

MILITARY AUTO TRAIN

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by

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Fort Leavenworth, Kansas
1999

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DTIC QUALITY INSPECTED 4

19990909 333

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302 and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 4 Jun 99	3. REPORT TYPE AND DATES COVERED Master's Thesis 7 Aug 98 – 4 Jun 99
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4. TITLE AND SUBTITLE Military Auto Train	5. FUNDING NUMBERS
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6. AUTHOR(S) MAJ Scott J. Lofreddo	
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD 1 Reynolds Ave., Bldg. 111, Rm. 123 Ft Leavenworth, KS 66027-1352	8. PERFORMING ORGANIZATION REPORT NUMBER
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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING
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11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for Public release; distribution is unlimited	12b. DISTRIBUTION CODE A
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<p>13. ABSTRACT (Maximum 200 words)</p> <p>This study investigates the use of rail transportation as a method to simultaneously transport military personnel and equipment from a unit's home station to the Joint Readiness Training Center or the National Training Center. It describes the problems associated with current methods of transportation available for military force projection and explains why the military Auto Train can fill a transportation niche unique to deploying Army units. The study identifies five sample transportation modes, including the military Auto Train, and evaluates them using performance and equipment criteria.</p> <p>Rail transportation has an important place in the force XXI Army. This thesis explores the reasons why the Military Auto Train is an important alternative to modes of transportation presently in use and describes the configuration and characteristics of a military Auto Train, and the benefits it provides to Army unit commanders.</p> <p>This study concludes that the military Auto Train can provide a more time efficient form of transportation than the sample transportation modes. Furthermore, the thesis provides a base plan in the event the United States Army decides to embrace this innovative transportation concept.</p>
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14 SUBJECT TERMS	15. NUMBER OF PAGES 97
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL
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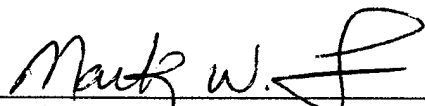
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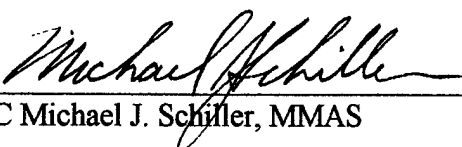
THESIS APPROVAL PAGE

Name of Candidate: Major Scott J. Lofreddo

Thesis Title: Military Auto Train

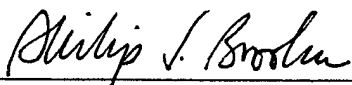
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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

MILITARY AUTO TRAIN by Major Scott J. Lofreddo, Transportation Corps, USA, 98 pages.

This study investigates the use of rail transportation as a method to simultaneously transport military personnel and equipment from a unit's home station to the Joint Readiness Training Center or the National Training Center. It describes the problems associated with current methods of transportation available for military force projection and explains why the military Auto Train can fill a transportation niche unique to deploying Army units. The study identifies five sample transportation modes, including the military Auto Train, and evaluates them using performance and equipment criteria.

Rail transportation has an important place in the force XXI Army. This thesis explores the reasons why the Military Auto Train is an important alternative to modes of transportation presently in use and describes the configuration and characteristics of a military Auto Train, and the benefits it provides to Army unit commanders.

This study concludes that the military Auto Train can provide a more time efficient form of transportation than the sample transportation modes. Furthermore, the thesis provides a base plan in the event the United States Army decides to embrace this innovative transportation concept.

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CHAPTER 1

INTRODUCTION

Overview

One of the greatest challenges facing the architects of the Force XXI Army is the question of how to reduce transit times from power projection platforms in the United States to potential global trouble spots. This argument could also be extended to developing a cost-effective and suitable way to simultaneously transport personnel and their equipment to the Joint Readiness Training Center at Fort Polk, Louisiana, or to the National Training Center at Fort Irwin, California. The Army Chief of Transportation, Brigadier General Harper, and his staff made these remarks during the recent United States Army Training with Industry Conference at Fort Eustis, Virginia, on 12 May 1998.¹ This briefing explained how Army planners are constantly searching for ways to deploy soldiers and their equipment quickly while reducing transportation costs. The concepts presented at this briefing had merit, but they seemed to have ruled out the use of steel wheels on steel rails as a viable alternative to the combination of air and ground transportation currently in use.

Why not use the nation's railroads to simultaneously transport personnel and equipment? It is a simple concept which has advantages for both the deploying commander and the Army as a whole. A light infantry battalion-sized task force uses rail transportation to move its personnel and equipment from a home station to a combat training center. This deploying unit conducts both deployment and mission tasks in conjunction with the travel time to the training area, while the Army benefits by spreading

transportation cost savings across the command spectrum. In short, this thesis proposes a military auto train.

Presently, the National Railroad Passenger Corporation (Amtrak) uses this concept to expedite paying customers and their automobiles, back and forth from Florida to the Washington, DC, area. This thesis contends that the military auto train could accomplish three important tasks. It could provide a better return on investment (both in regard to time and money), provide better in transit visibility and security of Army equipment, and provide deploying commanders the latitude to conduct in-route planning within a specially equipped mobile Battalion Tactical Operations Center. A drawing of this innovation is contained in appendix A.

Significance of the Study

Railroad transportation has an important place both in the nation and the Force XXI Army. The United States military has used the nation's railroads to move its personnel and equipment on many occasions throughout history. During the Second World War, the nation's railroads moved staggering amounts of traffic to support the war effort. In fact, at no time during the war years did railroads haul less than 64 percent of intercity freight. In 1943, for example, the total was 72 percent of all transported freight or over 46 billion ton-miles.² During August of the same year, the American railroad system moved close to one million troops in addition to the large civilian requirements imposed by wartime travel restrictions.³ This same concept can provide the present Army with a way to increase versatility and decrease transportation costs associated with strategic deployments.

The military auto train is well suited to transport a light infantry battalion task force. The last light infantry battalion task force, from the 10th Mountain Division, to deploy to the Joint Readiness Training Center consisted of 775 soldiers and 150 pieces of equipment.⁴ Based on these figures, the proposed military auto train would be approximately 55 cars (5,500 feet) in length, would weigh about 5,500 trailing tons and would be operated, under contract, by the nation's rail lines. The train would be large enough to transport roughly 800 soldiers and their equipment, but agile enough to navigate the nation's railway mainlines and sidings without difficulty. The railroad equipment would be procured by the United States Army and maintained by the Military Traffic Management Command. This idea is flexible enough to allow for the movement of a battalion-sized task force element from contiguous Army installations to either of the combat training centers one day and, after the movement is completed, immediately free to redeploy the battalion which has just completed the training rotation.

The benefits, both to the Army as a whole and unit commanders in specific, are numerous. Installations would receive the benefit of cost savings and streamlined transit over the present air and ground deployment methods while unit commanders benefit by combining planning and deployment timelines, unencumbered by the usual home station distractions, such as unit personnel taskings, or installation support requirements. The military auto train allows units the time to conduct continuous planning and coordination once it deploys from its home station. Officers and noncommissioned officers would be able to focus on the mission at hand, with the comfort of knowing their soldiers and equipment were safely in tow. The mobile Battalion Tactical Operational Center conducts

uninterrupted planning and command and control while linked to intelligence assets, logistics nodes, and higher headquarters via electronic means. With a continually operating battalion Tactical Operations Center, deploying units could exercise their onward integration into the training scenario and receive and plan mission orders while in transit. They could even complete unit mandatory classes such as Equal Opportunity and Consideration for Others training during the movement to a training site. Upon arrival at the battalion's destination, the Battalion Tactical Operational Center remains a self-contained operation, independent of any outside support requirements.⁵

Problem Statement

Why should Army leadership embrace this idea? Deployments cost time and money. Army leaders must find ways to reduce these costs without degrading the readiness or effectiveness of deploying units, in order to increase the resources available to strengthen the fighting force. Currently, the United States Army uses a mixture of air and surface transportation assets to move its soldiers and equipment to a training event or overseas crisis. These transportation requirements account for a large portion of the funds allocated to a combat training center rotation. For example, in fiscal year 1999, the most recent transportation costs for a light infantry brigade task force deployment (including air and ground modes of transportation) from Fort Bragg to the Joint Readiness Training Center was \$2.48 million. This cost does not reflect the \$1.313 million allocated to Air Force Special Assignment Airlift Mission aircraft used to move helicopters and oversized or oversized cargo.⁶ If this figure is divided roughly by three to reflect a light infantry battalion sized-task force movement, the division spent \$820,000 to move the tailored

force. As another comparison, a similar air deployment by 325 soldiers from the light infantry brigade at Fort Lewis to the National Training Center cost \$151,308, including commercial buses used to move personnel from the commercial aircraft debarkation point at George Air Base in Victorville, California.⁷

Each transload of personnel or equipment requires time, money, and effort. In many cases, soldiers utilize as many as three modes of transportation before they arrive at a combat training center. The time used to complete this move, coupled with the time it takes to establish billeting, messing facilities, and command headquarters could be better used by the deploying command. Although these deployment functions are currently sequential in nature, they should be simultaneous to reduce time and effort.

Research Question

This thesis maintains that the United States Army can use rail transportation as an efficient means to simultaneously transport personnel and equipment from a deploying unit's home station to the Joint Readiness Training Center or the National Training Center. The thesis will argue that rail transportation is more efficient and economical, both with regard to time and resources, than using the present combination of air and other ground modes of transportation. Furthermore, the thesis will contend that rail transportation provides deploying commanders the flexibility of establishing a continuous Battalion Tactical Operations Center for planning while enroute to their destination. Finally, the thesis will declare that the Army can realize the potential of these innovations by using the existing national rail car fleet and with a minimal amount of investment.

Supporting Questions

Before the primary question of this thesis can be answered, the following subordinate questions must be identified and answered. First, is the military auto train an efficient mode of transportation? The answer to this question should be answered, not only from a resource perspective, but from a time perspective as well. Is this transportation concept economically viable? Can the Army adequately resource this concept from the existing commercial rail equipment resources? Will governmental or civilian bureaucracy have an impact on the viability of this concept? Will the condition and capacity of railheads at United States Army installations and combat training centers be a factor in determining the feasibility of this study? Finally, What level of civilian and military expertise is needed to implement this service?

Assumptions

The thesis will make three assumptions to begin this study. First, tactical units can deploy personnel via rail from their home installations to the Joint Readiness Training Centers at Fort Polk, Louisiana, or the National Training Center at Fort Irwin, California. Since both installations currently receive a portion of rotational unit equipment by rail, the use of passenger rail equipment at the same installations should not pose a problem for servicing rail carriers. Second, the study will assume there is a sufficient amount of information available to present a valid argument. Considering the initial quantity and quality of information from the Combined Arms Research Library and independent sources, this assumption appears to be valid. A final assumption presupposes the measures of efficiency must be definable. Since the measures are quantitative in nature

(transit hours, cost per item moved, cargo space, etc.), this assumption seems to be valid as well.

Background

Amtrak's Auto Train traces its origins back to 1966. Managers in the passenger department of the Atlantic Coast Line Railroad informed the United States Department of Transportation that they were looking at innovative ways to capture the lucrative tourist trade from northeastern United States markets to Florida. The idea presented by these managers was the transport of passengers and their automobiles on the same train to compete against the adjacent highways and motels. Preliminary research indicated that passengers would enjoy their vacation more if they arrived in Florida rested, while eliminating their overnight drive on a pre-interstate road network of detours and local traffic, gaining the use of their own automobiles. This idea had value, but was discarded by senior railroad officials once private passenger operations were seminationalized as a result of the Rail Passenger Service Act enacted by President Nixon in 1970.⁸

Even as the National Railroad Passenger Corporation (Amtrak) assumed the responsibility of operating the nation's passenger trains on 1 May 1971, others in the rail industry were still looking at the passenger and automobile train concept. On 6 December 1971 the Auto Train Corporation began operations. This business venture was established to make a profit. The routes (initially Lorton, Virginia, 15 miles south of Washington, DC, to Sanford, Florida, 45 minutes north of Walt Disney World and expanded in 1974 to include Lexington, Kentucky, to Sanford, Florida) were carefully selected for profitability, trip duration, and demographics. The Lorton to Sanford route would have been expanded

to a more northerly terminus in New Jersey or Pennsylvania but due to clearance restrictions north of Washington, DC, this option was discarded.⁹

The Auto Train Corporation filled an important niche in the national transportation infrastructure until two derailments and their subsequent insurance claims drained the corporation of fluid operating capital. The private corporation operated its last train on 30 April 1981. Even as this venture ceased operations, others in the industry still saw potential in the idea. In 1983, Amtrak incorporated the private Auto Train business plan into its own and began operating the Amtrak Auto Train.¹⁰ Amtrak continues to operate this service between the terminals in Lorton and Sanford. During fiscal year 1997 (October 1996 to September 1997) Amtrak's Auto Train transported over 240,000 passengers, 117,000 automobiles, vans, and motorcycles and posted a two million dollar profit during fiscal year 1997.¹¹

There are both similarities and differences between Amtrak's Auto Train and the proposed military version. Both versions operate with passenger-carrying equipment forward of vehicles and equipment. This is due to the excess movement of running gear (couplers and draft gear) or "slack action" while the train is moving. Originally, the Auto Train operated with the equipment behind the motive power, but this made for a rough ride for the passengers at the rear end of the train.¹² Both versions do not allow for any regularly scheduled stops for the pickup or discharge of passengers or time-consuming switching moves. The Amtrak Auto Train covers its scheduled 861 miles in 16.5 hours (average of 52 miles per hour) with one servicing stop for water and diesel fuel.¹³ The most significant difference between the two versions is the loading requirements for

equipment. Because Amtrak has a finite number of auto-carrying equipment (64), it must load automobiles two hours prior to departure. The military version would use 89-foot fully enclosed, bi-level autoracks from the private railroad sector and would not be affected by this restriction.¹⁴ Additionally, Amtrak's auto train caters to a specific clientele, the northeast United States to Florida vacation market. The military auto train is not restricted to such a market and would actually move between Army installations as the demand for this unique transportation changes.

Scope

The scope of this study will be limited to the simultaneous transport of personnel and light equipment, which includes wheeled vehicles and containerized cargo. The simultaneous transport of personnel and heavy equipment (tanks, armored personnel carriers, recovery vehicles, etc.) will not be discussed due to their inherent weight restrictions and train-handling characteristics. For these deployment requirements, a separate unit train is proposed. One which closely follows the schedule of the military auto train, as the solution to any potential argument against the concept of this study. Only the movement of a light infantry battalion task force from Fort Drum and Fort Bragg to the Joint Readiness Training Center or from Fort Lewis or Fort Carson to the National Training Center will be discussed. These combinations will be used to determine the validity of the primary research question. This is not to say that units from other installations could not use the military auto train, but that including them is not in the scope of this study.

Definitions

Auto Train Corporation: For the purpose of this thesis this term is used to describe private operations of the Auto Train concept. The corporation was established to transport passengers and their automobiles, motorcycles, or vans from Lorton, Virginia, to Sanford, Florida, and later Louisville, Kentucky, to Sanford, Florida. The corporation commenced operations on 6 December 1971 and ceased operations on 30 April 1981.

Combat Training Centers: For the purpose of this thesis, the term combat training centers refers to both the Joint Readiness Training Center at Fort Polk, Louisiana, and the National Training Center at Fort Irwin, California.

Efficiency: One of the subordinate questions this study will address is how to define efficiency with regard to time and resources. To begin the research of this topic, a baseline definition of efficiency from which to work will be established.

Time efficiency is defined as the average time it takes for all task force personnel and their equipment to travel between an origin and destination.

Equipment cost efficiency is defined as the annual cost to operate railroad equipment used to deploy soldiers and their equipment from one location to another, divided by the number of trips per year.

