



INDIAN INSTITUTE OF MANAGEMENT CALCUTTA

WORKING PAPER SERIES

WPS No. 679/ September 2011

Determinants of profitability of US Class I Freight Railroads

by

Bodhibrata Nag

Associate Professor, IIM Calcutta, D. H. Road, Joka P.O., Kolkata 700 104 India

Determinants of profitability of US Class I Freight Railroads

Bodhibrata Nag

Abstract

US Class I railroads have been operating profitably and carrying substantial market share of traffic, in spite of the inherent disadvantages of rail transport as well as highly developed road, water and air transport infrastructure. This paper examines the key initiatives that railroads have taken to reach this stage, as well as the factors which have enabled them to successfully deploy these initiatives. The paper then discusses the implications of these measures in terms of long term growth of the railroads and for the society.

Keywords: rail transport, railroads, freight, technology, USA

1. Introduction

US railroads play a dominant role in the economy of the United States of America. The US freight-rail system carries 16 percent of the nation's freight by tonnage, accounting for 28 percent of total ton-miles, 40 percent of intercity ton-miles, and six percent of freight value. (American Association of State Highway and Transportation Officials, 2009) About 70 percent of domestically produced automobiles, 70 percent of coal delivered to power plants and 35 percent of the grain harvest moves by rail in the US. (Laurits R. Christensen Associates Inc., 2009)

US railroads have to compete with well developed alternate modes of transport operating on one the world's best logistics infrastructures. There are about 98 air carriers, 680 thousand inter-state motor carriers, 680 marine vessel operators and 2300 pipeline operators using about 4 million miles of highways (of which 47,000 miles are Interstate Highways), 13 thousand miles of navigable waterways (including the Great Lakes- St. Lawrence Seaway), 20 thousand civilian airports, 167 thousand miles of oil pipelines and 1.5 million miles of gas pipelines in 2007.

Again none of the US freight railroads are government owned. On the other hand US railroads are subject to regulation by various agencies such as the Federal Railroad Administration and the Surface Transportation Board on a number of aspects, such as permission to construct or operate a railroad network, abandon or discontinue operations. While railroads around the world flounder in face of competition from other modes of transport, US railroads operate profitably without government subsidies- a good indication of which is the operating ratio given by ratio of operating expenses to operating revenues. The operating ratio of US railroads varies from 0.71 to 0.73, in comparison to 0.87 for Russian Railways and 0.95 for Indian Railways for the period 2010-11.

Of particular interest are the US Class I railroads which account for 70 percent of the railroad industry's mileage operated, 89 percent of its employees, 84 percent of originating traffic and 92 percent of its freight revenue. Class I railroads are those with annual operating revenues of \$319.3 million or more as of 2005 (amount is adjusted annually for inflation and must be reached or

exceeded for three consecutive years for a firm to be considered Class I) as per STB guidelines. The class I railroads are the Burlington Northern/Santa Fe(BNSF); the Canadian National-CN (which controls the merged Grand Trunk Western and Illinois Central); Canadian Pacific-CP (which controls the Soo Line); CSX Transportation; Kansas City Southern Railway; Norfolk Southern(NS); and the Union Pacific(UP).

There has been little research on the factors that have enabled the US Class I railroads to evolve to a profitable operating industry in competition with a developed and efficient trucking industry. This paper examines the various operational aspects of the US railroads, the regulation mechanism and the industry structure to determine these factors. This paper is organized as follows: the unique features of the railroad industry are elaborated in Section 2 followed by a discussion on the key profit enhancing initiatives adopted by US railroads in Section 3, the enabling environmental factors in Section 4, implications of initiatives and enablers in Section 5, followed by conclusions in Section 6.

2. Unique Features of the railroad industry

The railway industry primarily consists of a network of railway lines, on which freight or passenger cars are hauled by locomotives. Each line comprises a pair of tracks which are spread at a certain distance apart; the distance between the inner sides of the heads of the two tracks is known as the gauge of the railway line. There are a number of gauges used throughout the world such as standard gauge of 1435 mm (used in 60% of the world's railways mainly in Europe, United States, Canada, China, North and South Korea, Australia, Middle East, North Africa, Mexico, Cuba, Panama, Venezuela, Peru, Uruguay, Philippines, and high speed lines of Japan and Spain), the Indian gauge of 1676 mm (used in 7% of the world's railways mainly in Indian subcontinent, Argentine and Chile), the Iberian gauge of 1668 mm (used in Portugal and Spain), the Irish gauge of 1600 mm(used in Ireland, Australia and Brazil), the Russian gauge of 1524 mm(used in 17% of world's railways mainly in the CIS states and Mongolia), the Cape gauge of 1067 mm (used in 9% of the world's railways mainly in southern and central Africa, Indonesia, Japan, Taiwan, Philippines, New Zealand and Queensland Australia) and the meter gauge of 1000 mm (Southeast Asia, Argentina, Brazil, Switzerland and East Africa). There could be either a single line, allowing movement of trains in either direction, or more than a single line. In case there are more than a single line, say a double line, the network could be configured such that trains run on only direction on each line; for example, trains could be running north to south on a line and trains could be running south to north on the adjoining line. Adjoining lines may also be provided with crossovers at suitable locations to enable trains to move from one line to the other adjoining line in case of any eventuality.

Trains can either move backwards or forward only. A train can overtake another train running in the same direction or cross another train running in the opposite direction only at stations provided with additional loops (lines running parallel to the main line); one of the trains is admitted into the loop, while the other train passes over the main line. Train wheels cannot be steered, as in road vehicles. Thus switches are provided wherever tracks cross, merge or diverge. These switches could either be manually or machine operated. Manual operation of switches could be done locally or remotely through handles and rods from a central cabin 2-3 miles away. Machine operation of switches can be done from control stations situated thousands of miles away.

Since trains have a very large mass and run on low friction wheel-rail interface, the distance covered before a train comes to a complete stop is very high. While the stopping distance for an automobile is only 200 feet, that for a passenger train is 2960 feet and for a freight train is as large as 17580 feet when travelling at 55 kph (White, 2003). It is for this reason that the railway network is broken up into discrete blocks, each block typically being 3 to 5 km on high traffic density networks; once a train enters a block, no other train is allowed to enter the block till the earlier train has left the block. Signals are provided at the beginning of each block to inform the train driver whether entry to the block is permitted or not. Again these signals may be manually operated from a nearby station or remotely operated from control stations situated thousands of miles away.

Stations must be manned to carry out manual operation of switches and signals. Such stations may be spaced 2 to 10 km apart, depending on the density of traffic. On the other hand, operations from remote control stations do not require manning of the stations. However remote operation requires investment in remote operated switches and signals related infrastructure. Further remote control center operations could either be manual or computer controlled. In manual control centers, operators remotely set the switches and signals and thereby control train movement over the operator's assigned territory. Typically each operator could be assigned 100 to 200 miles of territory. Operators while scheduling the movement of trains attempt to maximize line utilization while minimizing delays and interruptions of train running. However, with increase of traffic density it becomes difficult for operators to manually schedule the trains optimally- computers are then used to assist the operators in making optimal decisions.

A train may consist of a few cars to about a hundred cars joined together through couplings. Since a block remains occupied till a train clears the block, there are two ways to ensure maximum utilization of the block- first, ensure that a train clears the block within the minimum possible time (which means that the speed of train should be as high as possible) and second, ensure that the train consists the maximum number of cars (freight or passenger) possible. However the maximum number of cars that a train can accommodate is limited by a number of factors: first, the capacity of the locomotive to haul the weight of the train over the route that the train will travel; and second, the capacity that can be accommodated at crossing loops at stations en route, which is determined by the length of the loop.

Hauling locomotives are commonly of two types: the first type run by diesel engine power and the second type run by electric power. The second type, electric locomotives, requires trackside power carriers to transmit electric power to the moving locomotives through collectors. Since diesel locomotives do not require such trackside power carriers, and have typical capacity of 4500 gallons of fuel in its tanks, it only requires re-fuelling every 1200 miles with fuel consumption of 3.5 gallons per mile. However, the maximum hauling capacity of diesel locomotives is lower than that of electric locomotives. Owing to the additional investment required for operation of electric locomotives in trackside power carriers, these are used mainly for high density and heavy haul traffic in South Africa, Australia, Japan, India, China, Russia and most countries of Europe.

If a shipper requires movement of material in a full train (say consisting of 100 cars) from point A to point B, the railroad company simply gets all the cars of the full train loaded at point A, and carries them to B for unloading by the consignee by B. These trains are termed as "unit trains" and are preferred by all railroads since it is the simplest movement possible and involve very little

intermediate work. But shippers do not always require shipments as full train loads and might require shipments in only 2 to 3 cars. Further each shipper might have a different origin and a different destination. Say a shipper 1 wishes to send 50 car loads from P to Q, the route of which traverses through X and Y; similarly, say another shipper 2 wishes to send 50 car loads from R to S, the route of which also traverses through X and Y. Since the railroad would wish to maximize its track utilization, by running trains of maximum capacity, the railroad will take the following steps: first, send shipper 1's 50 car loads as a train from P to X and send shipper 2's 50 car loads as a train from R to X; second, form a single train with shipper 1's 50 car loads and shipper 2's 50 car loads and run it from X to Y; third, on arrival of the train at Y, the train is broken up into two trains one comprising shipper 1's 50 car loads (which is sent to Q) and the other comprising shipper 2's 50 car loads (which is sent to S). A terminal yard will however be required at X and Y for forming and breaking up the train. Such terminal yards usually comprising three separate yards: first, the reception yard, where trains arrive for re-configuration; second the classification yard, where the sorting, breaking and forming of trains are done and; third the departure yard, where the trains are placed after formation in classification yard for inspection, prior to departure. Each of the yards, reception, classification and departure, will consist of a number of parallel lines. The number of lines in each yard will be decided on basis of number of trains being handled in the particular terminal. Such terminals are provided at strategic locations on the railroad network to cater to anticipated traffic pattern.

All railroad assets require maintenance, since availability and reliability of assets are key imperatives in railroad working. Maximizing availability implies the downtime of the asset should be minimized as far as possible. Maximizing availability of assets ensures that there exists opportunity to maximize the return on investments. Again if any asset breaks down in service, it causes cascading repercussions on the entire railway network. For example, if a locomotive breaks down while hauling a train on a block, not only the next train cannot enter the block but also all following trains are affected. Thus asset reliability is singularly important in railroad working.

Asset maintenance affects railroad working differently. Track, signals, switches and power carrier maintenance require closure of traffic flow on the network section under maintenance. Cars and locomotives are sent to shops strategically located on the network for maintenance.

Crew operating the locomotives need to be constantly alert to track and locomotive conditions, in order to ensure safe passage of a train over a railway network. A railroad working could be seriously disrupted if a crew fails to observe a signal or observe speed restrictions on a weak track or drive properly over a steep gradient. Therefore most countries have set norms for the maximum number of hours that crew can work continuously as well as minimum period of rest that must be provided to crew after working. Further crew need to be well acquainted with the features of network territory where crew operate. Therefore railroads partition the network into districts and designate crew sets to the different districts. Each district usually consists 200 to 300 miles of railroad network. Crew is based at a particular station of the network and rest stations are provided at the district boundaries. The district network size and the locations of crew base and rest stations are chosen such that crew can run a train from base to rest station within the maximum allowed working hours. After working a train from base station to rest station, crew take rest for a minimum period of time before taking another train in the return direction. Similarly after reaching the base station, crew will have to undergo a minimum rest period before running a train again. Thus if there

are two adjoining districts D1 and D2 with rest station located at the boundary of D1 and D2, D1 crew will operate from a train from their base station to the rest station where after the D2 crew will operate the train till their base station. Trains are thus consecutively handled by crews of different districts on its route.

Rail capacity (or the maximum flow through the railroad network) is affected by the following factors: number of tracks, number and length of loops, number of crossovers and other connections, type of signaling, speed limits, grades and curvature, availability of freight cars and locomotives, overhead clearances for movement of double-stack containers, traffic mix and terminal facilities. (Battelle, 2010) Other factors affecting capacity are operating strategies (e.g., size, speed, and timing of trains), motive power and freight car capacities, reliability of infrastructure and equipment, and extent of redundancy of infrastructure and equipment.

3. Keys to profitability of US Class I Freight Railroads

Railroads require enormous investments in the track and rolling stock (locomotives and cars are termed as rolling stock in railroad parlance). Since these investments are sunk costs, railroads have two options in remaining profitable: control costs and augment revenues. Railroads have also revamped their organization structure to facilitate better customer orientation and service.

3.1 Cost Control measures

US Class I freight railroads have adopted various cost control measures which are discussed below. It will be observed that many of these measures could be adopted in the US, since unique situations exist in the US business and regulation environment.

3.1.1 Concept of core owned network

Owning a network implies incurring regular cost of maintaining the network and its associated assets such as signals and switches. US Class I railroads have thus taken measures over the last three decades to identify and strengthen a core network, which promises to have high volume and profitable traffic. Simultaneously other parts of the network have been abandoned, thus relieving the railroad the liability of maintenance. Abandonment has largely occurred in the north-central agricultural states (which did not require dense networks after advent of trucks and paved roads in the late 1920s), few competitively over served routes (such as Chicago to Omaha), relatively heavily settled areas with good trucking services (such as Illinois, Indiana and Ohio) and mines having exhausted reserves (such as iron ore mines of Michigan and Minnesota). Abandonment also has occurred as a result of mergers and consolidations among railroads, which led to duplicative or redundant lines. The Class I railroad system today has less than half the number of miles it had in the 1920s. (Cramer, 2007)

Further railroads have agreements amongst themselves which allow other railroads to utilize their networks. These agreements take many forms: (a) Where two railroads each own only one single line between points A and B, the two railroads could agree amongst themselves to both use one of the lines for movement only from A to B and the other line for movement only from B to A. Movement in both directions on a single line can cause delays due to crossings that have to be arranged for traffic moving in opposite directions. On the other hand, movement in a single

direction causes no such delays since trains are simply following each other in the same direction; this is especially evident if most of the traffic is flowing at the same speed. A variation of this arrangement is the formation of a joint company solely for maintenance and operation of the network between points A and B. (b) Railroads could agree to pay charges to use others' railroad tracks. Railroads could use their own locomotives and crew for hauling traffic on others' railroad tracks or could pay for use of track owning railroad's locomotives and crew for hauling traffic. This arrangement affords the railroad customers to ship goods from or to points beyond the railroad's network while ensuring maximum utilization of the track capacity. Railroads also have arrangements to use others' railroad tracks to provide alternate routing of traffic in event of incapacitation of portions of their own network owing to accidents or natural calamities.

This concept of core networks has been facilitated by the 1980 Staggers Act, where the Surface Transportation Board (STB) can allow railroads to abandon or discontinue operations over any part of its network. Further the STB guidelines make it mandatory to railroads to provide its facilities to other railroads, wherever feasible.

Regional and short-line systems have been formed mostly through networks abandoned by the Class I railroads. The regional and short-line systems differ from Class I railroads through less stringent labor cost structures (being subject to relaxed labor rules and flexible salaries compared to Class I railroads), less stringent government requirements for track and equipment maintenance and record keeping standards and business models. Many regional and short-line railroads receive public funding support. They serve an important function in providing the first and last service miles for Class I railroads. These regional and short-line railroads are 94.5 percent private and 5.5 percent public-owned. These railroads originate 16 percent of national rail traffic, generate nine percent of railroad revenue, while operating more than 20 percent of total system mileage. (American Association of State Highway and Transportation Officials, 2009)

3.1.2 Leased rolling stock

Railroads do not own all the rolling stock used for service. Instead railroads lease freight cars and locomotives depending on the requirement. There are different types of leasing arrangements depending on the leasing time and whether the railroads undertake maintenance of the rolling stock or not.

This arrangement has been facilitated by the growth of leasing industry since the late nineteenth century in response to a growing demand for specialty freight cars. Further Class I railroads have also joined together to form TTX which is a railcar leasing company.

While this arrangement reduces the risk of investments, it has other benefits too. These railcar leasing companies can specialize in other related areas too, which are immensely beneficial to railroads. Examples are (a) provision of maintenance services for leased equipment (b) design of specialized cars tuned to customer requirements (c) establishment of facilities for testing of car designs.

There have never been attempts at vertical integration in the US railroad industry. Industries for manufacture of locomotives and freight cars as well as for development of automation, diagnostic and software services have grown, along with standardization efforts of organizations such as

Association of American Railroads (AAR). While this arrangement has spared the railroads in incurring capital expenses for development of such complementary industries, it has also ensured development of specialized expertise in these industries.

3.1.3 Reduced maintenance load

Railroads have reduced maintenance frequency for track and rolling stock through utilization of various measures. This has resulted in twin benefits of increased availability of assets as well as reduced cost incurred in maintenance efforts.

Most railroads use technology to improve maintenance productivity of its assets. BNSF for example has deployed TPI (Track Prediction Indices) and PARS(Planning & Activity Reporting System). TPI is a single database that integrates information captured by track inspectors, track geometry cars, rail flaw detector cars along with maintenance history on a section as well as record of suppliers providing materials. PARS allows prioritizing of maintenance activities to locations where greatest needs exist. BNSF uses condition based maintenance (CBM) of its locomotives in addition to traditional planned maintenance, thus enhancing the reliability of locomotives to a large extent. Examples of such practices are vibration analysis of turbines and generators, oil and water tests for viscosity and contamination, wear-particle analysis, thermography to detect hot-spots in locomotive electric panels and sonar pressure for power assemblies. Similar CBM is also applied to the freight cars. Fault detection technologies for freight cars deployed on the trackside include WBD (warm bearing detectors), HBD (hot bearing detectors), WILD (wheel impact load detectors), LAHD (low air hose detector), TPD(truck performance detector), hollow/worn wheel detectors, and TADS(trackside acoustic detectors). UP has also deployed wheel temperature detectors, to detect brake settings. UP uses Lat-Lon's RailRider technology to improve equipment performance on its Express Lane guaranteed perishable service started with CSXT in 2000. This consists of self contained units attached directly to refrigerated box cars, where they measure temperature fluctuation, excessive vibrations, and mechanical malfunction. Data is transmitted wirelessly via Aeris MicroBurst through cellular phone network. Similar units to monitor ride quality (through accelerometers) are being used for ride quality sensitive automotive parts and rolled paper shipments. This on-line fault detection reduces inbound inspection time, allowing maintenance to concentrate only on cars with exceptions. Rugged hand-held PDAs have been deployed with maintenance workers for track inspection and defect reporting, bridge inspection and signal/grade crossing inspection. (The Magnificent 7: Union Pacific steps up to the challenge, September 2004)

3.1.4 Shedding non-core activities

US railroad firms have been gradually shedding off non-core activities. Cramer (Cramer, 2007) lists a few such divestments: CP Air divested by CP in 1987; CSXT divested its ACL Barge Unit in 1998, its Sea-Land International liner business in 1999, CTI logistics in 2000, CSX Lines domestic container shipping in 2003, CSX World Terminals in 2005; NS divested its North American Van Lines in 1998; UP divested its Skyway Freight Systems in 1998 and Overnite Trucking in 2003-05.

Few railroads have entered into alliances with OEMs for equipment maintenance. GE services CSX's fleet of GE locomotives using CSX employees at various CSX owned maintenance plants, through its onsite managers for supervision and technical direction. Similarly Alstom Canada

assumed management of Canadian Pacific Railway's Ogden equipment overhaul and repair shops in Calgary, Alberta. (Strategic Innovations in North American Railroad Management, 2005)

3.1.5 Inter-railroad Coordinating and Pooling

Railroads have coordinated amongst themselves in pooling resources through various agencies such as TTX or the Association of American Railroads (AAR).

For example, TTX manages the Reload Pool and the North America Boxcar Pool (NABP). The Reload pool permits railroads to pool their auto-rack fleets for transportation of finished vehicles; while the NABP allows railroads contribute their own equipment to the pool, and TTX facilitates their efficient distribution across the network.

The AAR collects data of railroad performance measures on a weekly basis from all railroads, administers standards in the train industry relating to technical issues of interoperability between railroads (such as data communication, train control communications, operating rules, axle loads, total weight per unit of train length, etc), maintains and publishes a comprehensive Manual of Recommended Standards and Practices for freight cars and locomotives, administers standards of dimensions of consignments, bridges and tunnels in association with Railway Industrial Clearance Association of North America (RICA). (Cramer, 2007) and maintains and publishes Interchange Rules containing technical standards required to be met for rail cars to be acceptable for nationwide operations. AAR's subsidiary Railinc Corporation maintains a national register of freight equipment, nationwide freight car location information, an official register of freight car rental rates, and inter-railroad billing and payment systems. AAR's Transportation Technology Center Inc (TTCI) manages the FRA owned Transportation Test Center (located at Pueblo, Colorado) to carry out railroad research and testing for AAR, FRA, suppliers, overseas clients and railroads on areas such as passenger car analysis and testing, tests on prototype cars and locomotives, acceptance tests for cars and crashworthiness tests. AAR also provides quality assurance services to manufacturers of safety critical freight car components, such as wheels axles, bearings, truck frames, and brakes.

AAR allows railroads to share their expertise and best practices, while developing industry standards and practices to enable seamless transport across different railroads. For example, locomotives are not changed while crossing from one railroad to another, since operations practices are standardized across all railroads allowing crew of one railroad to operate a locomotive of another railroad.

3.2 Revenue augmentation measures

Railroads have adopted various measures to augment revenues. Few measures have also resulted in significant cost cutting too, as discussed below.

3.2.1 Augmentation of train hauls

Carrying capacity of freight cars along with number of cars hauled by trains has been progressively increased by railroads. This has been accompanied by investment in improving the load carrying capacity of tracks and bridges along with increases in tunnel clearances to accommodate higher cars and double stack container flat cars.

Average train lengths for auto trains are 64 to 57 cars, for bulk trains 86 to 112 cars, for general merchandise 81 to 82 cars and for intermodal trains 111 to 164 cars. (Cambridge Systematics, Inc., 2007) Typical each coal rake comprises upto 125 wagons with payload of 100 tonnes payload each, thus carrying 12500 tonnes. Average shipment size has increased dramatically from 582 tons and 6 carloads per waybill in 1987, to 9,634 tons and 86 carloads in 2006 for Powder River Basin coal. (Laurits R.Christensen Associates Inc., 2009)

3.2.2 Central Traffic Control

All the Class I railroads have switched over to centralized system of traffic control for ensuring the most efficient use of resources. Under the centralized systems of traffic control, the dispatching of trains over the entire territory is controlled at a centralized location, usually the corporate headquarters of the railroad. Centralized system of traffic control allows integration of various activities of a network at a single location, while being computer aided for optimal decision making. Typical activities that are carried out are planning, controlling, and monitoring of the flow of trains over the whole system with a view to maximize service levels and control costs, along with locomotive management, crew management, maintenance scheduling, and terminal operations management. Centralized traffic controls of various railroads are able to exchange information on real time basis which enables seamless flow of traffic as well as updates on traffic movements for the shipper. The net result of centralized traffic control is that average speeds of US railroads are much higher than other world railroads resulting in faster turn-around time, better utilization of assets and hence higher returns and lower unit costs. The NTKM per freight car per day on US railroads is the highest in the world at 16,251 million compared to 11,583 million on Australian railroads, 10,608 million on Chinese railroads, 10,104 million on Russian railroads, 9,892 million on Canadian railroads, 6,994 million on Japanese railroads and 6,344 million on Indian Railways.

The central traffic control computer systems provide additional advantage to the railroads in generation of enormous database of traffic patterns on various parts of the railroad network. This database allows for simulation of behavior of the network under different forecasts for commodities thus providing railroads with systematic inputs for network augmentation or strengthening decision making.

3.2.2 Partnership with other transport modes

Railroads have entered into partnerships with trucking companies, seaports, and others in the transportation logistics chain to augment traffic volumes over their networks or to attract high value traffic. Here railroads handle the long-haul movement of large quantities of containers and trailers between major hubs such as seaports and major population centers, while truckers handle the short-haul movement to/from the customer's "front door."

Since freight haul becomes more economical on rail for distances above 500 miles (Cramer, May 2007), truckers consolidate loads for shipments by rail over long distances. Thus major trucking companies such as Schneider, JB Hunt etc have contracts with railroads for regular scheduled shipments by rail. Express logistics services such as UPS also have contracts with rail for shipment of low-end products by rail.

Over the past decade, railroads have introduced scheduled intermodal services with guaranteed reliability (e.g., within 1.0 hours of schedule, 99 percent of the time). This method of operation entails running trains of specific configurations between a particular origin-destination pair according to a pre-determined schedule. The benefits for the road partner is that the hauling time by railroad is consistent, allowing the roadways to guarantee a level of service to its own customer. The benefit for the rail partner is that uncertainty in train operations are minimized and optimal utilization of assets can be realized. CN has attributed its below average operating ratio (around 67) to scheduled services. Norfolk Southern, CSX and BNSF are also trying out scheduled freight train services. (How CN does it, May 2001) (E.Hunter Harrison- The master of scheduled railroading: Railroader of the year, January 2002)

The rapid shift of US industry towards JIT practices, with implications of smaller consignments and reliable delivery services had made the railways inherently less competitive than roadways. However the alliances with roadways by the railways have enabled the railways to capture part of the low volume high value freight traffic. The geographical spread of the US has enabled the induction of such alliances since the necessary transshipment times and transfer costs are a negligible fraction of the total time and cost. (Paul Amos, 2009) The US railroads have demonstrated their competitive ability through their ability to evolve with the markets that they serve, to rapidly develop new services that are responsive to shippers' needs and to become customer "problem solvers" not "order takers". (Thompson, August 1995) Multimodal transport has allowed also railways to increase market reach without additional investments in network expansion. (Paul Amos, 2009)

3.2.3 Valued added services

Few railways have started collaborating with manufacturers for providing supply chain solutions. A prominent example is the 10-year alliance between Union Pacific(UP) railroad and Daimler Chrysler, wherein UP will oversee the distribution logistics of Daimler Chrysler through a web-based delivery management system named Insight Network Logistics. The delivery management system will track every car Daimler Chrysler makes in the United States, from the factory to the dealer, through coordinating the use of both railroads and trucks and managing the schedules involved, to ensure that Daimler Chrysler receives the most efficient and cost-effective shipping timetable. (Strategic Innovations in North American Railroad Management, 2005)

3.3 Organization Design

The US railroads have a single marketing organization which allows for close coordination with the customer and operations. This allows the railroads to tune packages to customer requirements and coordinate closely with operations.

Since 1981, BNSF made a number of organizational changes to better address market needs: the marketing organization, which was previously partitioned by geographic regions, was reorganized by commodity groups; previously independent sales and marketing organizations were integrated and placed in the commodity group structure; in addition a separate intermodal commodity group was created containing marketing and operations together. (Harvard Business School, 1989)

A few features of US railroads organization structure is worth noting. The COO is the nodal executive handling operations, technology and marketing. Concentration of these three key activities in a single executive allows focused marketing and delivery of services (through operations) with the best possible technology. This arrangement is in sharp contrast to many railroads having functional organizations, where effective operations are dependent of functional technical organizations handling locomotives, crew and cars. The arrangement allows for effective accountability and development of a lean organization tuned to customer sensitivities.

4 Enabling factors

A few enabling factors aided the efforts of the Class I railroads to be profitable. The first factor is the passage of the 1980 Staggers Act. The Staggers Act allowed railroads a high level of freedom in setting rates and gave railroads the right to negotiate private rate contracts with shippers. The Staggers Act mandated a rail cost recovery index to measure the impact of inflation on railroad and permitted quarterly rate changes to offset the increased costs of labor, materials and supplies, through the Rail Cost Adjustment Factor (RCAF).

The second factor is that US Class I railroads have become totally freight oriented. Prior to Amtrak's creation as a sole intercity U.S. passenger rail carrier in the continental United States by the Rail Passenger Service Act of 1970, railroads used to incur hundreds of millions of dollars in annual losses from passenger operations. Amtrak's creation allowed railroads to exit passenger business. Freight railroads must however grant Amtrak access to their track upon request and give priority status to Amtrak trains over all other customers. In addition to Amtrak, many commuter and light rail systems operate primarily or exclusively over tracks owned by freight railroads.

The third factor is that US Class I railroads receive federal funding for undertaking works which might not be directly linked to commercial activities of the railroad but have community, societal or national implications. Examples of such federal funding are the Section 130 Rail-Highway Grade Crossing Program, National Highway System (NHS) Program for funding improvement of highway links, Surface Transportation Program (STP) for funding lengthening or increasing vertical clearances on highway bridges, or improving at-grade crossings, Congestion Mitigation and Air Quality (CMAQ) for funding transportation projects that improve air quality, Transportation Infrastructure Finance and Innovation Act (TIFIA) providing credit assistance (up to one-third of project cost) for major transportation investments of national significance, Railroad Rehabilitation and Improvement Financing (RRIF) provides credit assistance, National Corridor Planning and Development (NCPD) and Coordinated Border Infrastructure (CBI) programs for projects that serve border regions near Canada and Mexico and for high-priority corridors throughout the United States, Transportation and Community and System Preservation Pilot Program (TCSP) for funding for a wide variety of transportation and public policy initiatives to achieve locally determined goals (typically used for rail realignment, overpass construction, and studies of grade separations and redevelopment of rail-served brown fields) and Transportation Enhancements (TE) for supporting non-traditional transportation-related improvements, and have been used for rehabilitation of historic/cultural rail facilities and for branch line improvements .

The fourth factor favoring US railroads is the large continental spread of the country which results in long distances of transportation. The average distance of freight traffic hauled by rail is one the

highest in the world; US at 1439 km for US Class 1 railroads compared to 1520 km for Canadian Pacific, 1450 km in the Russian Federation, 1362 km for Brazil's BR Ferronorte, 1235 km for Canadian National, 1210 km for Mexico, 838 km in China, 831 km for Brazil's BR EFC Carajas, and 661 km for India. (United Nations Conference on Trade & Development, 2010). Typical examples of these long distance movements are the movement of coal from Powder River Basin of Wyoming to South and Northeast US and the container traffic from Californian seaports to Texas and St.Louis markets. As mentioned earlier, since freight haul becomes more economical on rail for distances above 500 miles (Cramer, 2007), US railroads gain significant advantage over road transport for very long distance traffic.

The fifth factor favoring the US railroads is the prevalence of a few very high density traffic routes. A major reason for few high density routes in the US is extent of urbanization; about 81.4% of population resides in urban agglomerations in the US (United Nations Department of Economic & Social Affairs Population Division). Only 36 largest cities in the US make up 39.5% of the US population; in contrast 43 largest cities in India make up only 12.1 % of the Indian population. The high concentration of population in certain urban agglomerations translates into major traffic destinations, due to demand in those locations. An example of this is the transportation demand associated with the thermal electricity production industry. Analysis of distribution of electricity power generation capacities shows that 48% of installed power generation is located in only the ten states of Texas, California, Alabama, Georgia, Florida, Illinois, Michigan, Ohio, Pennsylvania and New York. (U.S. Energy Information Administration, December 2010) Thus there are very high density routes from the coal fields of Powder River Basin to these states. Thus while 74% of coal originated from the three states of Wyoming (52.2%), West Virginia(13.2%) and Kentucky(9.2%), 58% of the coal terminated in these ten states of Illinois, Texas, Missouri, Virginia, Wisconsin, Ohio, Georgia, Pennsylvania, Indiana and North Carolina.

5. Implications

Class I railroads have leveraged the enablers to evolve to the present industry structure of a few typical high density large lead distance routes. It has further taken proactive measures to cut down costs through leasing of rolling stock, reducing maintenance activities and shedding non-core activities whilst augmenting revenues through introduction of heavy haul trains, centralized traffic control and garnering traffic through partnership with industry and other traffic modes. These steps have led to a spiral effect of high profits followed by high investments in productivity enhancing measures such as computer aided dispatching, automatic equipment identification, automatic fault detection devices, equipment diagnostics etc. which in turn have led to high service levels.

Fig: Spiral of Profits

There has been a rapid expansion of information and communication technologies in the last three decades. US railroads have successfully deployed their applications for improvement of productivity, asset utilization and customer service and to become much less labor intensive. The US railroads thus operate with much less manpower than other railways around the world. However applications of information and communication technologies have required induction of labor with higher skill levels. Examples of higher skills are train crews who can minimize energy and maintenance costs through driving techniques, terminal staff who can drive modern materials

handling equipment, train and traffic controllers who can use sophisticated IT systems, marketing staff who can manage client relations and not just waybills etc. (Paul Amos, 2009) It must be noted that this deployment of new technologies required sufficient investments, which was possible since railroads were profitable in the first place.

One of the direct implications of deployment of information and communication technologies is has been the ability of US railroads to capture a significant share of the intermodal market. This market provides significant revenues to the railways, over and above the marginal cost. This also increases rail's share in tertiary product transportation and growing involvement in the nation's economy. The synergy demonstrated in this venture between rail and truckers has been possible only through greater deployment of information and communication technologies by both the rail and trucking companies especially in areas of waybill generation and tracking. In the US, shipment visibility is far greater today with advanced tracking technologies (such as Automatic Equipment Identification transponders for tracing freight cars) and web-based services, whereby customers can follow their individual shipments in real-time and make rerouting decisions en route if necessary.

Further US railroads have closely partnered with roadways to provide seamless intermodal transport. Freight containers are attached to truck beds for shipments to rail yards, then transported by rail to a distribution "hub," where they were again picked up by trucks for the final leg of their journey. These containers could also be transported by ship to port locations where they were transferred to rail for the journey inland. The intermodal system encourages cooperation and business collaboration between road and rail for the benefit of both industries. