service for lack of parts throughout the period, although the situation

improved significantly after March 1944. Although the situation created a management headache and led to some temporary losses of transportation capability, permanent losses were slim. Truck registrations in 1944 were only 2.9 percent under those in 1941, reflecting general success in keeping an older vehicle fleet on the road (24:206; 34:209,211).

Varying state highway laws constituted a difficulty to be overcome to assure efficient use of transportation in WWII. The Constitution reserves to the states the right to regulate within their own borders such activities as highway traffic. In exercising those rights, the states had set a number of restrictions. Among these were weight and size limitations on trucks, requirements for licenses and fees, requirements for trucks to use designated state ports of entry, and so on. In the field of freight transport, perhaps the regulations most restrictive on operation of the truck fleet as a truly national system were those concerning truck size and weight limitations.

Limitations such as these were not inefficient in and of themselves. On the contrary, they were necessary to protect roads and bridges from unnecessary deterioration. Difficulties arose instead from the variation of such limitations. For instance, Kentucky maintained a truck weight limit of 18,000 pounds on its roads while its neighboring states of Illinois, Indiana, and Ohio allowed weights between 40,000 and 57,750 pounds. In another instance, California allowed trucks of up to 76,000 pounds on its roads while Oregon allowed only 64,000 pounds. In either case, a truck being used in interstate travel which crossed the state with the lower weight limit either had to restrict its load to that state's maximum, or break bulk and make multiple crossings of the state to get its full load across. Similar difficulties were

encountered in the application of size limitations and with the methods used to calculate truck weights (34:143-4).

These conditions always formed something of a bar to interstate trade. During WWII the problem was compounded by the frequent location of new war industries and military posts "in States where traffic formerly was relatively light and where weight and size limitations were exceptionally low" (34:145). Adhering to the existing state limitations constituted a waste of transportation capacity and degraded service to essential industries and military activities.

The ability of any Federal agency to authoritatively address the issue without violating the Constitutionally guaranteed rights of the states was limited. Federal government action was thus restricted to urging voluntary state action and coordination, both between states and carriers and among the several states themselves.

The ODT Director requested the states voluntarily reduce restrictions where necessary to expedite wartime traffic. ODT personnel also intervened in several cases to ask state officials to relax restrictions to allow the swift movement of individual shipments of special importance and "vouching for the good faith of the carriers involved" (34:145-6).

More significantly, the President formed a committee consisting of representatives of the Departments of Commerce, Treasury, War, Navy, and Justice, the OPA, the ODT, and other agencies to consider ways to address the problem. This committee carried on work originally initiated by a conference called by the Secretary of Commerce. A May 1942 meeting of the committee and the Governors' Conference executive committee resulted in the issuance of an "emergency formula" which set

out recommended uniform national truck limitations. By the end of May 1942, all the states had adopted the formula. This resulted in "immeasurable improvement" in the situation overall (34:146).

Waterway Freight Traffic. While the quantity of freight hauled on all modes of transportation grew during the war, the amount of traffic carried on domestic waterway routes fell, both in absolute terms and relative to all other modes. This drop was almost solely because of the loss of safe transit on Atlantic coastal routes. The German submarine threat there "had a more profound effect in distorting the normal pattern of transport in the country than anything else that happened during the war" (24:267).

Some water routes, especially on the Great Lakes, showed marked increases in traffic hauled during the war. Most showed lesser increases; some important inland waterways had declines in traffic. As an example of the limited use of domestic water transport, Rose noted

> the Mississippi River System, offering exceptional water transport services in a most important industrial and agricultural area, did not participate fully in the movement of war traffic at any time during hostilities. (24:263)

Given the heavy burden under which the railroads and, to a lesser extent, the highway carriers were laboring, the failure of water transport to pick up a larger share of the load is somewhat surprising. Rose attributed that failure to the preference of shippers --as expressed in their choices of shipment mode-- for the greater speed and flexibility of land transportation, as well as to the urgency of wartime demand requiring greater shipment speed than that offered by barges and ships (24:251,262). Even if less extensively relied upon than other

modes, water carriage of freight was an important contributor to national transportation capacity.

Transport over the Great Lakes was of special importance during the war. Freight traffic hauled on them reached previously unprecedented highs during the war. Of that traffic, iron ore was of the greatest significance. Ores represented one of the largest cargoes carried on the Lakes prior to the war. The large increase in wartime production of steel called forth an accompanying greater movement of ores over the Lakes. Just under 90 percent of the iron ore used by the steel industries of both the United States and Canada was transported in this manner during the war (24:253-4).

The vessels available to carry this —and all other— traffic on the Great Lakes declined during the war. In 1941 the Lakes fleet was composed of 734 vessels with a total hauling capacity of over 3.1 million gross tons. In 1945 it included 670 vessels accounting for 2.97 million tons capacity. This largely reflected the withdrawal by the WSA of ships from the Lakes fleet and their placement in international service (24:252).

The necessity of hauling the increased traffic load with reduced capacity called forth several management efforts. The largest portion of the ODT's work in controlling waterway traffic in the war was composed of facilitating the "voluntary cooperation" of vessel operators. Management of Lakes traffic also called for more formal measures (34:177).

Voluntary actions were advanced through the creation and use of Regional Advisory Committees composed of vessel operators. Those committees were

> familiar with the problems peculiar to their particular regions, could represent and speak for the body of operators, as well as interpret the orders of the department, and encourage compliance with its policies. (34:177)

Formal ODT orders controlling Lakes traffic took the form of a series of directives of steadily tightening severity. In May 1942 the ODT sought to make more shipping space available for iron ore by prohibiting grain shipment over the Lakes except by permit. On June 1 of the same year it imposed similar restrictions on the shipment of coal on the Lakes. In September 1942 the WPB firmly established iron ore as having the highest transportation priority. The ODT followed in October 1942 with an order that effectively pulled the entire Great Lakes fleet under its control. It restricted vessels on the Lakes to the movement only of cargoes authorized by the ODT. The ODT maintained that control throughout the war (24:255; 34:181).

While iron ore received priority for use of Lakes transport, other commodities also moved in great quantity. In 1940 more coal moved over that route than ever before. In each of the years 1941 through 1945 more coal was carried over the Lakes than in 1940. Grain carriage showed similar (though lesser) gains, as did movement of limestone, an essential commodity in the making of steel (24:258).

Freight movement over waterways other than the Great Lakes, while not equal to their importance to the overall effort, did provide a number of success stories. These were typified by various schemes which moved petroleum products by barge from Gulf Coast ports over protected coastal waterways or on the Mississippi River system to points in Florida or the interior Midwest. At those termination points the oil products were fed into pipelines for continuing transportation to the

northeast. Such movements had the effect of relieving somewhat the pressure on the rail system (34:178-180).

Other successes were scored with barge movement of aviation gasoline to Army Air Forces fields situated on or near the Mississippi and Columbia River systems. As with barge transport of other petroleum products, this movement relieved other, more tightly pressed transport modes from some traffic burden (34:179).

The ODT took a number of actions beyond the tight control of Great Lakes shipping to attempt to achieve the greatest efficiency in water transportation. Among these were imposing similarly tight controls over ships hauling coal from the Hampton Roads ports to destinations in the northeast (34:180). Another was gaining permission from the Treasury Department for Canadian ship operators to move cargo between American ports. This practice was normally prohibited as a method of providing economic protection to American ship operators (34:182). The ODT was also instrumental in pressuring the WSA to guarantee maritime insurance coverage to ship operators carrying Lakes traffic after the normal 30 November closure of the Great Lakes navigation season. Normally, commercial insurance rates for such movements were so high the operation was uneconomical to operators. Providing government guaranteed insurance at reasonable rates allowed late year movement and prevented diversion of traffic to the railroads (34:181-2).

In the spring of 1943 late cold weather delayed the opening of the Lakes navigation season. The ODT was successful in having the Coast Guard perform "the most determined and sustained ice-breaking operation ever undertaken on the ...Lakes" to open the Straits of Mackinac and the port of Buffalo and allow the beginning of the 1943 season (24:252).

Another ODT action was the sponsorship of a building program which resulted in the construction of 629 river craft of various types. All of these were placed into service before war's end. Some difficulty was encountered, however, with 269 wooden barges constructed under the program. They were built to transport petroleum and on direction of a Presidential commission. Wood construction was specified to conserve steel. The ODT stated a number of reasons why wood was unsuitable for the purpose. The barges were directed to be built anyway. Upon their completion the Coast Guard refused to certify them as safe to carry petroleum. The Secretary of the Navy finally authorized their use for some limited petroleum carrying for that service. Their use for that purpose eventually yielded some very narrow success and other uses for them were also finally found so that not all was lost (34:183-4).

Pipeline Traffic. The principal products transported by pipeline in WWII were, as they are now, liquid petroleum products. Other liquids and gasses were also transported in this manner, but to a much lesser, even insignificant, extent. In 1941 there existed in the United States an extensive system of pipelines to carry liquid petroleum. It encompassed over 118,000 miles of line transporting crude oil and 9,000 miles of refined product line (34:190).

During WWII control of those pipelines, and of those newly constructed, was shared by the PAW and the ODT. The PAW was granted authority over the "designation of the quantity and kind of petroleum to be shipped" (34:189). The ODT had responsibility for providing transportation and for reviewing proposals for new pipeline construction or extension. It also developed plans to ensure pipelines were being used to their greatest efficiency (34:189).

None of the literature surveyed indicated that pipeline operation or PAW/ODT cooperation during the war presented serious difficulty. The most significant aspects of wartime control of pipeline transportation were extension of the system to meet increased wartime demand and accommodating the operation of existing portions of the system to meet the needs of the new extensions.

Thirty-three major pipeline construction projects were completed during the war, adding 9,845 miles of line to the system. The design of the system extension was essentially set during a three-month period of planning in early 1942. This planning was undertaken by the PAW in concert with the Petroleum Industry War Council, a group representing the needs and interests of those in all aspects of the oil industry (24:183,190).

Among the most important of pipeline extensions were new lines transporting oil from wells to refineries in Louisiana; a refined products line from East Chicago, Indiana to Toledo, Ohio which provided some relief for Great Lakes water carriers; and a 383 mile line carrying crude from West Texas to Cushing, Oklahoma. Many other relatively small lines were constructed to supply oil to the east (34:190). Although these would in normal times have constituted major projects in themselves, in WWII the importance of their construction was overshadowed by that of the Big Inch and Little Big Inch lines. These were the popular names given to pipelines carrying oil and oil products from the Gulf Coast to the eastern seaboard. They were more properly (if much less frequently) called, respectively, the War Emergency Crude Oil Pipeline and the War Emergency Products Line (24:190).

The need for a pipeline method of oil supply to the northeast as an alternative to over-reliance on ocean transport had been recognized as early as 1940. In December of that year the Secretary of the Interior had asked the President "...to consider the construction of one or more pipelines" from the oil producing regions to the northeast (24:190). Twice in 1941 proposals for such lines were advanced and disapproved by the Supply, Priority and Allocation Board. American entry into the war and the subsequent cutting of seaborne oil transportation to the east coast finally provided sufficient impetus for project approval. The WPB authorized materials for construction of the Big Inch lines in June 1942. Each was constructed as a government, as opposed to industry, project (24:190; 34:190).

Construction of the crude oil carrying Big Inch was commenced on 3 August 1942. It originated at Longview, Texas, passed near Little Rock, Arkansas and reached its first terminal at Norris City, Illinois. Construction to Norris City was completed on 13 February 1943. It was further extended from Norris City to refineries in northern New Jersey and Philadelphia. Construction to those points was completed in August 1943 (24:190-1). After completion to Norris City and before the eastward extension was finished oil was transported from Illinois to the east by rail, as previously documented.

The Little Big Inch was designed to carry refined petroleum products, either gasoline or fuel oil. It stretched from Beaumont, Texas to the New York area, following the same right of way as the Big Inch for much of its length. Its construction began in April 1943 and was complete in March 1944 (24:191-2).

Supplying each of the Big Inch lines with products to transport created requirements for new pipelines. Feeder lines for the Little Big Inch had to be constructed from refineries in Lake Charles, Louisiana and Houston to its origin in Beaumont. The system of feeder lines for the Big Inch was even more elaborate. It consisted of new construction of lines from oil fields, reversing the flow of oil in some existing lines, and the conversion of other existing lines from natural gas carriers to crude oil carriers (24:191).

The effect of the completion of the pipeline system serving the east was summarized this way:

> The completion of the lines relieved the intolerable strain on tank cars, which were diverted to shorter hauls where they could operate more efficiently; the Big Inch alone replaced 30,000 tank cars or from 60 to 75 tankers. Furthermore, the lines transformed drastically the pattern of petroleum transport. Early in 1941 the volume of oil moving by pipeline into the eastern states amounted to only 42,000 barrels daily; by the end of 1944, after the consummation of the wartime pipeline program, the movement surpassed 700,000 barrels per day. The overwhelming importance of the Big Inch lines is indicated by their combined daily capacity of 550,000 barrels, or one third of the prewar east coast demand. (24:192)

Air Freight Traffic. The quantity of freight cargoes other than mail transported by air prior to WWII represented an insignificant quantity --less than one percent-- of the total of all goods shipped in the United States (24:33). Similarly, the percentage of total revenues the civil airlines gained from transportation of freight other than mail was very small, no more than three percent (6:3).

While the quantity of goods moved by air was low relative to the total, the importance of air transport was not equally as low. The greater speed which air transport provided over surface modes made it especially valuable to the carriage of high value and very urgently

needed freight. As the quantity of goods with such qualities rose during the war so, too, did the importance of air transportation. Early in the war, air transportation was even used to bring to the American mainland over 970 tons of urgently needed critical production materials (6:206). The percentage of the national freight traffic which was moved by air rose only to just above one percent during the war, but the absolute quantity of freight (including mail) ton-miles carried by air increased almost five-fold. In 1941, air carriage of mail and freight accounted for a total of 18,376,566 ton-miles; in 1945, it totalled 87 million (24:33,273).

Even currently, air transportation represents premium transportation service delivered at relatively high cost. During WWII this was even more true. Development of transport aircraft and the airline industry were still so inadequately advanced that air travel was not routine. The limited availability of air transportation capacity made control of its use essential to the effective furtherance of the war effort.

Reflecting the high value of air transportation, government control over this segment of the transportation industry during WWII was the most comprehensive of any exerted over any mode. Airline personnel managed and operated their systems, but Federal Government control over civilian airlines --exercised through the military-- was "complete" (34:191).

Government control over the airlines was exercised through three major tools. The first of these was depriving the airlines of equipment and personnel. The second was by specifying the routes and schedules over which the airlines could operate their remaining equipment. The

third was by instituting a system of traffic priorities which effectively told the airlines what they could carry.

The airlines were deprived of equipment by its diversion to the military. Having failed in attempts to develop a practical transport aircraft purpose-built for military use (9:vii), the Army Air Forces (AAF) were dependent on the same type of aircraft as the airlines were. These were primarily the C-47 and the C-54, military versions of the DC-3 and the DC-4 (6:3). At the beginning of the war, the airlines owned "about 389" of these large transport aircraft. In May 1942, the President directed that 200 of them be immediately sold to the military (6:21). Wartime aircraft production controls which directed output of new aircraft construction to the military, vice the civil airlines, prevented the airlines from making good any of these losses during the war (9:viii).

The airlines represented not only a ready source of air transport equipment. In 1942 their approximately 2,600 pilots were the "largest single reservoir of experienced pilots" in the country (6:31). Many of those pilots had received their flight training in the AAF and held commissions as reserve AAF officers. They were quickly recalled to active duty, the first large group of them called up in March 1942 (6:32; 9:ix). Pilots without previous military experience were also brought into active military service, along with other critical airline personnel. These included "executives,...crewmen, and mechanics and technicians of all sorts" (9:viii). The net effect of these moves was to take from the airlines the human assets they relied on.

There were good reasons for the withdrawal of these assets from civilian work. Air transportation was to be of critical importance in

the war. The Navy provided itself with some airlift through its Naval Air Transport Service (NATS), established in December 1941. The AAF, however, possessed the greatest amount of transport aircraft. Its Air Transport Command (ATC), established in June 1942, eventually operated a worldwide system that provided lift to all services. It reached a WWII peak strength of 200,000 personnel and 3,700 aircraft but the wartime beginnings of military airlift were more humble. Its entire stock of medium and long range transport aircraft consisted of 11 converted B-24s on loan from other duties and "40 to 50" other transports (6:19-20; 9:ix). The asset diversions to the military from the airlines were required for the AAF to quickly establish any meaningful airlift capability at the start of the war (6:11).

The few assets left to the airlines were virtually completely devoted to military traffic. Airline equipment and personnel were extensively used to operate ATC charter airlift missions all over the world and throughout the war. Of all the airlift which ATC provided worldwide, airlines operating under charter provided 88 percent in 1942, 68 percent in 1943, 33 percent in 1944, and 19 percent in 1945 (6:31). Thirty-five of the two hundred aircraft left to the commercial carriers were devoted to moving ATC traffic (24:268). Additionally, airline crews were used throughout the war to fly military charters on ATC-owned aircraft. Originally this was on the aircraft the carriers had been directed to sell to the military. The practice of using chartered airline crews to operate ATC equipment became even more prevalent in 1944 and 1945 (6:19). Civilian crews were also used to ferry newly produced military aircraft to overseas theaters (6:11-12).

The airlines effectively provided valuable support to the military but the conduct of these charter operations was not without friction. Airline personnel sometimes felt interfered with by military officials. Some in the military felt the commercial carriers' performance was too often driven to promote the interest of the airlines and "the convenience of their employees" (6:12).

Beyond directly moving military cargo, the airlines also contributed to the war effort by training personnel. This was accomplished in one major way through the Airlines War Training Program. Under this program, established in 1942, the airlines trained military transport pilots, navigators, radio operators, and other air-and-ground crew members. Over 9,000 personnel were trained in the program, but the AAF's inability to direct enough trainees to it prevented it from being significantly successful. The program was terminated in 1943 (6: 39-41). More successful was a smaller program which provided training to AAF aviators. In this program, AAF C-47 co-pilots were provided with flight experience by replacing airline co-pilots with them on some Pan-American Airways contract flights (6:43).

Airline operations outside of those controlled by contract with the military were also tightly regulated. In December 1941, an Executive Order directed the Secretary of Commerce to control the operations of the airlines as requested to support the war effort, and to do so "as requested by the Secretary of War." The same order directed the Secretary of War "to take possession and assume control of the civil aviation lines to the extent necessary ..." to support the "...prosecution of the war" (34:191). The ODT, though ostensibly in charge of all civilian transportation, was almost totally uninvolved

with air transportation. Its role was strictly confined to presenting to the WPB the material requirements of the airlines. The ODT abdicated even that limited responsibility to the WPB later in the war, and maintained only simple representation on the WPB committee responsible for material allocations to aircraft production (34:191).

Control of air transportation was virtually all through the military. The Secretary of War's control was exerted through the ATC, and that of the Secretary of Commerce through the Civil Aeronautics Board (24:270). In practice the two agencies largely acted in concert, with the ATC directing the implementation of plans formulated by the CAB. Among the directives implemented was one which dictated to the airlines the routes over they had to operate and the stops on them which they must schedule in order to support wartime requirements. Also specified, based on CAB recommendations, were how the aircraft the airlines continued to own would be divided among them; the number of airline-owned aircraft to be operated by each carrier for the War Department; the number of airplanes each airline was to sell to the government; and "the number of schedules to be operated by each carrier" (24:272).

The Federal Government not only dictated to the airlines how they would operate their equipment. It also specified what traffic the airlines could carry. This was accomplished by imposing a nationwide system of traffic priorities for air movement.

The system was designed and directed by the Department of War through the ATC. It was implemented in the field by agents of the Air Transport Association (ATA), the air carriers' national industry organization. Policies and directives relating to operation of the

priority system were issued by the ATC to the ATA's field organization, which by War Department order was established as the ATC's field organization as well. Agents of the ATA, in turn, performed the actual work of receiving and acting upon applications for priorities (24:271).

Five classes of air priorities were established, I through V, with class I representing the highest priority. Most air cargo fell into class IV (24:271).

The combined effects of the tight control imposed on the commercial carriers were more efficient and effective use of commercial aircraft. The airlines had less equipment to operate during the war but it was used so efficiently that much more traffic, as cited earlier, was carried. This was party accomplished by operating aircraft with greater loads. Another contributor was the more intensive operation of aircraft. The daily average milage of commercial aircraft in 1941 was "about 1,000." By 1945 the same figure was 1,742 (24:274). Use of the priority system limited the allocation of premium air transportation to those cargoes which truly required it. "Millions of pounds" of cargo were either denied air transportation, or accepted for shipment and later displaced by higher priority traffic (24:271-2).

Conclusions by Previous Researchers

This section is a discussion of conclusions reached in previous research into the conduct of wartime transportation. It, along with the background presented earlier, provides a basis for the formulation of the lessons learned that follow in the next chapter.

The literature reviewed revealed little in the way of extensive conclusions specifically regarding the control of transportation in

WWII. Rose reached several conclusions specific to transportation and they are summarized below. Other research presents conclusions or asserts lessons learned of a much more general nature, usually addressing the totality of the WWII mobilization. To the degree that transportation is specifically addressed at all, it is typically in a manner similar to Abrahamson's comment in referring to WWII railroad performance that "someone had learned the lessons of 1917-1918" (1:146).

On the assumption that conclusions reached about the lessons learned about the WWII mobilization generally refer to some degree to the management of transportation specifically, those apparently relevant to transportation that were revealed in the literature reviewed are also discussed.

Rose attributed the successful operation of the railroads in WWII primarily to preventing congestion at the ports and to refraining from the use of transportation priorities for specific traffic. He also concluded that the WWII experience demonstrated that the national stock of railroad cars should be treated as a single pool --regardless of ownership-- to achieve their most efficient use in a similar emergency (24:277-8).

Rose asserted that the success of government control of transportation could be partly laid to its assumption of a policy-setting role and its non-interference with the day-to-day operation of the industries or carriers (24:279). He asserted government's failures to be in inadequately defining the authority of the many agencies -- both permanent and wartime-- concerned with transportation. He also cited as a failure the ODT's occasionally inefficient use of the resources of other agencies, specifically citing those of the ICC and

the OPA. In light of the WWII experience Rose questioned whether there had been a need for the establishment of the ODT at all and speculated that the same functions could have been just as well carried out by the ICC, thus reducing the potential for jurisdictional disputes (24:279-82).

Finally, Rose judged as a failure the attempt to centrally manage the Certificate of War Necessity program. He stated the attempt was an efficient use of ODT manpower but did not match the diversity of the industry and individual carriers which it was intended to control (24:281-2).

In a 1989 thesis England advanced a set of eight lessons learned regarding mobilization in WWII derived from his research. Those apparently relevant to transportation are summarized here. England asserted that a "trial and error approach to mobilization" was used and was ineffective. He concluded that successful mobilization depends on a partnership between government and industry. He found that pre-war preparations in "plans, stockpiles, government funding, etc. ..." reduces the time required for mobilization to be effective. England also asserted a need to accept shortages as inevitable in war with the consequent need for mobilization planning to address methods to work around potential shortfalls (10:91).

Peppers included in a list of lessons learned from WWII logistics generally those summarized as follows. He asserted that it is unlikely we will have a long time to prepare for the next major war and consequently must plan to fight it with what is available at the time. He asserted for the same reason a need to maintain a constant state of readiness to support war. Peppers also forwarded the idea that

"logistics planning bodies" (21:148) needed to support total warfare, including those needed for domestic economic and industrial control, must be created and maintained in a state of immediate readiness. Relatedly, he stated a need to maintain active mobilization planning within all elements of the "national logistics infrastructure" (21:149).

Reed *et al* drew numerous conclusions from their study of mobilizations in support of WWII, Korea, and Vietnam, the bulk of which concerned WWII. They cite a requirement for planning to be flexible enough to address a variety of contingencies, and for it to "...stress capacity to meet a wide range of possible scenarios" (23:7-2-3). They assert finding that planners should work as much as possible within existing laws rather than planning for sweeping changes in legislation (23:7-8). They also concluded that mobilization planners should not be overly concerned with the administrative structure of the mobilization but rather focus on the functions which must be performed (23:7-9). Finally, they found a need for a strong central mobilization manager to resolve disputes among agencies and to coordinate their activities (23:7-10-11).

III. *Analysis*

This chapter presents an analysis of the data revealed in the review of literature. The presentation is in the form of a series of lessons learned in management of domestic transportation in WWII. The lessons learned are of a level of abstraction intended to make them of use to any current transportation planner and are therefore not restricted in application to specific times, places, or situations. Examples of specific WWII experiences are used only to demonstrate the events providing the foundation for the lesson drawn.

Lessons Learned

1. The transportation assets available to support domestic transportation at the start of a war —no matter the war's length— will not likely be greatly expanded during the war.

England's contention of the inevitability of shortages and Pepper's assertion of a need to prepare to fight with material available at the start of a war are validated by the WWII domestic transportation experience. Despite the relatively long duration and constantly growing traffic demands of WWII little new transportation equipment was made available to support the domestic economy. Pipeline construction did increase but the more heavily used rail and highway modes of transport were required to operate throughout the war with only minimal additions of new equipment. More urgently needed military orders had in WWII, as they likely always will, a higher call on scarce resources and manufacturing capacity than did domestic transportation.

2. Management of the national transportation system in wartime should stress maintenance of the flow through it rather than the priority movement of specific traffic.

The application of this principle was reflected in the efficient operation of the rail/water port interfaces in WWII. It can be broadened in scope to include any bottleneck in the transportation system. It is important that the right material move through the system at the right time. It is vital, however, that whatever material is in the system --no matter its importance-- is kept moving. The system must not be allowed to clog.

3. Planning must include the flexibility to meet a wide range of situations.

The vagaries of war might, and probably would, result in the loss of some important transportation capacity. The inability to use coastwise shipping along the Atlantic coast in WWII provides a prime example. Others were the diversion of some Great Lakes shipping to ocean routes and the need to reduce truck movement. Current planning should include not only the use of existing assets but also provide for a variety of contingencies in which domestic use of important assets is lost.

4. The difficulty of the wartime transportation management task will rise along with the number of transportation providers managed.

This is amply demonstrated in the different experiences in government management of the railroads and trucking. Managing the railroads in WWII was a relatively easy task for the government despite the press of additional traffic. In large measure this was because the number of railroads was not large and there was a great measure of

central control already in the rail system. In contrast, bringing truck transportation and its many providers under control required a great deal more administrative effort and was less successful.

5. Transportation planning must be considered and fully integrated in all other mobilization planning, and vice versa.

The siting of military bases and new industrial plants in WWII had a significant effect on the transportation system. The availability of transportation also affected the ability of those installations to function effectively. Yet transportation considerations were not a major part of siting decisions until late in the war. Similarly, the use of scrapped truck parts as raw material in steel production produced gains in one area of the mobilization while harming another area. Such trade-offs may well be necessary and desirable, but they should be consciously made rather than accidentally produced.

6. Wartime transportation management should use the expertise of already existing government and industry agencies as much as possible.

The ODT's successful wide use of ICC personnel and control structures in WWII provided numerous examples of this principle, as did its reliance on industry groups such as the various port coal committees and the AAR. It is clearly more efficient and effective to use the expertise of individuals already well-versed in the peacetime operation of a system to manage it in wartime rather than to develop a new core of temporary experts. Current planners should count on using this expertise, and the agencies and individuals involved should be included when exercising mobilization plans.

7. Wartime policy priorities and agency responsibilities must be clearly defined and understood.

Valuable time and administrative attention were wasted in WWII in deciding jurisdictional matters and settling policy issues. The evolution of central management of refrigerator cars in WWII provides an excellent example of such a situation. These types of issues should be decided in pre-war planning when possible or by reference to clear general guidance provided by policy makers when pre-war agreements are not feasible.

Conclusions

This research traced the development of commercial transportation in America from its origins to the period just prior to WWII in order to describe the national transportation capacity available at the outbreak of the war.

The research revealed that at the onset of the war the United States enjoyed a varied stock of transportation assets. Individual transportation modes had achieved similarly varied states of development. Railroads were the most developed and carried the greatest share of domestic freight traffic; air carriers were the least developed and carried little freight. Water, highway, and pipeline modes were spread in between the two extremes.

Just as the development of individual transportation mode capacities differed so, too, had the patterns of ownership and industry relationships to the government. Each of those characteristics affected the ability of the individual modes to contribute to wartime mobilization.

The onset of WWII and the economic mobilization of the country to support its participation in it stimulated a massive expansion of industrial output. This drove an accompanying expansion of comparable magnitude in the freight traffic carried by American transportation providers.

In the face of this increased workload American transportation capacity remained relatively static throughout the war. Little new equipment was made available for domestic transportation during the war.

The increased workload was handled largely with the equipment available at the onset of hostilities. Further complicating the task, some normal distribution patterns were disrupted by hostile actions, wartime population migrations, and development of new industries. Shortfalls in capacity versus demand appeared in virtually all transportation modes.

Government management of almost all wartime transportation was centrally administered by a temporary wartime agency, the ODT. It undertook a number of steps to ensure the limited transportation capacity available was being used at its greatest efficiency. The ODT was granted broad authority to direct the operation of wartime transportation. In many cases it used that authority to specifically order various actions. In other cases the ODT was able to achieve acceptable results through the voluntary cooperation of shippers and/or carriers, or to revise normal institutional practices to make it possible for carriers themselves to institute efficient practices.

Management of air transportation during the war provided an exception to the general pattern of wartime management. It was virtually completely taken over and very closely directed by the government. Many of the carriers' aircraft were taken over by the government. Day-to-day operations remained in the hands of the airline owners and managers but they were allowed to operate only within a very narrow band of permissible actions.

The ODT made frequent and valuable use of the resources of other government agencies --notably the ICC-- and industry associations. In some cases this was by design; in others, by necessity. Not all relations with other agencies were productive. In several instances the different priorities and apparent missions of the ODT and other

government agencies were in conflict. Resolving those conflicts delayed the institution of needed actions and consumed management effort that could have been better spent in more productive pursuits.

The history of domestic transportation in WWII revealed in this research illuminated a number of successes and failures in its management. These, along with conclusions by other authors in previous research, were used to derive a series of general principles apparently applicable to current planning for transportation support of industrial mobilization. These were presented as a set of lessons learned in the previous chapter.

Recommendations for Further Research

This research concerned itself with identifying lessons learned from the WWII experience. Further research could profitably be applied in determining whether the lessons offered by WWII are reflected in plans now existing or being developed for management of domestic transportation in an industrial mobilization.

Constraints on time required this research to be limited to consideration of intercity freight transportation only. Wartime movement of passengers and the maintenance of urban transportation in wartime were also important in WWII, and remain of concern in the present. This is especially true given the prominence which private automobile travel has assumed in these areas. Either area suggests itself for further study.

Finally, it became clear during the course of this research that industrial mobilization in WWII has been extensively researched since the end of the war. Very, very many works are available documenting it

in whole or in part. Each of those works has something to offer the contemporary researcher, almost always something different in some way or another than work done before. It would have been immensely helpful in the conduct of this research to have had a central reference available that documented what, in general, was available in the literature concerning industrial mobilization in WWII. An extensive annotated bibliography encompassing as much of the appropriate literature on the subject as possible would have served the purpose nicely; preparation of such a work would seem a worthy future effort.

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The conduct of extended warfare by the United States anywhere on the globe is dependent on the ability of the American industrial base to support it. Such support is in turn dependent on the support of American transportation. In recent years the potential for an extended conventional war has increased. This has increased the need to make adequate plans for domestic transportation support of such a contingency. The objective of this research was to examine government management of domestic freight transportation in World War II and to draw from that examination any principles apparently applicable and helpful to current transportation planners. This research encompassed a literature review resulting in a description of the development of the five modes of domestic freight transportation through 1941, a brief examination of the conduct of the industrial mobilization supporting American participation in World War II, and an extensive examination of the management of domestic freight transportation by the Federal Government during the war. The successes and failures of government management of domestic freight transportation in World War II were subjected to an analysis which revealed a series of lessons apparently applicable to current planning for a similar contemporary contingency.

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