Transportation efficiency is defined as the transportation mode used during the deployment multiplied by its Time Efficiency.¹⁵

Intermodal: Having to do with more than one mode of transportation, examples include containers on railroad flatcars or containers on ocean going vessels. For this study it means primarily wheeled vehicles and containerized cargo on railroad flatcars.

Military Traffic Management Command (MTMC): A sub unified command of United States Transportation Command. It serves as the Department of Defense single manager operating agency for military traffic, land transportation, and common user ocean terminal service.

Battalion Tactical Operations Center (BTOC): The command and control center for a battalion or battalion task force.

National Railroad Passenger Corporation (Amtrak): Federally mandated and subsidized organization which began operations on 1 May 1971. Amtrak received its authority to operate from the Rail Passenger Service Act of 1970. Amtrak was established to address the concerns associated with a deteriorating railroad passenger infrastructure of the 1960s. Amtrak allowed private railroads to shed private railroad passenger trains in exchange for an initial membership fee and the transfer of passenger equipment to government control.

Physical Plant: Those elements of a railroad which allow a train to move from its origin to its destination. It includes the trackage (rails, ties, switches, signals, etc.), the real estate the trackage is placed on, those buildings which assist in operating trains, and communications assets which facilitate train movement.

Summary

This chapter provides an overview of the importance placed on force deployment by the architects of the Force XXI Army and the significance of this study to the United States Army as a whole. It describes the problems associated with the current methods of transportation available for military force projection and explains why the military auto

train can fill a transportation niche unique to deploying units of the Army. This chapter introduces the primary question of this thesis, along with its supporting questions, and the assumptions made to begin information research. Finally, the important definitions of terms used throughout the discussion are provided to aid the reader of this thesis.

¹Brigadier General Harper, Chief of U.S. Army Transportation Corps, Training with Industry briefing with author, written notes, Fort Eustis, VA, 12 May 1998.

²David Jones, "The Joy and Thunder Days," *Trains*, June 1994, 34.

³Joseph M. Welsh, *By Streamliner New York to Florida* (Andover, NJ: Andover Junction Publications, 1994), 52.

⁴Ann Coleman, Chief, Unit Movements, Fort Drum Installation Transportation Office, telephone interview with the author, Fort Leavenworth, KS, 3 March 1999.

⁵Major John Norris, former infantry battalion staff officer and small unit instructor at the United States Army Infantry School, personnel interview with the author at Fort Leavenworth, KS, 9 March 99.

⁶Major Woodard, 82d Airborne Division Transportation Officer, e-mail to the author at Fort Leavenworth, KS, 21 January 1999.

⁷JoAnn McNally, Commercial Travel, Fort Lewis Installation Transportation Office, telephone interview with the author at Fort Leavenworth, KS, 8 March 1999.

⁸Joseph M. Welsh, 129-30.

⁹Howard Godwin, Manager, Passenger Operations, interview with author, written notes, CSX Transportation Headquarters, Jacksonville, FL, 20 May 1998.

¹⁰Bob Kaplan and Deane Mellander, Richmond, *Fredricksburg and Potomac Railroad, Linking North with South* (Silver Spring, MD: Old Line Graphics, 1990), 86, 103.

¹¹Amtrak Homepage. (www.amtrak.com). Internet. 1998.

¹²Doug Riddell, Amtrak engineer, e-mail to the author at Fort Leavenworth, KS, 23 October 1998.

¹³Amtrak National Timetable, 17 May 1998 (Washington, DC: NRPC), 35.

¹⁴Ibid.

¹⁵Kenneth J. Klassen, et al., "Efficiency and Productivity Measures for High Contact Services," *The Service Industries Journal*, London: October, 1998, 1-18.

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter is to examine both previous topic research and other source material, and explain how they assist in the formulation of the evaluation criteria contained in this thesis. The evaluation criteria help to answer the primary and supporting questions of this document. The literature review explains the reason for their selection, assigns a value to determines favorable or unfavorable outcomes to each subordinate question, and are ultimately designed to answer the primary question of this thesis.

Research Perspective

Military and railroad operations have a fundamental principle in common. Both are continuous twenty-four hour operations which require constant planning and monitoring. Each organization uses a unique collection of jargon and policies. As a result of this fact, the knowledge used while preparing this thesis was acquired through personal experiences while working with railroads and conducting military transportation planning.

The first four years of my military career were spent as an airborne infantry officer with the 82d Airborne Division. During numerous deployments away from our home station at Fort Bragg, North Carolina, I gained an appreciation of the importance of time to conduct both pre-deployment and during deployment planning. This was especially true during the division's eighteen-hour planning cycle. Between August, 1997 and July, 1998, I participated in the United States Army Training with Industry Program at CSX Transportation (CSXT). This assignment provided the background information needed to begin my research. CSX Transportation is a railroad which operates over 18,500 miles of

track in twenty states and a Canadian province. In addition to transporting the nation's freight, passenger train movements are also an integral portion of daily operations at CSX. The railroad operates sixteen daily Amtrak intercity passenger trains carrying in excess of 140,000 riders monthly¹ and over thirty commuter trains in the Washington, DC, metropolitan area.

My other qualifications for this study include an assignment as an Assistant Division Transportation Officer with the 82d Airborne Division and as a commander of a direct support maintenance company. While assigned in this capacity, I planned the deployment requirements for a brigade rotation (personnel and equipment) to both the Joint Readiness Training Center and the National Training Center. Each rotation utilized rail transportation as the primary means of deploying the brigade's organic equipment to and from each training center. As the commander of a direct support maintenance company, it was my responsibility to deploy and redeploy my assigned equipment to the National Training Center at Fort Irwin, California.

Previous Topic Research

Two primary locations to find previous research on the role railroads play in the movement of personnel and equipment are the Military Traffic Management Command and previous Masters of Military Arts studies at the Army's Command and General Staff College. The Military Traffic Management Command within the United States Transportation Command is the proponent agency in the Department of Defense for transportation and traffic management services, including railroads and worldwide single port management.² Although the Military Traffic Management Command has used the

nation's railroads for personnel movement when chartering domestic transportation, I have not found any previous studies which analyze the use of rail transportation to simultaneously move personnel and equipment in one train. The same conclusion is true with regard to the School of Advanced Military Studies and the Masters of Military Arts and Science program at the Command and General Staff College at Fort Leavenworth, Kansas. During the past ten years, a number of officers have written about the effects rail transportation may have on the United States Military, but none examined rail transportation as a conveyance to move both personnel and equipment.³

Other Resources

There are other sources of information which are relevant to this topic and act as a starting point to begin thesis research. While reviewing these topics does not directly affect the answer to the primary research question, they do provide insight into those information sources used for researching this idea. One of those sources are the hobby publications. *Trains*, published by Kalmbach Publishing, is the leading magazine on railroading from the hobbyist perspective. The publication provides feature stories, equipment roster and disposition information and analysis of railroad operating procedures by monthly columnists. Other hobbyist publications include *RailNews* and *Passenger Train Journal*, both published by Pentrex Media Group, *CTC Board*, published by Hundman Publishing and *Railfan and Railroad*, published by Carstens Publications.

Technical sources are those sources which provide specifications on the construction and physical operating characteristics of railroad equipment and railroad physical plant engineering data. This data is particularly important when discussing a

military auto train across the nation's railroad mainlines. Examples of this type of information include railroad timetables and operating rules. These documents govern train operations over certain portions of the railroad right of way and provide the train crew with the physical characteristics of the rail line they are operating on. Railroad companies are the best source of this type of data for two reasons. They use it to conduct daily operations and update it whenever there are changes to the rail line or operating rules. Railroads also prepare and distribute manuals concerning the equipment they own and operate. These manuals illustrate equipment dimensions, horsepower ratings, electrical wiring diagrams and maintenance requirements. Other sources providing technical information include Craig Anderson's *Amtrak, The National Railroad Passenger Corporation 1978-79 Annual*, *The Official Locomotive Roster and News*, and two publications concerning passenger car equipment by David Randall entitled *Railway Passenger Car Annual* and *The Official Pullman Standard Library, Vol. 7*.

United States Government publications provide an excellent insight into the strategic deployment requirements and transportation concerns of the United States military. They also provide a template for the organization structure of those units studied and setup diagrams of their unit operations centers. There has been a great deal of analysis recently on the requirements for a force projection Army. Especially in light of the recent deployments to Southwest Asia during the 1990s. The Congressional House Committee on Armed Services, Readiness Subcommittee report of 1992 explained the problems encountered while deploying by rail during the Desert Shield deployment of 1990.⁴ Additionally, the Army's Center for Lessons Learned produces documents

concerning lessons learned during strategic deployment. The most recent of these documents is the Reception, Staging, Onward Movement and Integration issue of Spring 1997.

Civilian Auto Train/Railroad Operations

The concept behind Amtrak's Auto Train provides the basis for the military auto train discussed in this document. As such, it is an important research instrument which helps develop the performance and equipment evaluation criteria discussed later in this chapter. I have reviewed research material which provides an analysis of the civilian Auto Train and railroads in general, and examines how railroads have performed in history, how the Auto Train Corporation ran its innovative train service, and how railroads operate today. There is a great deal of historical information available concerning railroads and rail transportation, ranging from the use of railroads during the Second World War to present day rail movements in support of United States based military training exercises. This information is beneficial because it provides the historical perspective for this thesis and it also provides a framework to draw from while refining my primary and subordinate questions. Two applicable sources which contribute information in this area are the June, 1994 issue of *Trains* and the book *Steel Rails to Victory* by Ron Ziel.

The June, 1994 issue of *Trains* focuses on the impact railroads had on the wartime transportation effort during 1941-1945. Through selected readings, first person experiences and factual articles, the magazine provides the reader with a salute to rail transportation during the Second World War. The article "Joy and Thunder Days," by David Jones, shows that in the past, our nations rail system have been used to transport

military equipment and military personnel. *Steel Rails to Victory* provides another view of railroads in operation during the Second World War. It chronicles the nation's effort to move men and equipment to seaports by rail with the ultimate goal of battle in order to win the war.

As stated in chapter one, the civilian Auto Train began as an idea in the Jacksonville, Florida headquarters of the Atlantic Coast Line Railroad, a predecessor of today's CSX Transportation.⁵ The *Trains* article "This highway is not on your Oil Company Map," in the December, 1974 issue details the operations of this concept when it debuted as the Auto Train Corporation. This article explains the concept of the operation from the view point of the onboard traveler. The author details the operation of the civilian Auto Train from the beginning of the trip at Lorton, Virginia to the end of its journey at the southern terminal in Sanford, Florida. Furthermore, the article outlines the service's unique equipment requirements and train handling characteristics. Railroad personnel also provide first hand experiences on the nuances of operating a 4,500 foot passenger train. Mr. Doug Riddell and Mr. Andy LeGrand, both experienced locomotive engineers, operated the civilian Auto Train during its inaugural year of 1974. They provided first hand knowledge on train handling characteristics and overall operations.⁶

Railroad operations have come under a great deal of analysis lately, especially in the wake of the recent railroad merger mania sweeping the North American continent. Much of it has been as a result of the congestion caused by the Union Pacific Railroad mergers with the Chicago and Northwestern Railway in 1995, and with the Southern Pacific Transportation Company in 1996. Railroad mergers have become the way to

increase profits while at the same time shedding redundant or unprofitable infrastructure. The Staggers Act of 1980 enabled railroads to deregulate their rates and abandon those routes which were non-productive or redundant. As a result, the industry saw an increase in merger patterns with the end result of creating larger and leaner corporations. In 1980, the Chessie System and the Family Lines created a 26,000-mile system in the Southeast, called CSX Transportation, to meet the transportation needs of its combined shippers. The Norfolk and Western Railroad and the Southern Railway combined their operations in 1982 to create a 17,500-mile system in order to counter the CSX merger in the region. During the 1990s, the same effect was happening in the western portion of the country. The Burlington Northern Railroad and the Atchison, Topeka and Santa Fe Railway merged their corporate banners to create a 30,000-mile railroad. With the advent of a 36,500-mile Union Pacific system in 1996, the western portion of the United States currently has two colossal railroad systems.⁷

The recent Union Pacific congestion problems in the southwest have been well documented, both in hobbyist/trade publications and business journals. *Trains* followed both Union Pacific mergers during the second half of the 1990s and explains the reasons for the current levels of congestion. From the business and financial perspective, an article in the 3 November 1997 issue of *Traffic World* explains the lost revenue, lost carloadings and damage to the United States economy.

Limitations and Delimitations

Due to the large amount of information available to the researcher concerning rail transportation, I have limited my review of research material to those topics which directly

affect the military auto train and the criteria established in this chapter. This ensures the presentation of a coherent argument without clouding the thesis with irrelevant facts and figures. I have used the concept of limitations and delimitations to focus my research efforts.

During this initial stage of research, it is important to discuss the limitations and delimitations of the thesis. Limitations and delimitations focus the scope of the primary and secondary research questions. This thesis has not been affected by any significant external limitations. I will, however, limit the scope of this study to the simultaneous transport of personnel and light military equipment, which includes wheeled vehicles and containerized cargo, from Army installations to combat training centers. I will not discuss simultaneous transport of personnel and heavy equipment (tanks, armored personnel carriers, recovery vehicles, etc.) due to their inherent weight restrictions and train handling characteristics. As an alternative I propose a separate unit train, one which closely following the schedule of the military auto train, to transport this equipment. I also will not discuss the impact those units which are stationed at locations other than Fort Drum, Fort Bragg, Fort Lewis or Fort Carson have on this study. The thesis will use movements from Fort Drum and Fort Bragg to the Joint Readiness Training Center and from Fort Lewis or Fort Carson to the National Training Center. Deployment and cost information gained from these combinations will determine the validity of the primary research question. This is not to say that units from other installation military auto train, but that including them is not in the scope of this study.

Performance and Equipment Criteria

I have developed two distinct groups of evaluation criteria to answer the subordinate questions of this thesis. In chapter 1, I explained why the senior leaders of the United States Army should look at the military auto train as a means of transporting soldiers and their equipment, the evaluation criteria will determine if the Army can use this concept as a means of transportation. Evaluation criteria are designed to examine two different facets of the military auto train. The first group, performance criteria, are used to compare the feasibility of the military auto train against four other transportation mode combinations. The second group of criteria, equipment criteria, are used to determine the suitability of the railroad equipment available in the civilian and military sectors.

In order to analyze transportation choices available to Army units, this thesis will review four separate modes of transportation and organize them into four different deployment choices. The transportation choices are:

1. Combination Number One: Air movement of personnel combined with the linehaul of wheeled vehicles
2. Combination Number Two: Air movement of personnel and the rail movement of wheeled vehicles
3. Combination Number Three: Bus movement of personnel and linehaul of wheeled vehicles
4. Combination Number Four: Bus movement of personnel and the rail movement of wheeled vehicles.

The military auto train and the four combined deployment choices will be evaluated using four principles called performance criteria. The performance criterion will objectively judge the feasibility of each transportation combination and the military auto train. The performance criteria are explained below.

Efficiency: *Webster's New World Dictionary* defines efficiency as "the ratio of effective work to the energy expended in producing it."⁸ Measuring efficiency is the most important aspect of performance. It answers the question "Is the concept worth the effort?" Since multiple measures can enhance an understanding of performance, I have divided the evaluation of efficiency into three separate ratios, all of which center around time and resources. These three efficiency ratios have been adopted from efficiency and performance measures outlined by Kenneth Klassen, et al., in an article discussing service efficiency. The efficiency measures described in this thesis reflect an adaptation of their comments. The first measure is time efficiency, or the average time it takes for all task force personnel and their equipment to travel between an origin and destination. The lower the time efficiency value the better the mode of transportation. Another criterion is equipment cost efficiency, or the annual cost to operate railroad equipment used to deploy soldiers and their equipment from one location to another, divided by the number of trips per year. This criterion is used when we explore the feasibility of purchasing or contracting for railroad equipment. Again, the lower the equipment cost efficiency the better the form of transportation. The third measure of suitability is transportation efficiency, or each transportation mode used during the deployment multiplied by its time efficiency. This criterion allows the separate measure of transportation efficiency for

personnel and equipment. The lower value is more optimal while a greater ratio is less beneficial to the military.⁹

Cost: Is the military auto train less expensive to operate than the other forms of transportation currently in use? The cost criterion determines the economic feasibility of the military auto train. It is measured as a straight cost to move the entire force from origin to destination installation. It is defined as the cost to transport 800 soldiers and 150 pieces of equipment, the sample size of a light infantry battalion task force. This criterion does not factor in time savings or other advantages. When all other criteria are equal, it is meant to provide a direct comparison between various modes of transportation. The lower the cost the better the mode of transportation.

In-transit Visibility And Enroute Security: These criteria are defined as a cost, because each mode of transportation evaluated can provide some form of in-transit visibility or enroute security for the cargo or equipment it transports. Both of these measures apply only to equipment and unit property such as crew served weapon systems or intermodal containers, in effect the equipment deploying units identify as sensitive cargo. The most optimum figure is zero, while the greater the cost the less beneficial the form of transportation.

Although equipment criteria are not a subset of performance criteria, they are extremely important in determining the feasibility of the military auto train as its own separate entity, and during its evaluation against other modes of transportation. If it is determined that there is no railroad equipment available to satisfy the equipment criteria, then the military auto train can not be compared against other forms of transportation

because it can not pass the equipment feasibility test. This study will examine the equipment criteria listed below.

Installations And Their Equipment Requirements: Do Army installations have sufficient space and equipment to load, store and service the military auto train? Are there enough storage tracks at combat training centers and Army installations to make this idea a valid one? If not, can the Army justify an expenditure of capital to make the military auto train a reality? A binary question which is partially connected to the size and makeup of the proposed military auto train. Obviously, the larger the train the less chance of available yard space available at Army facilities. If we use fifty-five cars as our train length (based on a light infantry battalion task force strength of 800 personnel), an installation must have at least 6,000 feet of siding space to adequately handle the proposed train. This figure is in addition to any installation siding space reserved for the Department of Defense heavy flatcar fleet prepositioned across the nation.

Motive Power: The requirements for diesel electric locomotives in support of this concept are straightforward. First, locomotives must be able to haul a train which contains between 53 to 55 cars, which has a trailing weight of approximately 5,500 tons and be able to maintain a continuous track speed of sixty miles per hour. Once these prerequisites are met, the quantitative measure for motive power is total horsepower output along with the ability to create headend electrical power. Headend power is used to supply trailing equipment with heating, lighting and air conditioning, as well as any power requirements of the dining equipment. The locomotives with the higher horsepower rating and which can create headend power are more beneficial.

Passenger Carrying Equipment: Those cars which billet soldiers must meet the guidelines established by the Federal Railroad Administration. These guidelines include retention toilet systems within each piece of rolling stock, as opposed to discharge toilets which dump refuse on the railroad right of way.

Although not a requirement of the Federal Railroad Administration, rail passenger carrying equipment must have 480-volt headend power system to be compatible with Amtrak and other United States passenger train systems.¹⁰ Unlike rail passenger travel a half century ago, when steam heat and cooling were the norm, today's passenger car heating and cooling systems are electric because they are more efficient and less labor intensive to maintain. Additionally, there are some pieces of safety equipment which should be addressed. There are sections of railroad right of way in the United States which require the use of an automatic train stop (ATS) system. Automatic Train Stop is required when passenger trains are operated in excess of seventy-nine miles per hour.¹¹ If the military auto train is to take advantage of these routes (the Burlington Northern Santa Fe trackage from Needles, California to Barstow, California and the CSX RF&P subdivision are two examples) it would require locomotives equipped with this safety feature. Both Burlington Northern Santa Fe and CSX locomotives operating on these lines are equipped with such a device. Modern railroads also use a flashing rear end of train device, commonly called a "FRED," to complete the tasks railroad personnel in the caboose used to accomplish. The "FRED" acts as a brake pipe pressure indicator, provides the engineer with train handling information via radio signals and functions as a lighted marker in times of limited visibility. Although not required under federal law for

passenger carrying trains, this device would provide an additional measure of safety for the soldiers and their equipment.

During the discussion of rail equipment, there are two issues which should be investigated. The thesis should recommend which type of equipment resource plan is more cost efficient to the military: purchase or lease of rail equipment. The question of purchase should address diesel electric locomotives, passenger cars and equipment hauling cars (flatcars, and bi-level autoracks). This recommendation should also consider equipment maintenance requirements. Which maintenance plan provides a better return on investment for the Army? Is it an Army resourced maintenance program or a program which outsources equipment maintenance to civilian contractors, such as Amtrak's heavy maintenance facility at Beech Grove, Indiana?

Unit Vehicle And Equipment Cars: There must be enough freight equipment available to operate the military auto train. At first, given the massive size of the rail car inventory in the United States, this seems like a irrelevant criterion. Still, many of these cars are in captive service, meaning they are assigned to a particular industry or market segment, and must be available to meet the needs of a valued customer. The measure then becomes how many cars are available to meet the needs of a new or emerging service like the military auto train.

Summary

This chapter addresses the available information which will be used to answer the subordinate questions of this thesis. As a whole, the information available was relevant to the thesis topic, it was recent with regard to railroad operations and United States

government publications, and was drawn from a multitude of different literary sources.

The four major sources of information were previous research related to the topic, railroad hobbyist publications, technical railroad sources and the United States Government.

Although there are a number of sources which talk about the relationship between the military and the nation's rail lines, I have not found any which discuss the movement of personnel and equipment on the same train. As a result, the thesis builds its basic research from three areas. Railroad hobbyist magazines provided data which focused on all aspects of railroading, from operations to equipment characteristics. These hobbyist magazines also provided balanced data concerning the problems associated with recent railroad mergers and data. A number of articles from *Trains* dealt with not only the advantages of these mergers, but also with the service problems associated with integrating larger and larger railroad systems across the United States. The publications within the technical category provided information which focused primarily on railroad operations and physical plant characteristics of individual railroads. United States Government publications provided data which focused on governmental reports on strategic military deployment capability and United States Army publications dealing with war fighting doctrine.

¹Amtrak, "Amtrak Ridership Update," *RailNews*, August, 1998, 24.

²Military Traffic Management Command Homepage. 1998. Internet.

³Combined Arms Research Library, Fort Leavenworth, KS. School of Advanced Military Studies and the Masters of Military Arts program thesis collection.

⁴Brigadier General Harper, Chief of United States Army Transportation Corps, Training with Industry Briefing with author, written notes, Fort Eustis, VA, 12 May 1998.

³Joseph M. Welsh, *By Streamliner New York to Florida* (Andover, NJ: Andover Junction Publications), 129-30.

⁶Andy LeGrand, Supervisor, Passenger Operations, interview with author, written notes, CSX Transportation Headquarters, Jacksonville, FL, 20 May, 1998. Doug Riddell, Amtrak engineer, e-mail to the author at Fort Leavenworth, KS, 23 October 1998.

⁷Michael W. Blaszak, "Megamergers to the Far Horizon," *Trains*, April, 1997, 36-46.

⁸Victoria Neufelt, *Webster's New World Dictionary*, 433.

⁹Kenneth J. Klassen, et al., "Efficiency and Productivity Measures for High Contact Services," *The Service Industries Journal*, London: October, 1998, 1-18.

¹⁰Amtrak, "Beech Grove Overhauls. . .," *RailNews*, February, 1999, 25.

¹¹Anonymous, "ABCs of Railroading," *Trains*, December, 1997, 93.

CHAPTER 3

RESEARCH DESIGN

This chapter outlines the process the thesis will follow to apply the performance and equipment criteria, presented in chapter 2, against the subordinate and primary research questions proposed in chapter one. Research design is just as its name implies. It is a strategy used to present research findings in a logical manner in order to arrive at a conclusion. This chapter details each step in that process, including: identifying the parameters of the thesis, defining the evaluation criteria, data collection and the analysis of this information as the answer to the research question. This conclusion, presented in chapter 5, is the answer to the primary research question and a presentation of a proposed version of the military auto train.

Methodology

In order to show a logical argument, this thesis will present its data using the case study method as described in *Robert K. Yin's Application of Case Study Research, Volume 34. Case Studies*, by definition, should specify the conditions for designing and investigating, the collection and analysis of pertinent data, and report of these findings.¹

This thesis will adapt these findings using the following process:

1. Research question definition;
2. Identify evaluation and equipment criteria;
3. Identify sample transportation modes;
4. Expertise needed to implement the solution;
5. Counter arguments;

6. Data Analysis; and

7. Conclusion.

Research Question Definition

The first step in preparing a logical thesis is to define the research question. The thesis is a hypothetical understanding of the topic, which is open to future revision. It is derived from an understanding of both theory and practice. This thesis is clarified through limitations and delimitations, it develops a strategy for data analysis, through evaluation criteria, and provides a medium for presenting the results of the evaluation.² The primary research question, can the United States Army use rail transportation as an efficient means to simultaneously transport personnel and equipment from a deploying unit's home station to the Joint Readiness Training Center or the National Training Center, is derived from a number of subordinate questions. In order to answer the primary question, this study must sequentially answer each subordinate question with regard to the criteria established in chapter two. Each subordinate question links facts and analysis with the main research question. In this way, these questions act as building blocks in the foundation of the overall thesis. Without the benefit of this sound foundation, a thesis can not adequately stand on its own merit.

Identifying Evaluation And Equipment Criteria

Once the thesis research questions have been identified and focused, the criteria for the comparison of transportation modes and equipment are established. The performance and equipment criteria, and the scope of the thesis established in the previous chapter, provide a basis from which to complete the additional steps in the research process. The

accomplishment of this step before conducting any actual research ensures objectivity when comparing modes of transportation or determining equipment feasibility.

Identifying Sample Transportation Modes

Once the evaluation criteria have been founded, the number of case studies, in this illustration transportation modes, to be evaluated are established. According to Robert Yin, a thesis using multiple case studies should follow the process of replication, which allows the investigator to predict similar results occurring to each case study.³ This thesis has selected five transportation modes, including the military auto train, for evaluation. Each selection was based on both topic relevance and criticality of the mode to the study.

To gather data on these sample transportation modes the use of primary research through personal interviews is extremely important to this study. They provide first person knowledge on the subject and, in many cases, provide a point of view which does not easily translated to written text.

Interviews are a part of a larger process known as triangulation. Triangulation is the act of obtaining information from three different sources, such as personal interviews, documents, and participant-observation, which point to the same conclusion. This allows the researcher to feel confident that the thesis findings are valid.⁴ The interviews used in this study fall into three different categories: written, personal, and telephone. Each provides its own benefits and drawbacks. In the military, training is conducted with a specific standard and goal in mind. The same idea holds true with regard to research. Information gathering is separated into specific areas of knowledge expertise. In order to understand railroad operations, civilian railroad employees and those military individuals

which had a strong working knowledge of railroad transportation were interviewed. The same rationale was used to gather research on military requirements and light infantry battalion deployment characteristics.

Expertise Needed To Implement The Solution

This area of research is divided into two subsets, military and civilian railroad expertise. As with the evaluation and equipment criteria, this research category helps to determine the answer to the primary research question. Criteria outlined in chapter 2 determine the level of expertise needed, in both the civilian and military areas, to operate the military auto train. Success is defined as a level of expertise high enough to meet the performance goals of efficiency. Research findings should indicate the requirements needed of trained civilian and military railroaders as well as the number of personnel needed to operate this train.

Counter Arguments

As the thesis is refined, potential counter arguments to my position are identified. It is important to capture the comments and counter arguments of the leaders and soldiers who will use this form of transportation, as well as the comments and concerns of those who will fund and operate it. This study will also rely on the research committee to provide critical counter arguments to my thesis position. This process seems to be prevalent throughout the research design process. This thesis expects and encourages critical comments during the process of argument preparation and will address them throughout the academic year.

Data Analysis

During the data analysis phase of the research design, the thesis uses a strategy called pattern matching. Pattern matching is the process of using two or more rival hypothesized protocols, in this case transportation mode combinations, to evaluate against identified criteria and causes the thesis process to use instruments and tools external to the investigator. As a result, the investigator will tend to rely on fieldwork and information gathering technics such as participant-observation. Ultimately, the data collected will be expressive, favors process over outcome, and becomes a rich description of the topic being evaluated.⁵

Thesis Presentation

The final stage of the process is thesis presentation. The conclusion of the research effort, which is to answer the primary research question, and future recommendations are presented in chapter 5 of the completed study. This final chapter will present an analysis of research findings against the performance and equipment criteria used to determine the feasibility of the military auto train as proposed. The analysis of the findings are presented using the case study as an evaluation tool. The case study accomplishes four objectives during the conclusion process. It captures the outcome of the analysis and provides feedback to the reader. It is separate from the study database and contains explicit presentations of the evidence used to draw the conclusions of the thesis.⁶

A proposed military auto train recommendation is presented as a “cook book.” This format allows planners to implement the military auto train as needed. Although this

step in the research process completes the written portion of this thesis, verbally defending the study, along with the viability of the presented solution, becomes the last step in the learning process.

Summary

This chapter explains the research design process used to explain and evaluate the military auto train and four other transportation mode combinations and is used to answer the subordinate and primary research questions of this thesis. It provides a review of each step in the process, from identifying the primary question of the study through thesis presentation. Once the design of the thesis has been established, then the process of information gathering can begin.

¹Robert K, Yin, *Application of Case Study Research, Volume 34*, 33.

²Ibid., 73.

³Ibid., 34.

⁴Ibid., 69.

⁵Ibid., 69-70.

⁶Ibid., 75

CHAPTER 4

FINDINGS

This chapter presents the research findings associated with the military auto train as answers to the subordinate questions of the thesis. Similar to the stone blocks of a pyramid, each question answered during thesis development must support the question above it. Thus, the keystone of any thesis is its primary research question. In this case, I answer the primary research question, can the United States Army use rail transportation as an efficient means to simultaneously transport personnel and equipment to combat training centers, by answering each of the supporting thesis questions. The same process holds true when gathering and presenting information findings. These findings are introduced first with regard to the supporting research questions and then to any unique requirements of the deploying unit or civilian railroad. Based on the answers to these questions, I will determine a proposed equipment package to meet the deploying force structure, and present this analysis in chapter 5. My solution will identify motive power and crew support requirements, and examine dimensional restrictions which affect the transit of Army equipment.

This thesis will evaluate the military auto train, and four transportation mode combinations, based on the evaluation criteria established in chapter two. The four combined transportation modes are:

1. Combination Number One: Air movement of personnel combined with the linehaul of wheeled vehicles.

2. Combination Number Two: Air movement of personnel and the rail movement of wheeled vehicles.

3. Combination Number Three: Bus movement of personnel and linehaul of wheeled vehicles.

4. Combination Number Four: Bus movement of personnel and the rail movement of wheeled vehicles.

Supporting Research Questions

Is the military auto train an efficient mode of transportation? The military auto train is an efficient mode of transportation for the following reasons. From the time soldiers and equipment board the train until they detrain at a combat training center, they are moving using one contiguous mode of transportation. The entire battalion moves en masse, and arrives at the training center at the same time. Once it is spotted at an offload ramp, equipment is immediately available for download while the Battalion Tactical Operations Center remains in operation while performing its command and control function. Depending on the number of aircraft, commercial buses, commercial linehaul trucks or independent rail transportation, soldiers and equipment might arrive at a training center over the course of many hours or even days. This can severely hurt the availability of a battalion command's combat power while planning for its initial mission. In this way, the concept of deploying personnel and equipment via rail supports one of a force projection Army's greatest mission essential tasks, Reception, Staging and Onward Integration or RSO&I.

Still, does this argument make up for the time savings using other modes of transportation? Time efficiency is critical to any plan, whether it applies to a military or civilian operation. Flying time between Fort Drum, New York, home of the 10th Mountain Division and Fort Polk, Louisiana, home of the Army's Joint Readiness Training Center, is estimated at 3 hours and 30 minutes. The proposed travel time for the military auto train covering the same distance is 29 hours (rail mileage multiplied by an average speed of 55 miles per hour and the current average speed of Amtrak's Auto Train).¹ It takes approximately 28 hours and 18 buses to transport a 800 soldier light infantry battalion task force the approximately 1,500 miles between the two locations. The transit times for rail shipments is approximately 120 hours using freight train schedules. On the highway, commercial trucks are allocated 48 hours to cover the entire route. Flying time between Fort Bragg, home to the 82d Airborne Division and Fort Polk is estimated at 4 hours and 15 minutes, while it takes the 18 buses approximately 23 hours and 30 minutes to drive the roughly 950 miles between the two installations. The military auto train would cover the same distance in 19 hours. Rail and commercial truck shipment times were 72 to 96 hours and 48 respectively.²

Between Fort Lewis, Washington, home of a brigade from the 25th Infantry Division, and the National Training Center at Fort Irwin, California, the military auto train would require 22 hours to cover the distance. Travel times for aircraft are 2 hours and 30 minutes, while it took 24 hours for commercial buses to make this 1,195 mile drive. The rail shipment times were 96-120 hours and it took an average of 72 hours for truck transportation to cover the distance between the two locations. The travel times between

Fort Carson, Colorado and Fort Irwin for charter aircraft were two hours and thirty minutes (including travel time to the airfield), while it would take 18-22 hours (depending on traffic and weather conditions) to cover the 994 miles by bus between the two locations. The military auto train requires about 19 hours to journey between the two points. Rail movement times were estimated at 48-60 hours and commercial trucks were given 48 hours to cover the distance.³

Soldiers and their leaders could capitalize on this free time by combining the actual deployment with other critical tasks during the journey. Major James Danna III, a former infantry battalion operations officer offers these suggestions. During the time it takes to travel to a training center, leaders could combine follow on mission planning or brief backs to the battalion commander with the actual deployment. Noncommissioned officers could conduct pre-combat inspection of individual equipment, brief soldiers on the upcoming mission and, in general, conduct troop leading procedures. Major Danna remarks, "There never seems to be enough time to conduct these (troop leading procedures) types of things, we always gloss over these tasks on the way to the aircraft (to deploy)." He also observed that this transportation concept could even apply to a unit such as the 82d Airborne Division, which almost always uses aircraft to deploy. "The division could use local training at Fort Bragg to maintain their airborne proficiency while using the train to increase rail loading skills and exercise those tasks required to deploy by a mode other than air." This conforms with the division's mission essential task to alert, marshal and deploy. Major Danna also pointed out another strength of this concept, deploying units arrive at a training center in one lift and at the same time. He remarked that in his

experience it was always frustrating to require a piece of equipment, critical to the first mission of the battalion, and being told it had not arrived on the installation.

The available data suggests this transportation concept is an efficient form of moving military units. Although travel times by air are considerable shorter in all route segments, deploying battalions using the military auto train could conduct a multitude of tasks congruent with travel times and arrive at a training center as one complete unit.

Is this transportation concept economically viable? A subordinate question of this thesis is determining if the military auto train is economically viable. Economical viability, simply put, is whether a transportation idea is cost beneficial to the United States Army. To determine viability, we must gather the costs to transport personnel and equipment using each mode of transportation. The economic findings are separated into two categories, those costs associated with moving personnel and equipment between their origin and destination and other costs, such as in-transit security.

The costs to move personnel and equipment were derived from a number of sources, including the Military Traffic Management Command's air and ground movement sections and the using units. During its 1999 brigade rotation from Fort Bragg, North Carolina to the Joint Readiness Training Center at Fort Polk, Louisiana, the 82d Airborne Division spent \$678,562 to move the task force using fourteen charter aircraft in both directions.⁴ As a comparison, the Military Traffic Management Command personnel movement section contracts for both civilian aircraft and commercial buses to move military personnel. In order to transport a light battalion task force of 800 personnel between Fort Bragg and Fort Polk it would require three widebody aircraft at a cost of

\$205,000 in each direction. The cost for eighteen commercial buses between the same locations is \$129,600. Again, to move the same sized force between Fort Drum and Fort Polk, the estimated charter aircraft cost for three 330 seat DC10 was \$381,000 in each direction. Eighteen contracted commercial 47 passenger buses between the same points cost an is estimated \$99,000.⁶

Cost for personnel movement from Army installations located in the western United States to the National Training Center at Fort Irwin, California are similar. Personnel movement from Fort Carson, Colorado to Fort Irwin by the same number of chartered aircraft cost an estimated \$240,000. The ground transportation costs were approximately \$66,600 for the required eighteen 47-seat commercial bus between the two route pairs. When deploying from Fort Lewis, Washington to the National Training Center, it would cost \$450,000 for three widebody aircraft and \$75,600 for eighteen commercial buses.⁶

Costs for moving personnel by military auto train would be approximately \$61 per mile. This figure is derived from typical long term lease or excursion cost estimates supplied by CSX Transportation's government sales section, the Association of American Private Railcar Owners, and the National Corridor Passenger Initiative, a not for profit rail passenger advocacy group. It is based on equipment and maintenance costs, labor costs, and operational costs such as fuel and insurance.⁷

Transporting equipment is also reviewed during this study. The figure below explains the costs associated with transporting the equipment of a light infantry battalion task force from each of the solicited Army installations by linehaul truck and rail

transportation. For this study, linehaul trailer capacity is three vehicles. The capacity of 89 foot bi-level autoracks is ten HMMWVs and four 20 foot containers for the 89 foot flatcar equivalent.

Table 1. Equipment Transportation Costs⁸

Transportation Mode	Fort Drum to JRTC	Fort Bragg to JRTC	Fort Lewis to NTC	Fort Carson to NTC
Linehaul Truck	1,673.10	1,124.20	1,227.60	1,121.25
Rail (89 foot car)	3,924.00	4,324.00	2,783.00	1,657.00

As a comparison, actual deployment costs for the 82d Airborne Division's last brigade rotation were \$1,182,481, or approximately \$388,000 per battalion.⁹ The cost to move equipment on the military auto train between city pairs in both the eastern and western portions of the country would be similar to the present rail rates. This is because private railroads, instead of the Military Traffic Management Command or Amtrak, would provide the rail cars required to move military equipment.¹⁰

Another cost associated with deploying to either of the combat training centers is in-transit security. During fiscal year 1998, the average cost for enroute security using rail transportation was \$350 per railcar (typically a 89-foot flatcar with an average cost per twenty foot piece of equipment equaling \$87.50) regardless of the traffic origin and destination.¹¹ The cost for providing security while using commercial linehaul was \$350 (or about \$116 per twenty-foot piece of equipment). Actual costs are relatively similar.

During its 99-02 rotation to Fort Polk, the 82d Airborne Division spent \$7,500 on in-transit security of sensitive items and equipment.¹² As a minimum, deploying light infantry battalions have at least fifteen pieces of equipment which require in-transit security. Obviously, using military personnel to guard sensitive shipments during transit would cost the government nothing. This idea presents its own set of drawbacks. First, these soldiers would not receive the benefit of training with the unit because they would be detached from the battalion right before the actual deployment date. Second, in many cases, these soldiers would not be bonded or licensed to guard sensitive equipment across state lines. In transit security costs for the military auto train are zero because it is provided by the onboard deploying unit. Since the equipment moves with the soldiers, a constant guard is established and maintained between a unit's home station and its destination.

The research indicates that the military auto train is economically viable, both from a transportation cost perspective and from the costs associated with in-transit visibility. Chapter 5 will analysis this concept against four transportation combinations to determine which modes of transportation are the most effective when transporting both personnel and equipment.

Resource Requirements

Can the Army adequately resource this concept from the existing commercial rail equipment resources? Equipment resource requirements are based on one important factor, the size and make up of the transported unit and its deployment and training requirements. With this fact in mind, the resource requirements should branch into two sections, military unit and military auto train requirements. The military unit requirements

are established by leaders and soldiers who will use the service. Military auto train requirements are those tools needed to transport the deploying battalion's personnel and equipment. In many cases, the military auto train requirements are directly linked with the requirements of deploying units.

Military Unit Requirements

Another supporting research question of this thesis is: Can the Army adequately resource the military auto train concept from the existing commercial rail equipment resources? The first place to look is at the deployment requirements of a light infantry battalion task force. How many soldiers and pieces of equipment determine a deploying force? What are the essential planning needs of the battalion staff and coordinating agencies, such as Military Traffic Management Command, when conducting a unit deployment? These questions focus on two aspects of the deployment process, the procedure of establishing command and control during a unit's movement and the actual act of deploying. The sources reviewed provide data on the requirements and experiences of deployable units. The bulk of the information in these categories deals with Army strategic deployment policies, battalion task force manning requirements and Military Traffic Management Command planning guidance.

What is the physical make up of a light infantry battalion task force? The requirements of the deploying unit determine the size and scope of the transportation mode selected to transport it. Since this study exams the ways of transporting the soldiers, and their equipment, of a light battalion-sized task force, we must look at both

the personnel and equipment strengths which make up this unit. The personnel strength of a typical light infantry battalion is as follows:

35 Officers (including warrant officers)

25 Noncommissioned Officers (E7 and above)

500 Enlisted soldiers.¹³

Using an additional reference from which to draw on, the same type of infantry battalion from the 82d Airborne Division numbers 704 soldiers. This unit has a larger complement of officers, noncommissioned officers and enlisted soldiers.¹⁴ Based on historical figures from the National Training Center and the Joint Readiness Training Center rotations during fiscal year 1998, an average of 800 soldiers and between 130-160 pieces of equipment were needed whenever one of these two types of battalions deployed as an infantry task force.

A unique feature of the military auto train is the mobile Battalion Operations Center. This rolling command center provides the benefit of en-route planning for those battalions deploying to either of the two combat training centers. Although there is no specific doctrine explaining the setup of a battalion Tactical Operations Center, Field Manual 63-2-1, *Division Support Command*, gives a basic framework of a design. Still, many Army units use their own experiences to establish Standard Operating Procedures for the setup of Tactical Operation Centers. For example, The 75th Ranger Regiment Planning Standard Operating Procedures manual describes a way of establishing a Tactical Operations Center at the regimental level. The Regimental Logistics Standard Operating

Procedures establishes many of the same procedures, albeit for an Administrative and Logistics Operation Center.¹⁴

The basic framework of a tactical operations center contains the Administrative and Logistics section, which houses the battalion adjutant (S-1), the battalion logistics officer (S-4), an administrative area and assistants and planners within these two sections. The tactical operations center also contains an operations section, which has the battalion operations officer (S-3), the battalion intelligence officer (S-2) and the staff planners which are part of this section. A battalion planning area must also include an area to brief subordinate leaders, a planning area for the commander or executive officer and an location containing the communication equipment for the battalion to remain in contact with national intelligence assets or home station.

What are the planning needs of the battalion staff and its home station installation during the deployment cycle? Essentially, they are the tasks which have to be accomplished to move a unit from origin to destination. Army Field Manual 101-5, *Staff Organization and Operations*, provides guidance for the staff planning process and the Military Decision Making Process. The Army's Field Manual 71-2, *The Light Infantry Battalion Task Force*, provides information on the characteristics of a battalion task force, equipment requirements and employment criteria. Both of these manuals provide an insight into the requirements of a deploying unit. More important are the comments of those leaders who will have to use this form of transportation. Major John Norris, a former mechanized infantry battalion staff officer and instructor at the United States Infantry School at Fort Benning, Georgia states, "There are several distinct advantages

that stand out clearly with your COA (course of action), improved security for unit equipment, faster deployment timeline, and more cost effective unit deployment. An additional selling point with your COA is the opportunity for the unit to continue the planning process while deploying to a training or real world requirement.”¹⁵

Strategic Deployment has become an integral part of the United States Army as it transitions from a forward deployed force to one relying on force projection capabilities. There have been a number of studies concerning force deployment, including The Mobility Requirements Study Bottom-Up Review.¹⁶ Additionally, the Army has written a Field Manual 100-17 entitled *Mobilization, Deployment, Redeployment and Demobilization* specifically to address this important issue.

Military Auto Train Requirements

Once the requirements of the user and supporting installation have been identified, the next step in the process is to determine the resource requirements of the military auto train. Initial research focus centers on the logistic questions associated with the military auto train and the structures which support it. This data is separated into three categories, equipment, motive power and operational support requirements.

Equipment

A primary concern of this study is the availability of an existing pool of passenger carrying railroad equipment from which to draw. Can the military auto train draw its equipment from Amtrak? Most of the equipment in this pool, built during the post World War Two years, was purchased from private railroads by Amtrak and the civilian Auto Train in 1971. It is interesting to note that it was the United States Army which gave

Amtrak excess passenger equipment during the fledgling years of the new corporation. When Amtrak was faced with a shortage of crew dormitories, The military provided the solution. Surplus Army hospital, ambulance and kitchen cars were given to the new company at no cost. The cars, built between 1952 and 1954, were stored at Army installations in Arizona and California and were used sparingly during the years since they were built. Amtrak's Beech Grove shops rebuilt, refitted and repainted the cars and they were immediately pressed into service.¹⁷

There are a number of sources which provide detailed information regarding this passenger car fleet. This data traces the equipment's historical ownership and provides manufacture's technical information such as original construction specifications, condition and location of passenger equipment, and in many cases the disposition status of many of these cars. By combining this information, the history of each passenger car in the Amtrak inventory can be documented, including current seating configurations and rebuilding history. The publications which provide the greatest amount of information in this area are *The Official Pullman Standard Library, Volume 7*, the *Railway Passenger Car Annual, Volume I*, the *Amtrak, The National Railroad Passenger Corporation 1978-79 Annual* and Amtrak's own equipment directory from 1996.

Another source of equipment is new passenger cars, but research show this is not a viable option. With the exception of Amtrak and metropolitan commuter agencies, there has not been a new railroad passenger car purchase in the United States since 1969.¹⁸ Because of this fact, there is not a large body of excess passenger equipment existing in the private railroad sector today.

The Railroad Passenger Service Act, commonly referred to as Railpax, authorized the funding and creation of a semi-government Amtrak in 1970. It was created by the United States Government to help off-set the spiraling costs of the national passenger train system. This act allowed the nation's private railroads to shed their unprofitable passenger trains, and concentrate on the more lucrative freight business. As a result of this fact, Amtrak received the funding required to acquire a fleet of rolling stock from the private railroads.¹⁹ One of Amtrak's equipment prerequisites was stainless steel body and underframe construction whenever possible. Stainless steel construction was preferred by the corporation, because it was rust free, easy to maintain and had a shiny appearance.²⁰ Amtrak's consulting groups made an exhausting survey of the existing equipment pool to find the best cars in the private fleet. From 3000 of the best cars, Amtrak purchased 1190 passenger cars, of which 741 were stainless steel and 331 stainless steel sheathing. These cars cost \$16.8 million, or \$14,000 per car.²¹ Many of these cars were retired during the early 1980s when new equipment, such as the Superliners and Amfleet II long distance coaches, took their daily assignments. The remainder of these stainless steel cars were rebuilt from steam heat and self contained air conditioning to headend power specifications between 1979 and 1982 and dubbed the 'Heritage' fleet.²² Although it looked like it had a monopoly on the equipment pool in 1971, Amtrak was not the only rail carrier in the market for passenger equipment.

During 1971, both Amtrak and the civilian Auto Train Corporation were drawing from the same pool of equipment to begin their respective passenger train services. The civilian Auto Train was a private corporation which purchased its cars using \$7 million

raised from the sale of 700,000 shares of common stock. Due to the age of this equipment and its low resale value (these two companies were the only agencies operating railroad intercity passenger service at the time), the Auto Train's passenger cars had to be purchased outright, without financing.²³ Many of these cars were re-purchased by Amtrak when the Auto Train Corporation went bankrupt in 1983.

Owning and managing rail equipment should not be new to the United States Army. Between World War Two and the Korean War, the Army had an expansive fleet of rolling stock used for troop movements. Many of these cars were subsequently rebuilt and found their way on to the rosters of civilian railroads and Amtrak during the 1960s and 1970s.²⁴ The Army still manages 1,599 heavy duty flatcars which are strategically placed across the nation. These cars are used to transport the M1 series main battle tank, the Bradley fighting vehicle and other pieces of military equipment in the event they require rail loading.²⁵

Using an average of 800 soldiers, 150 vehicles, and 30 containers for a typical light infantry battalion task force, the military auto train would require the following types of passenger equipment. A description of the configuration and size of each passenger car is contained in chapter 5.

1. 16 coaches. (48 seats per coach with a latrine on each end of the car) to transport and billet the enlisted personnel. (705 below the grade of E7)
2. 2 sleepers. (including various sleeping room configurations) to transport and billet the officers and senior noncommissioned officers within the battalion. One sleeper

car configured with double bedrooms would billet company commanders, battalion staff, field grade officers, the battalion sergeant major and the battalion commander.

3. 2 lounge cars. Due to the nature of the trip and the length of the journey, one lounge car per 400 soldiers is required.

4. 2 diner/kitchen cars. To feed the entire battalion in route and at certain times during the deployment two diners or kitchen cars are required.

5. 1 power car. Used as a prime source of headend power for a 20-25 car passenger train. This power car is required to augment the headend power provided by the diesel locomotives.

There are no passenger cars designed to function as a battalion tactical operations center, but there are cars which can be modified to fit the battalion planning requirements. Amtrak has modified a number of passenger cars to suit the needs of the corporation. In the past, it has modified excess sleeper cars from revenue producing sleeping berths into crew dormitory sleepers to meet the needs of its crew.²⁶ This same concept could be used to refit excess passenger car bodies into a mobile Battalion Tactical Operations Center.

The average battalion-sized task force deploys with 150 wheeled vehicles of multiple types. In addition, there are approximately thirty containers (twenty-foot equivalents) of equipment per battalion task force. Based on dimensions supplied by the Military Traffic Management Command's Transportation Engineering Agency, a 89-foot fully enclosed bi-level autorack can transport ten HMMWVs. For this study, unless otherwise noted, wheeled vehicle length will be approximated at twenty feet and containers will be approximated as twenty foot equivalents. Army Ambulances are too tall

to be transported in bi-level autoracks and must be transported using 89-foot flatcars. Five-ton trucks and large tactical trailers will all be transported using flatcars. Again, full dimensions and freight car characteristics are included in chapter 5. To move an entire battalion's compliment of vehicles and containers would require a total number of ten bieval autoracks, eight 89-foot flatcars to transport containers and twelve additional flatcars to transport outsized cargo.

One caboose is required to act as a rolling guard post for continuous surveillance of the battalion's sensitive items containers or equipment. Each caboose is climate controlled, restroom equipped and in contact with the Battalion Tactical Operations Center by radio.

From the research gathered, there seems to be enough surplus passenger carrying equipment available to field at least one military auto train trainset. Amtrak has approximately 105 cars available which are not in daily revenue service stored across the United States. They include Heritage Fleet equipment and at least thirty five bi-level cars originally built for the Santa Fe Railway's *El Capitan* Chicago to Los Angeles train in 1957.²⁷ It is important to note, however, that Amtrak is also using existing surplus baggage cars to augment its present baggage carrying capacity on certain long distance trains, especially in the Northeastern United States. This rebuilding program may have an effect on the availability of excess equipment as time goes on.

The military auto train should use civilian railroad freight cars to transport military equipment. The reason is twofold. First, Amtrak does not have enough fully enclosed

auto carriers to lend for military applications. These auto carriers are former Canadian National Railway cars equipped with passenger car wheelsets from old Railway Express Agency cars. Special dampening devices and shock absorbers on the cars help to control the ride and avoid excessive sidesway or bouncing that may damage the automobiles inside.²⁸ Second, there is a larger supply of various types of cars to choose from in the civilian inventory which makes car availability greater.

In-transit Support

As the military auto train conducts operations there will be occasions when things do not always go as planned. How will services be performed in route or how will repairs be made in the event equipment failure? All passenger train require some form of servicing during the length of its trip. Passenger cars require fresh water, and the discharge of brown water, locomotives require fuel and commissary supplies need to be restocked. The civilian Auto Train made Florence, South Carolina a major servicing point in 1971. Both Amtrak and the former Auto Train Corporation relied on this facility to conduct a 500 mile in-route train inspection, refuel diesel locomotives and water the passenger cars.²⁹ On east coast routes (Fort Drum or Fort Bragg to Fort Polk) and west coast routes (Fort Lewis or Fort Carson to Fort Irwin) the same type of servicing locations are required. The eastern routes have several commercial railroad facilities which could be used to support the military Auto Train. CSX Transportation operates a large classification yard and diesel servicing facility at Hamlet, North Carolina, Waycross, Georgia and Atlanta, Georgia. These locations are capable of in-transit repairs or servicing to the train. The Conrail (soon to be CSX property) provides many of the same

services at their yard in East Syracuse, New York.³⁰ Closer to Fort Polk, the Kansas City Southern Railway has a large yard at Shreveport, Louisiana which can conduct engine refueling, repairs to freight cars and locomotives and general repairs to passenger equipment.³¹ On the west coast the same levels of service can be conducted at Barstow, California, Denver, Colorado or Seattle, Washington. The Burlington Northern Santa Fe Railroad maintains extensive shop facilities, including refueling racks, at each of these locations.³² In all cases, the military auto train would be regarded as just another train on a railroad system and should not impact the daily operations of any railroad it travels.

As this train continues to operate in regular service, much of the equipment will require heavy maintenance. The United States Army can use one of two solutions to maintain this equipment. It could continue to base the equipment at Amtrak's Beech Grove maintenance facility, using Amtrak personnel to refit and repair the military auto train equipment. Or the Army could outsource the maintenance requirements to a number of independent contractors. CSX Transportation operates an extensive locomotive backshop at two locations, Waycross, Georgia and Huntington, West Virginia, and a car rebuilding facility at Russell, Kentucky. Also on the east coast, the Conrail (soon to be Norfolk Southern property) maintains a locomotive heavy maintenance facility at Altoona, Pennsylvania. Additionally, there are maintenance facilities at Livingston, Montana, operated by Livingston Rebuild Center, which rebuilt locomotives and equipment on a regular basis.³³

Motive Power

The military auto train requires diesel locomotives for motive power. There have been quite a number of diesel electric locomotives specifically built for railroad passenger operations and many for the dual purpose of moving both freight and passengers. Some of the first diesel electric engines, built by the Electro-Motive Division of General Motors in 1937, were for passenger trains. The criteria for motive power states that locomotives must be able to haul a train which is between 53 to 55 cars in length and a trailing weight of approximately 5,500 tons at a continuous speed of sixty mph. In addition, it is preferable for each locomotive to be able to generate some amount of headend power to light and climate control the trailing passenger equipment.

Amtrak's own database is the best source of information for passenger locomotives which are still in service. There are also a number of other sources which discuss railroad motive power, both from the historical and technical point of view. Both of these categories provide an analysis of the type, horsepower rating and number of locomotives required to power a train of this size. Amtrak's 1996 corporate equipment data base, and *Trains* articles from February, 1996 and June, 1998, provide locomotive technical specifications, remanufacture information and the current disposition of motive power used to power Amtrak intercity passenger trains.

Other information sources provide a historical perspective on motive power requirements. The December, 1974 issue of *Trains* provides motive power information for the original auto train Corporation. The original version of the auto train required two 3,600 horsepower locomotives, totaling 7,200 horsepower, while maintaining a top speed

of seventy nine miles per hour. During the 856 miles of travel, the overall average speed for the train was sixty miles per hour. The General Electric U36B locomotives utilized by the private company did not produce headend electrical power because the trailing passenger cars were heated using steam generation. Air conditioning was provided by self contained, pulley operated air conditioning units mounted underneath each passenger car.³⁴

Trains also documents the motive power requirements of the current Amtrak version of the Auto Train, from its reemergence in 1983 until the present. The September, 1993 issue details the genesis in the changes to this service and also contains information on the changes in locomotive technology and horsepower ratings. During 1993, Amtrak's version of the Auto Train was powered by three Electro Motive Division F40PH locomotives which generate 3,000 horsepower each. This total of 9,000 horsepower was capable of handling the 45 to 50 cars associated with a train of this size.³⁵ Only one F40PH in a locomotive set can provide headend power at a time, which reduces the available tractive effort horsepower to 2,290 horsepower for that locomotive.³⁶

Again, interviews with former railroad engineers which operated the Auto Train Corporation's trains act as credible sources of information. These interviews provided critical first hand knowledge of the performance characteristics of locomotives assigned to previous Auto Trains and a look at the motive power for the 1997-1998 version. On 1 December 1997, I had the opportunity to ride the northbound (Sanford, Florida to Lorton, Virginia) Amtrak Auto Train with Mr. Harold Godwin, Manager of CSX Transportation Passenger Operations as he conducted an inspection of train operations on the tenant CSX

trackage. Powering the fifty-car train were two General Electric 4,200 horsepower locomotives, designated AMD-103s. The ride was smooth, evenly powered and on schedule as far as Florence, South Carolina. This train arrived at the Lorton, Virginia depot twenty minutes behind the advertised schedule not because it was under powered, but due to route congestion on the CSX mainline.³⁷

Based on details provided by Mr. Godwin, the most reliable locomotives currently used in passenger service on North American railroads are the Electro-Motive Division products equipped with the type 645E3, 16 cylinder diesel engines.³⁸ This power plan has been used in a number of different models to date including four and six axle units (those diesel electric engines with four or six electric traction motors--one per axle). Amtrak purchased this type of power plant, in the new F40PH model, beginning with thirty locomotives in 1976. These locomotives, and an additional 186 similar units made up the backbone of Amtrak's motive power roster from the mid-1970's until 1993. During fiscal year 1993, the corporation began to take delivery of new General Electric diesel electric locomotives to replace the fleet of F40PHs. These new units, and subsequent orders in 1995-1997, rendered the older but still reliable F40PHs excess.³⁹ Amtrak currently has seventy three of these F40PH diesel locomotives in storage (operational, but not in daily operational status) and thirty-three on lease, or available for use by freight railroads, for a total of 106 units.⁴⁰

Bureaucracy

How will government or civilian bureaucracy affect the success of this transportation idea? This criterion is subjective in nature and reflects the mood and

response of those associated with military transportation at the Military Traffic Management Command, tactical units at various Army installations and civilian railroad personnel expected to operate such a train. Clearly a subjective measure, but crucial to the overall success of the idea of the project.

Webster's New World Dictionary defines bureaucracy as "the administration of government through departments and subdivisions managed by sets of appointed officials following an inflexible routine." While conducting my research findings I observed bureaucracy in both the civilian and military sectors, albeit at different levels. The civilian sector includes private railroads and, for this study, the quasi-government National Railroad Passenger Corporation (Amtrak). Throughout the research process, those personnel in the civilian railroad industry seemed genuinely helpful in providing information, facts and analysis of the military auto train concept. My personal observations indicate this behavior is due to the underlining potential of making a profit on potential new business. Although railroads do not have unlimited capacity to haul additional tonnage, they are always looking for ways to increase their profit margin.

Unfortunately, I did not receive the same level of cooperation from managers at the National Railroad Passenger Corporation (Amtrak). As I made phone interviews with equipment managers, government sale representatives and corporate communications personnel, I received a feeling of stonewalling and suspicion. The overall consensus was that I was trying to begin a service which would never succeed or might take away from a project which was already in operation. This may affect the procurement or long-term lease of equipment from the corporation. Congress has legislated that Amtrak must be

self-sustaining by the year 2002. The military Auto Train seems to be one way to put excess passenger equipment back to work earning revenue for Amtrak.

When the term bureaucracy is used, more often than not, it is used to describe the United States Government. My research reflects a potential change to this paradigm. Branch chiefs and managers at the Military Traffic Management Command were extremely helpful in providing information geared to this study. As I conducted "cold" telephone interviews with these government officials I had my questions answered and, in many cases, electronic mail documents sent to me by the end of the business day. As a matter of fact, the personnel and equipment movement sections of the command provided me with additional resources from which to draw information. These sources, most notably the Military Traffic Management Command's Transportation Engineering Agency, provided data on all Army installations upgraded using Army Strategic Mobility Plan. This information is presented in the installation requirements section of this chapter.

With the many daily projects occurring in every unit within the Army, I was prepared to follow a long trail to obtain cost information on unit deployments. My presumption was that my requests would fall on indifferent ears. Again, my initial assumption was wrong. The Fort Polk Emergency Operations Center, Current Operations section provided information on unit deployment strengths within three hours of my initial call. The Division Transportation Officer at the 82d Airborne Division provided written cost figures on the past two division training center rotations within one week of my initial contact. My inquiries were also well received by the Installation Transportation Officers at Fort Drum, New York, Fort Carson and Fort Irwin, California.

Army Installations

Will the condition and capacity of railheads at United States Army installations and combat training centers be a factor in determining the feasibility of this study? The Mobility Requirements Study Bottom-Up Review Update provides a large amount of relevant information concerning the capacity and characteristics of major Army installations in the continental United States. This report outlines the deployment criteria for the United States Army and advises on reconstruction of the rail infrastructure at those Army installations identified as force projection platforms. It also contains engineering data on those installations that contain deployable Forces Command units.⁴¹ This military auto train study focuses on six installations located on both sides of the United States. On the east coast, Fort Drum, Fort Bragg and Fort Polk are included in the study. On the west coast, the thesis will examine the facilities at Fort Lewis, Fort Carson and Fort Irwin.

Fort Drum, New York is the home installation of the 10th Mountain Division. The Army Strategic Mobility Plan has identified Fort Drum as a power projection platform and therefore, has mandated that the installation upgrade and maintain its critical deployment ports. As the proponent within the Department of Defense for deployment platforms, the Military Traffic Management Command Transportation Engineering Agency maintains data on this installation as well as the other installations in this study. Fort Drum has received over \$877,000 since 1995 to upgrade its deployment capabilities, of which \$667,000 was spent on rail infrastructure upgrades. Fort Drum also has a yard holding capacity of 140 50 foot railcar equivalents or approximately 8,400 feet. Additionally, the rail facility has received infrastructure upgrades of outdoor lighting, new loading ramps

and snow removal equipment. The installation is served by the Consolidated Rail Corporation until Spring of 1999, when ownership will shift to CSX Transportation.⁴²

Fort Bragg, North Carolina is home to the 82d Airborne Division. Obviously it is an airborne power projection platform (Pope Air Force Base is adjacent to the post) due to the nature of the division's mission, but it is also a projection platform for ground deployment. Fort Bragg has a yard holding capacity of 150 50-foot railcar equivalents which is approximately 13,500 feet. Additionally, the rail facility has received infrastructure upgrades of outdoor lighting, new loading ramps and reconditioned yard tracks since 1990⁴³ Fort Bragg has its own railroad, The Cape Fear Valley Railroad, which conducts switching duties on the installation. The Cape Fear Valley connects with the CSX Transportation at A & Y interlocking in downtown Fayetteville, North Carolina. This is important because the Cape Fear Valley can only move twenty cars at a time due to tight switching clearances along the right of way, and requires the railroad to make double moves when constructing trains which are greater than twenty cars. There are additional loading facilities located at CSX's Milan Yard, which is approximately twelve miles from the post, if required.⁴⁴

On the west coast, Fort Lewis, Washington is the home of the United States Army I Corps and one infantry brigade of the 25th Infantry Division, among other units. Fort Lewis is situated along a Burlington Northern Santa Fe Railroad branchline. Its existing rail facilities can accommodate 187 89-foot railcar equivalents or 18,513 feet of available storage space. The installation is scheduled to receive over \$3.4 million in rail facilities upgrades beginning in fiscal year 2002. These upgrades include outdoor lighting to

improve night loading operations and major yard rebuilding to reduce the number of railcar switching movements to create a more efficient outload process. At Fort Carson, Colorado the Army has allocated \$22 million for deployment upgrades, including rail facilities, to begin this year. These upgrades will help to rebuild the installation's rail yard into a 15,383 feet facility capable of storing approximately 256 railcars. Fort Carson also is a storage location for thirty-six heavy flatcars from the Department of Defense fleet. Both the Union Pacific and Burlington Northern Santa Fe Railroads service the installation.⁴⁵ The research suggests that there is a more than adequate rail yard capacity at each of the four Army installations sampled to store, service and load a train the size of the military auto train. In addition, each installation has an adequate number of loading platforms and outdoor lighting to conduct a twenty-four hour loading operation.

Combat Training Centers

Fort Polk, Louisiana is the home of the Joint Readiness Training Center. There are two potential rail load/unload facilities within one hour of the main post. The first is located on Fort Polk and serviced by the Kansas City Southern Railroad, and the other is located at England Airpark in Alexandria, Louisiana and served by the Union Pacific railroad. There has been a large amount of investment in the rail capacities of the Fort Polk facility. A total of \$1.7 million has been invested in the upgrade of the facilities at Fort Polk which rebuilt 3,500 feet of track, and installed additional outdoor lighting. The yard facilities at Fort Polk can store approximately 200 railcars at any given time. There are between ten to fifteen sixty-eight foot heavy duty flatcars stored here as well.⁴⁶ The Alexandria facility is located adjacent to the Intermediate Staging Base used by the Joint

Readiness Training Center's Operations Group. Units usually conduct last minute combat preparation and mission planning at this staging base before entering the training areas to begin the exercise. This track is little more than a one-track spur and is approximately one mile in length. In its current configuration, it can only handle one string of rail cars and circus style loading and unloading on the stub end.⁴⁷

The last installation studied is Fort Irwin, California. Fort Irwin is a unique Army installation in that it does not have any direct railroad facilities. All rail shipments to Fort Irwin are offloaded at either the Union Pacific facility at Yermo, California or the Burlington Northern Santa Fe classification yard at Barstow, California and transloaded on to commercial trucks or driven the 38 miles to the main post.⁴⁸ Both commercial rail facilities have over 20,000 feet of storage tracks and routinely handle freight trains of over 7,000 feet on a daily basis. Additionally, Barstow is one of two major locomotive rebuilding facilities on the former Santa Fe Railway (the other is Topeka , Kansas) and also has an extensive freight car repair and rebuild facility. Again, each combat training center rail load facility has more than enough yard capacity to store and load a 5,500-foot military auto train. To answer the subordinate research question of this study, there is enough capacity at all six installations studied to support this thesis.

What level of civilian and military expertise is needed to implement this service? The answer to this question is not designed to determine if the nation's rail lines have the work force skilled enough to operate trains or if military leadership has experience in train scheduling, but can they handle the work load of a military auto train in conjunction with their current daily operations. Railroad companies operate scores of trains everyday,

transporting different commodities on different schedules, but can they operate another train in conjunction with their other daily operations? The military auto train is appealing because it can move personnel and equipment in a timely manner. Have railroads shown they can accomplish this?

In commercial railroading, capacity equals money. Too much capacity during low traffic levels and revenues are lost paying extra property taxes and maintenance costs on little used track. Not enough capacity during periods of high traffic levels and railroads lose business and potential income. The latter situation affected railroads across the country during 1997 and 1998. As the Union Pacific tried to assimilate the properties of the Southern Pacific Transportation Company, while quickly abandoning or selling redundant lines as a result of the merger, it found itself with diminished capacity and congested mainlines. This problem had a rippling effect on the Union Pacific. "Problems spread like a virus, and operation on UP coagulated at selected points from Illinois to Oregon." Union Pacific's service delivery index, used to gauge shipper to receiver delivery times fell from 80.6 percent in June, 1997 to 65.4 percent on Union Pacific property and 34.8 percent on the former Southern Pacific properties, in July.⁴⁹ Even passenger operations were not immune from the problems associated with this merger. During this time period, Amtrak's *Texas Eagle* was rerouted east of San Antonio, Texas bypassing important stops at Austin and Fort Worth.⁵⁰ This situation would get worse before it got better. As traffic patterns shifted and transit times increased, the railroad's bottom line suffered. Union Pacific experienced a fourth quarter operating loss of \$152

million, while economists said the loss to the United States economy was a staggering \$2 billion.⁵¹

Clearly, this situation is not beneficial to time sensitive commodities ,especially passengers. Still, this downward trend seems to have begun a reversal. As of August, 1998, service levels on the Union Pacific began a long awaited improvement. In his article in the November, 1998 issue of Trains, Fred Frailey explains that the Union Pacific is spending large amounts of capital to increase capacity and bring the railroad's service levels up to where they were before the Southern Pacific merger in 1995. The railroad plans to spend \$2.4 billion in 1998, much of which will be spent on these capacity upgrades.⁵²

Does the military possess a level of experience to transport personnel and equipment on a reoccurring basis? The question is not asked so much to determine physically operating the service, but if it can schedule and resource such a concept. The Military Traffic Management Command has various departments which handle each mode of transportation. The rail movements section is more than qualified to schedule and track the military Auto Train. It oversees the nationwide Department of Defense heavy flatcar fleet and schedules over a dozen rail movements on a yearly basis.⁵³

Summary

This chapter answers the subordinate questions of this research thesis. In general, there is enough rail passenger equipment available to operate this concept. In addition, the Army installations surveyed can accommodate such a service. The economic and efficiency data presented above will be used in the next chapter to determine if the United

States Army can use rail transportation to move soldiers and their equipment simultaneously from home stations to combat training centers in the United States.

¹Amtrak. *National Timetable, May 17, 1998*. (Washington, D.C: NRPC, 1998), 35.

²Barbara Sutton, Personnel Movements, Fort Bragg Installation Transportation Office, telephone interview with the author at Fort Leavenworth, KS, 3 March 1999.

³Thomas R. Wright, Fort Carson Installation Transportation Officer, e-mail to author at Fort Leavenworth, KS, 19 February 1999.

⁴Major James Woodard, 82d Airborne Division Transportation Officer, e-mail to author at Fort Leavenworth, KS, 23 January 1999.

⁶Linda Hardaway, Military Traffic Management Command Surface Transportation Section, e-mail to author at Fort Leavenworth, KS, 20 January 1999.

⁷Don Childers, Market Manager, Government Sales and Marketing, CSX Transportation, telephone interview with the author at Fort Leavenworth, KS, 15 March 99. Eric Levin, Assistant Train Manager, Association Of American Private Railcar Owners, telephone interview with the author at Fort Leavenworth, KS, 16 March 1999. James Repass, National Corridor Passenger Initiative, telephone interview with the author at Fort Leavenworth, KS, 12 March 1999.

⁸Linda Hardaway, Military Traffic Management Command Surface Transportation Section, e-mail to author at Fort Leavenworth, KS, 28 October 1998 and 20 January 1999.

⁹Major James Woodard, 82d Airborne Division Transportation Officer, e-mail to author at Fort Leavenworth, KS, 23 January 1999.

¹⁰Linda Hardaway, Military Traffic Management Command Surface Transportation Section, e-mail to author at Fort Leavenworth, KS, 20 January 1999

¹¹Linda Hardaway, Military Traffic Management Command Surface Transportation Section, e-mail to author at Fort Leavenworth, KS, 28 October 1998.

¹²Major James Woodard, 82d Airborne Division Transportation Officer, e-mail to author at Fort Leavenworth, KS, 23 January 1999.

¹³ *Commanders' TOE Handbook, Infantry Battalion (Light)*, (Washington: HQDA, 1990), 15-17.

¹⁴ *Commanders' TOE Handbook, Airborne Division*, (Washington: HQDA, 1992), 226-232.

¹⁴ *75th Ranger Regiment Logistics Standard Operating Procedures*, (Fort Benning, GA: 75th Ranger Regiment, June, 1997), 1-9.

¹⁵ Major John Norris, former infantry battalion staff officer and small unit instructor at the United States Army Infantry School, personnel interview with the author at Fort Leavenworth, KS, 9 March 1999.

¹⁶ Brigadier General Gilbert S. Harper, Training With Industry Interview, 12 May 1998.

¹⁷ Craig T. Anderson, *Amtrak, The National Railroad Passenger Corporation 1978-79 Annual*. (San Francisco: Railroad Transportation Archives, 1978), 99-101.

¹⁸ W. David Randall, *Railway Passenger Car Annual, Volume 1, 1973-74*, (Park Forest, IL: Railway Production Classics, 1974), 90.

¹⁹ Joseph M. Welsh, *By Streamliner New York to Florida*. (Andover, NJ: Andover Junction Publications, 1994), 141.

²⁰ Bob Johnston, "Hail to Amtrak's Heritage," *Trains*, (February, 1994), 59.

²¹ Don Phillips, "For Amtrak, 1190 Cars. . .," *Trains*, (December, 1971), 16-17.

²² Bob Johnston, "Hail to Amtrak's Heritage," *Trains*, (February, 1994), 59.

²³ Jim Hediger, "This Highway is Not on Your Oil Company Map," *Model Railroader*, (December, 1971), 31.

²⁴ Craig T. Anderson, *Amtrak, The National Railroad Passenger Corporation 1978-79 Annual*. (San Francisco: Railroad Transportation Archives, 1978), 99-100.

²⁵ Steven Godwin, Mechanical Engineer, Military Traffic Management Command Transportation Engineering Agency, e-mail to author at Fort Leavenworth, KS, 16 February 1999.

²⁶ Mark Sublette, photo with caption, *Trains*, (September, 1995), 32.

²⁷ Mike Schafer and Joe Welsh, *Classic American Streamliners*. (Andover, NJ: Andover Publications, 1997), 54-55.

²⁸Jim Hediger, "This Highway is Not on Your Oil Company Map," *Model Railroader*, (December, 1971), 26.

²⁹Ibid.

³⁰Rod R. Betts, Conrail Director of Train Operations, Personal Interview with the author, Philadelphia, Pennsylvania, 17 March 1998.

³¹Internet. Kansas City Southern Industries, www.kcsi.com

³²Atchison, Topeka and Santa Fe Railway. *System Timetable Number One*, May 1, 1996. (Schomberg, IL: ATSF), 1996.

³³David Lustig, photo with caption, *Trains*, (February, 1999), 32.

³⁴Jim Hediger, "This Highway is Not on Your Oil Company Map," *Model Railroader*, (December, 1971), 24-26.

³⁵Bob Johnston, "Genesis: Amtrak's New Breed," *Trains*, (September), 1993, 41.

³⁶Louis A. Marre, *The Contemporary Diesel Spotter's Guide*, Milwaukee, WI: Kalmbach, 1995, 90-91.

³⁷Howard Godwin, Personal interview aboard the Amtrak Auto Train with author. 1 December 1997.

³⁸Howard Godwin, Personal interview with the author, Jacksonville, FL, 20 May 1998.

³⁹James W. Carr, *The Official Locomotive Roster and News*. Champlain, NY: DPA-LTA Enterprises Incorporated, 1996.

⁴⁰Scott A. Hartley, "Going, Going, But Not Gone," *Trains*, (January, 1999), 36.

⁴¹Kenneth R. Littlejohn, "USAR Force Projection Rock Drill," *Transportation Corps Professional Bulletin*, Winter 1997, 9.

⁴²Rod R. Betts, Conrail Director of Train Operations, Personal Interview with the author, Philadelphia, PA, 17 March 1998.

⁴³Steven Godwin, Mechanical Engineer, Military Traffic Management Command Transportation Engineering Agency, e-mail to author at Fort Leavenworth, KS, 16 February 1999.

⁴⁴ Nick Darnell, Clerk, Cape Fear Railway, telephone interview with the author at Fort Leavenworth, KS, 3 March 1999.

⁴⁵ Thomas R. Wright, Fort Carson Installation Transportation Officer, e-mail to author at Fort Leavenworth, KS, 19 February 1999.

⁴⁶ Meloni Ostroski, Directorate of Logistics, Fort Polk, Louisiana, telephone interview with the author at Fort Leavenworth, KS, 3 March 1999.

⁴⁷ Union Pacific Railroad Corporation, *System Timetable Number 2*. Omaha, NE: UPRR, 1995, 39.

⁴⁸ James Way, Fort Irwin Installation Officer telephone interview with the author at Fort Leavenworth, KS, 3 March 1999.

⁴⁹ J. David Ingles, *Trains*, (December, 1997), 22.

⁵⁰ Ibid.

⁵¹ Anonymous, *Trains*, (April, 1998), 21.

⁵² Fred W. Fairley, *Trains*, (November, 1998), 24-27.

⁵³ Military Traffic Management Command. Homepage. 1998. Internet.

CHAPTER 5

CONCLUSION

The purpose of this chapter is to answer the primary thesis research and present other areas of interest where the military auto train concept might be of value. In order to do this, the chapter will follow the process explained in chapter three. The first step in this process was to evaluate the train's equipment requirements against the equipment criteria. Second, after reviewing the sample combinations of transportation I evaluated them, along with the military auto train, against the evaluation criteria. Finally, this chapter is used to present the overall thesis findings and answer the primary research question. Future research topics and a sample version of the military auto train are also included to aid future research of this transportation concept and provide a visual picture of this train.

Evaluation Using Equipment Criteria

If the military auto train is to be a viable form of transportation for use by the United States Army, it must at the very least pass the equipment criteria explained in chapter 2. Equipment criteria are extremely important in determining the feasibility of the military auto train as a valid entity before its evaluation against the other four modes of transportation selected. Each of the four-equipment criterion must be answered in the affirmative before this train can be evaluated against the performance criteria. A brief review of each criterion, its evaluation standard, and the results of the military auto train evaluation is presented below.

The first equipment criterion used to evaluate the validity of this transportation concept is the rail capacity at Army installations. Army installations must have sufficient space and equipment to load, store, and service the military auto train. This includes enough storage tracks at combat training centers and Army installations to validate this concept. Based on the size of the average infantry battalion task force, the military auto train will be approximately 5,500 feet in length. Each installation must maintain at least this length of unused track capacity to adequately handle the proposed train. This figure is in addition to any installation siding space reserved for the Department of Defense heavy flatcar fleet pre-positioned across the nation. Each sample Army installation meets the requirements of this criterion. All four installations have over 6,000 feet of space to service the military auto train and has or is scheduled to have floodlighting and new loading ramps by fiscal year 2002.¹ Both Fort Polk and the rail yards servicing Fort Irwin also have the required number of yard tracks capable of handling the military auto train.

The second equipment criterion concerns the requirements for diesel electric locomotives. Locomotives must be able to haul a train that contains between fifty-three and fifty-five cars, that has a trailing weight of approximately 5,500 tons and be able to maintain a continuous track speed of sixty miles per hour. There are surplus diesels in the Amtrak inventory that satisfy this requirement. The company currently has over one hundred diesel locomotives on their roster available for long-term lease. The military auto train requires at least four of these 3,000 horsepower units to maintain the motion standards stated above.

The third equipment criterion outlines the requirements for passenger cars. Cars which billet soldiers must meet the guidelines established by the Federal Railroad Administration. These guidelines include retention toilet systems within each piece of rolling stock, as opposed to discharge toilets which dump refuse on the railroad right-of-way. Although not a requirement of the Federal Railroad Administration, rail passenger carrying equipment must have a 480-volt headend power system to be compatible with leased Amtrak engines and those of other United States passenger train agencies.

Amtrak's excess Heritage cars meet all of these requirements except one. These cars are not equipped with retention toilets and currently retain their as-built gravity dump discharge toilets. A change to the federally mandated retention toilet system from the present configuration would cost money. Mr. Chatas, Director of the Amtrak Intercity Business Unit, said that the cost of these improvements, and of other more cosmetic changes to seats and internal lighting, would range from \$35,000 to as much as \$100,000 per car, depending on the type of car.² This same fact was collaborated by James Repass, President of the National Corridor Passenger Initiative, a nonprofit transportation advocacy group which helps get political support for rail passenger corridors in the United States. He stated that any Heritage fleet cars Amtrak possesses would not only require the improvements stated above, but also require a completely new or rebuilt undercarriage due to wear. This would certainly increase the cost of repairs to as much as \$100,000 per car.³ Because of this reality, the use of twenty-five cars from Amtrak's Heritage fleet for service as a military passenger train is only feasible with a capital expenditure of approximately \$2.5 million. The safety equipment outlined in chapter 2 of

this study does not affect the validity of this transportation concept, but is recommended for the protection of soldiers.

The final equipment criterion is the availability of vehicle and container-carrying railroad freight cars. There must be enough commercial freight equipment available to operate the military auto train. According to Beverly Cox, Rail Movements, Military Traffic Management Command, at any given time commercial railroads can provide as many as 150 freight cars of any type within three to five days of actual movement. During management of the past twelve rotations to either combat training center, she has not experienced a shortage in any type of car requested within that given time frame.⁴ Since the Military Traffic Management Command schedules rail moves as part of its daily mission and as the proposed mission of the military auto train, this requirement should not be a concern. It seems there are freight cars available to meet the needs of a new or emerging service like the military auto train.

Sample Transportation Modes

In order to analyze transportation choices available to Army units from the four sample installations, this thesis reviews four transportation mode combinations in addition to the military auto train. These four mode combinations were chosen to represent the transportation choices used by the Army to move personnel and equipment to each of the combat training centers. They were analyzed using the performance evaluation criteria explained earlier. As a review, the performance criteria are efficiency, operating cost and in-transit security costs. The transportation choices are:

1. Mode 1: Air movement of personnel combined with the linehaul of wheeled vehicles.
2. Mode 2: Combination Number Two: Air movement of personnel and the rail movement of wheeled vehicles.
3. Mode 3: Bus movement of personnel and linehaul of wheeled vehicles.
4. Mode 4: Bus movement of personnel and the rail movement of wheeled vehicles.

Evaluation Using Performance Criteria

The military auto train and the four combined deployment choices will be evaluated using three principles called performance criteria. Each performance criterion objectively judges the feasibility of the sample transportation choices contained within this thesis. The performance criteria are explained below.

Efficiency

The first performance criterion is efficiency. Efficiency is divided into three types: time, equipment cost, and transportation efficiencies. The first measure, Time Efficiency, is the average time it takes for the entire task force and its equipment to travel between an origin and destination. The quicker the task force arrives at a combat training center, the better the mode of transportation.

Table 2. Time Efficiency (Hours)

Transportation Modes	Fort Drum to JRTC	Fort Bragg to JRTC	Fort Lewis to NTC	Fort Carson to NTC
Military Auto Train	29	19	22	19
Mode Combination 1	48	48	72	48
Mode Combination 2	120	96	96	60
Mode Combination 3	48	48	72	48
Mode Combination 4	120	96	96	60

The second criterion is equipment cost efficiency, or the annual fixed cost to operate railroad passenger equipment to deploy soldiers from one location to another, divided by the number of trips per year. This criterion is used to examine the feasibility of purchasing or leasing of railroad passenger equipment. Again, The quicker the task force arrives at a combat training center, the better the mode of transportation.

Table 3. Equipment Cost Efficiency (Dollars)*

Trips per Year	6	12	18	24
Passenger Equipment Leased from Amtrak	525,000	525,000	525,000	525,000
Direct Transfer of Equipment to US Army	416,666	208,333	138,888	104,166
Purchase of Equipment by US Army **	58,333	29,166	19,444	14,583

* Includes \$2.5 million in capital expenditures required to elevate equipment to operational readiness.

** Status based on a purchase cost of \$14,000 per passenger car.

The third measure of suitability is transportation efficiency, or each transportation mode used during the deployment multiplied by its time efficiency. This criterion allows the separate measure of transportation efficiency for personnel and equipment. The lower value is more optimal while a greater ratio is less beneficial to the military.

Table 4. Transportation Efficiency (Hours)

Transportation Mode	Fort Drum to JRTC	Fort Bragg to JRTC	Fort Lewis to NTC	Fort Carson to NTC
Military Auto Train	29	19	22	19
Air	3.5	4.25	3.45*	4.0*
Linehaul Truck	48	48	72	48
Commercial Bus	28	23.5	24	18
Rail	120	96	96	60

*Includes ground travel time to airport of embarkation and from airport of debarkation to the National Training Center.

With regard to transit time, in all cases the military auto train can move a light infantry battalion task force's complement of personnel and equipment between its origin and destination faster than the sample transportation mode combinations. Air travel for personnel is faster than the military auto train; however, due to the longer transit times of commercial truck or equipment moving within special train service schedules, the combined unit transit times are longer.

To use one of the sample transportation modes other than the military auto train, units must load and ship their equipment prior to personnel deployment or receive their

equipment after personnel arrive at a combat training center. Either way, soldiers are separated from the tools they need to plan or conduct a successful mission immediately upon arrival at a training site.

At first glance, the cost to operate Amtrak-leased equipment versus Army-owned equipment is greater; however, this does reflect unforeseen future maintenance requirements for which the Army has no organic capability to solve. It also does not factor in the flexibility that leasing provides by allowing newer car substitution (coaches, lounges, sleepers, or diners) for equipment which is non operational equipment.

Cost

The second criterion is cost. It is defined as the cost to transport 800 soldiers and 150 pieces of equipment, the sample size of a light infantry battalion task force. It is measured as a straight cost to move the entire force from origin to destination installation. This criterion does not factor in time savings or other advantages. When all other criteria are equal, it is meant to provide a direct comparison between various modes of transportation. The lower the cost is the better the mode of transportation.

The cost to transport a light battalion task force is dependent on the choice of transportation combinations. Using the military auto train to move a task force-sized battalion is less expensive than transportation mode combinations 1 and 2, both of which use aircraft to transport personnel. In general, the cost of transporting a soldier by the military auto train is comparable with transportation mode combinations 3 and 4, which use commercial bus transportation.

Table 5. Cost to Transport a Battalion Task Force (Dollars)

Transportation Mode	Fort Drum to JRTC	Fort Bragg to JRTC	Fort Lewis to NTC	Fort Carson to NTC
Military Auto Train	215,015	189,195	156,385	107,294
Mode Combination 1	391,533	262,270	425,016	250,001
Mode Combination 2	366,738	270,920	405,381	218,794
Mode Combination 3	177,272	119,188	132,859	119,040
Mode Combination 4	152,477	127,838	113,234	87,833

*Includes the costs associated with freight equipment lease.

Intransit Visibility and Enroute Security

This criterion measures the cost to provide guards on sensitive items during movement. It is defined as a cost, because each mode of transportation evaluated can provide some form of intransit visibility or enroute security for the cargo or equipment it transports. This evaluation applies only to equipment or unit property, such as crew-served weapon systems inside intermodal containers or any other equipment deploying units identified as sensitive cargo. The most optimum figure is zero, while the greater the cost, the less beneficial the form of transportation.

The cost to provide intransit visibility for sensitive Army equipment is less via the military auto train than either commercial linehaul or independent rail service. It is the same for those units which move smaller sensitive items, such as crew-served weapons, by aircraft.

Table 6. In-Transit Visibility Cost (Dollars)*

Transportation Mode	Fort Drum to JRTC	Fort Bragg to JRTC	Fort Lewis to NTC	Fort Carson to NTC
Air	0.00	0.00	0.00	0.00
Military Auto Train	0.00	0.00	0.00	0.00
Linehaul Truck	116.00	116.00	116.00	116.00
Rail	87.50	87.50	87.50	87.50

*Cost of surveillance per for each 20 foot piece of equipment.

Equipment Ownership and Maintenance

Like any piece of equipment, the military auto train will require regularly scheduled maintenance during its service to the United States Army. Due to the complexity of rail equipment maintenance and the status of the project as an emerging transportation choice for the Army, the thesis research and analysis supports the recommendation that the Army leases the rail equipment and diesel electric locomotives required for the service are leased, under a long-term agreement from Amtrak. This equipment should be maintained, under an outsourcing contract with the passenger corporation, at its maintenance facilities in Beech Grove, Indiana. This provides the Army with an avenue to start the project, but also gives the agency an alternative to the equipment ownership burden in the event the service does not meet its needs. In a conversation with Mr. John Chatas, Director of Amtrak Intercity Passenger Services, he stated that the heavy maintenance facility at Beech Grove has a more than adequate excess maintenance capacity and would provide the government agency with an

additional source of income.⁵ This fact is further confirmed by Amtrak President George D. Warrington in a recent interview. Amtrak recently accepted a bid to overhaul and refurbishment the Fort Worth, Texas, transportation agency equipment worth over \$7 million. The arrangement calls for the overhaul of four diesel locomotives and ten bi-level coaches. Mr. Warrington said about this deal, "This contract is a good example of how we intent to put our facilities and expertise to work to improve our bottom line."⁶ This study has collected and analyzed the data associated with the military auto train and four other transportation mode combinations and evaluated them against both equipment and performance criteria. The final step in the research design process is to answer the primary question of this thesis.

Primary Research Question Answer

Can the United States Army use rail transportation as an efficient means to simultaneously transport personnel and equipment from a deploying unit's home station to the Joint Readiness Training Center or the National Training Center? The answer to this question is yes. The military auto train provides less-expensive, intransit visibility costs than any other surface transportation mode. From the standpoint of time management this concept is extremely efficient. The military auto train transports the entire sample battalion task force of 800 personnel and 150 pieces of equipment quicker than the four sample transportation mode combinations. This concept also provides deploying commanders the flexibility of maintaining a continuous battalion tactical operations center for planning while enroute to their destination, an option that the other transportation modes cannot currently provide.

The same conclusion is mixed, however, with regard to economic efficiency. The military auto train is less costly than moving personnel by aircraft and equipment by ground means. In all but one case the military auto train is more costly than moving personnel by commercial bus and equipment by surface transportation. Still, it transports an entire battalion between installations quicker with the option to accomplish more training tasks.

Based on the comments provided by two former light infantry battalion staff officers, both of which have deployed to a training center in the past, the military auto train is a viable option. It includes the additional benefits of lower in-transit visibility costs, reduced overall transit times, and cheaper transportation costs versus air modes, and the military auto train becomes an excellent tool for providing cost effective transportation to the force XXI Army.

Potential Future Research

Transporting personnel and equipment simultaneously by rail can accomplish other transportation and billeting roles as required by the United States Army, the Department of Defense, or the United States Government. These additional transportation roles for the military auto train deserve further consideration. Can the United States Army expand this concept to include transportation for units conducting port support activities at major seaports of embarkation or as tactical operations centers during domestic disaster relief, especially hurricanes, tornadoes, or civil disturbance? A military auto train might even be used as a mobile command post during counter drug operations in the Southwestern United States. Can sister services within the Department

of Defense also benefit from this transportation alternative? The United States Marine Corps could use this train in much the same way the Army would, albeit with different personnel and equipment requirements.

There is relevance to other governmental agencies as well. The United States forestry service could use this train as billeting and messing and as a command post during wild fires in the northwest or wherever the nation's railroads have access to forestry land. The same idea holds true for the Federal Emergency Management Agency. What better way to provide immediate housing and a command center for Federal Emergency Management Agency personnel in areas without power or governmental buildings? Obviously, other governmental agencies may have the need to operate such a deployment and command post structure during their daily operations, and all could not be listed here. One possible solution to the management of such a train used by different government agencies is to allow Amtrak, a quasi-governmental agency itself, to operate this service. Amtrak has the locomotives, passenger equipment, and railroad operational expertise to accomplish such a task and has been operating passenger trains for over twenty-five years. This solution also supports the vision of Amtrak's president, Mr. Warrington, by providing an opportunity to put Amtrak's facilities to use to order to improve the company's financial bottom line.⁷ The proposed train would be approximately 5,500 feet in length and contain between fifty to fifty-five cars. Below is a listing of each type of passenger car, along with its function and specific equipment used to operate the service.

To move a battalion-sized element of approximately 800 personnel and 150 wheeled vehicles, the following equipment, in order from the head of the train to the rear of the train, is required.

1. Diesel Electric Engines (4). Based on the Davis formula, which calculates train resistance, four diesel electric engines are required to produce headend electrical power and an estimated 2.05 horsepower per ton (for a total of 11,290 horsepower), in order to maintain a continuous over-the-road-speed of sixty miles per hour. The locomotives would come from Amtrak (a sister government agency), which now has a surplus of F40PH (3,000 horsepower each) type locomotives due to a purchase of newer Genesis engines in the mid-1990s. This study recommends modifying these engines by installing separate headend power diesel generators, similar to the F40PH-2s built for Massachusetts Bay Transportation Agency train service (the current electrical power configuration is a part of the EMD 645E3 prime mover), as a separate backup to the power car.⁸ These engines would also control a electro-pneumatic brake system designed to operate long trains with increased handling and control. This system is designed to permit higher train speeds while decreasing stopping distances and decreasing the costs associated with brake shoe changes and maintenance. During testing in April 1997, two trainsets were compared during 30,000 miles of service. One trainset equipped with this innovation replaced fourteen brakeshoes and zero wheelsets. The conventional trainset had to replace three brakeshoes and eleven wheelsets. At a cost of \$6 per brakeshoe and \$1,500 per wheelset, expenses for the electro-pneumatic equipped train were \$78 versus \$16,518 for the conventionally equipped train.⁹ This new design is perfect for the military

\$16,518 for the conventionally equipped train.⁹ This new design is perfect for the military auto train because it would reduce maintenance costs, not to mention an increase in train speed, lower fuel consumption, and improved ride quality.

2. Power Car (1). One seventy-eight foot power car (drawings contained at appendix A), fitted with a sound insulated 500-kilowatt generator, is required to provide in-route power for up to twenty three passenger cars requiring electrical power. It also is used to provide headend power to the train while at a combat training center or during locomotive servicing.

3. Baggage Cars (3). One seventy-eight foot baggage car is used to transport soldiers' accompanying baggage, equipment, and supplies. Ammunition and heavy weapons are transported at the rear of the train, in containers for this purpose. Two additional baggage cars, specially fitted to facilitate the in-route planning of a battalion staff, would be the fourth and fifth cars back from the locomotives. These cars have permanent planning and briefing areas and office areas for a battalion staff and should be capable of tactical satellite communications, secure mobile facsimiles, cellular phones, and internet applications. They also include additional storage space for the battalion's planning materials and maps. A drawing of these specially fitted baggage cars is at appendix A.

4. Sleeper Cars (2). Two ten roomette, six bedroom sleeper cars (capacity of twenty-two per car) for senior battalion leaders. The sleepers are required for staff members conducting continuous planning in the adjacent tactical operation center cars. This equipment, along with the remainder of the passenger cars mentioned, would come

from the Heritage pool of Amtrak equipment currently stored at their Beech Grove, Indiana maintenance facility. All equipment has been upgraded to headend power (as opposed to steam heat) by Amtrak.

5. Coaches (16). The train would require between sixteen forty-eight seat coaches, depending on infantry battalion task force size, to accommodate soldiers during their deployment. Each coach is equipped with a latrine area, small baggage storage space, and reclining seats with footrests. In order for soldiers to obtain the best utilization of attached lounge and dining space, the same number of coaches should be positioned fore and aft of the lounge and dining cars. Coaches could be equipped with closed circuit televisions for movies or to receive intelligence briefings and updates from the battalion tactical operations center in-route.

6. Lounge Cars (2). Two lounge cars are available to all soldiers during the deployment. A lounge car, equipped with tables, chairs, and small refreshment area, is located at each end of the coaches to eliminate congestion near the dining cars at the center of the train. Lounge cars are stocked using unit Moral, Welfare and Recreation funds or the proceeds of sales from the lounge car could help to augment a battalion fund raising program.

7. Dining Cars (2) or a Kitchen Car and Dining Car. These cars provide messing in route. These cars are either stocked prior to departure or in-route. Kitchen cars are full-length kitchens capable of preparing preset meals from scratch. Dining cars have small kitchen and pantry areas to prepare meals while in-route. They can be configured to

serve forty-eight soldiers at a sitting or set up to serve military type rations in a serving line configuration.

8. Bi-level Autoracks (10). These cars are used to transport the battalion's wheeled vehicles. Each eighty-nine foot bi-level car is capable of transporting ten HMMWV-sized vehicles. These cars are ordered from and delivered by the private railroad industry prior to deployment.

9. Flatcars (20). A combination of sixty-foot and eighty-nine foot multi-purpose flatcars used to transport five-ton tractors, trailers, containers and other cargo that could not fit in the autoracks. Again, these cars are ordered from and delivered by the private railroad industry prior to deployment.

10. Caboose (1). Located at the end of the train and used by the in-transit guard force. This car has a portable generator, a toilet facility, communications with the head end and the body of the train and enough bunk beds for a four-man guard contingent. It is also equipped with a two-way, end-of-train telemetry device and electro-pneumatic system for safe operation.

Summary

The military auto train is a viable transportation alternative for use by the United States Army. It reduces the deployment time of a light infantry battalion task force between its home station and a combat training center and allows an entire battalion task force worth of equipment to arrive at the destination simultaneously. This train provides the benefit of continuous planning while in transit, allowing staff personnel to focus on a recently received mission from higher headquarters. This battalion tactical operation

center remains operational throughout the deployment, linked to intelligence and logistics assets via electronic means. Upon arrival at its destination, the operations center is self contained and ready to support battalion operations.

The military auto train also provides intransit visibility and security of sensitive equipment, reducing the costs associated with such a service. Finally, the thesis recommends outsourcing of train maintenance requirements, primarily to Amtrak, a government agency which maintains the appropriate maintenance skill sets at its Beech Grove, Indiana heavy maintenance facility. The military auto train can provide a value to the United States Army and with future research, other agencies within the Department of Defense or the United States Government.

¹Steven Godwin, Mechanical Engineer, Military Traffic Management Command Transportation Engineering Agency, e-mail to the author at Fort Leavenworth, KS, 16 February 1999.

²Jim Chatas, Director, Amtrak Intercity Business Unit, telephone interview with the author at Fort Leavenworth, KS, 20 January 1999.

³James Repass, National Corridor Passenger Initiative, telephone interview with the author at Fort Leavenworth, KS, 12 March 1999.

⁴Beverly Cox, Military Traffic Management Command Surface Transportation Section, e-mail to author at Fort Leavenworth, KS, 20 January 99.

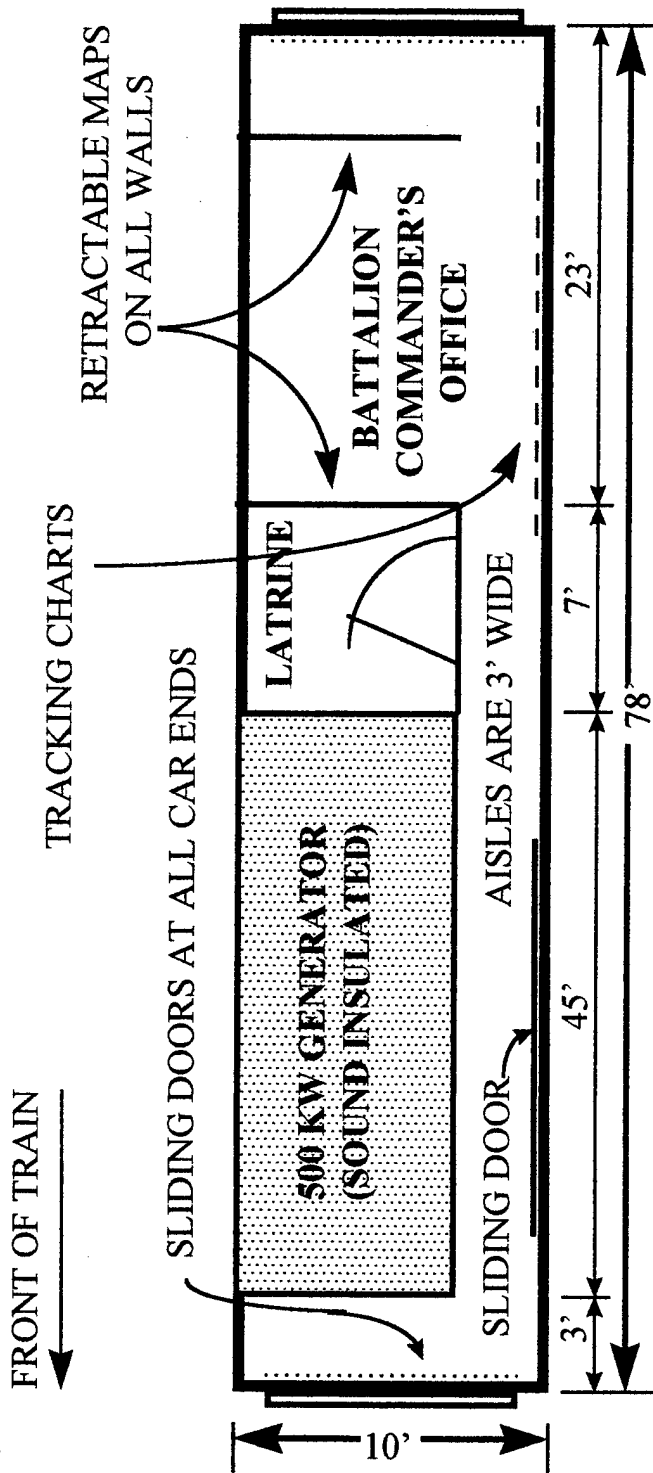
⁵Jim Chatas, Director, Amtrak Intercity Business Unit, telephone interview with the author at Fort Leavenworth, KS, 20 January 1999.

⁶George D. Warrington, President, National Railroad Passenger Corporation, "Beach Grove Overhauls, Metrolink Operations," *RailNews*, February 1999, 25.

⁷Ibid.

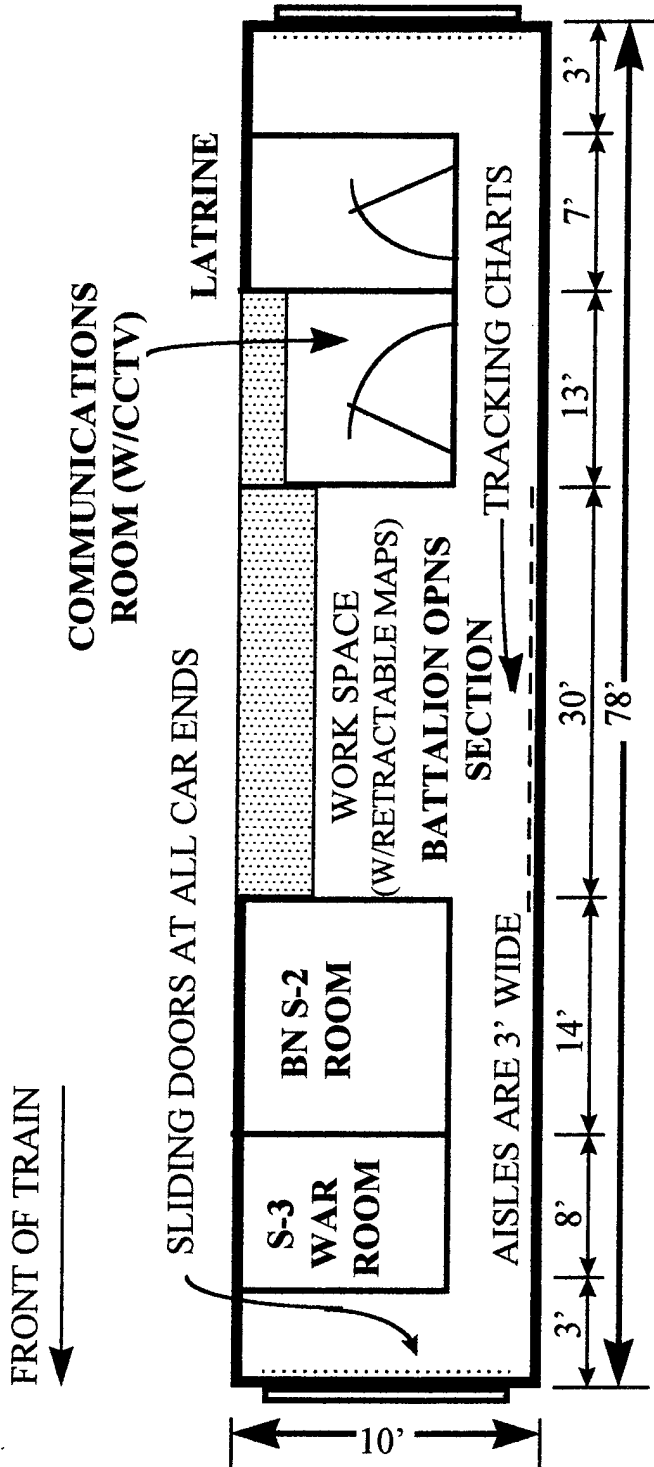
⁸Louis A. Marre, *Contemporary Diesel Spotters Guide* (Milwaukee, WI: Kalmbach, 1995), 90, 97, 333-342.

⁹Anonymous, *Railway Age*, March 1998, 39-46.



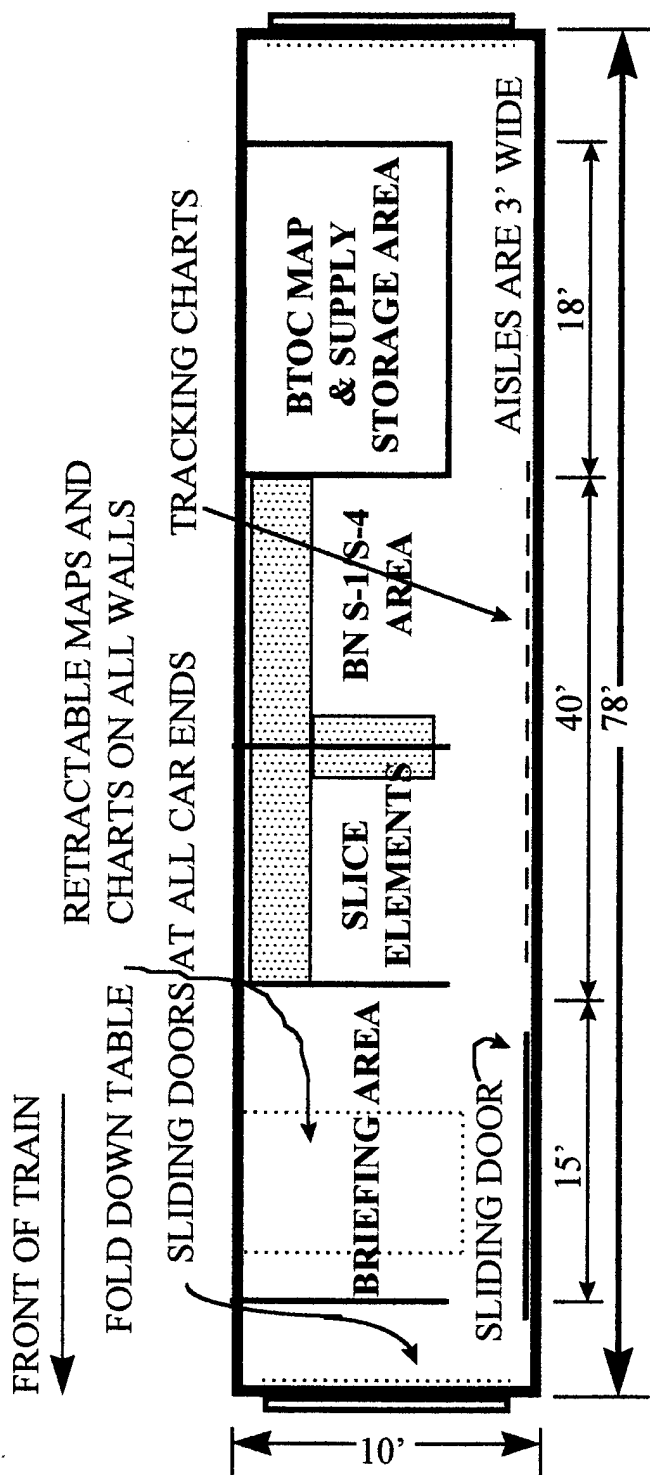
POWER CAR IS EQUIPPED WITH COMPLETE IN LINE TRAIN COMMUNICATIONS, CLIMATE CONTROL AND LATRINE. BATTALION COMMANDER'S OFFICE CAN BE USED AS A BRIEFING AREA IF NEEDED.

**POWER CAR--BATTALION COMMANDER'S OFFICE
EQUIPMENT USED: 78 FOOT BAGGAGE CAR**



PLANNING CAR ONE IS EQUIPPED WITH COMPLETE COMMUNICATIONS (TO INCLUDE CABOOSE), CLIMATE CONTROL, LATRINE AND IS SEMI-PERMANENTLY COUPLED TO PLANNING CAR NUMBER TWO.

**BATTALION TACTICAL OPERATIONS CAR
EQUIPMENT USED: 78 FOOT BAGGAGE CAR**



PLANNING CAR NUMBER TWO IS EQUIPPED WITH COMPLETE COMMUNICATIONS, CLIMATE CONTROL AND IS SEMI-PERMANENTLY COUPLED TO PLANNING CAR NUMBER ONE. CAR ALSO HAS STORAGE AREA AND BRIEFING AREA W/VIDEO TELEVISION CAPABILITY.

**BATTALION ADMIN/LOG CAR
EQUIPMENT USED: 78 FOOT BAGGAGE CAR**

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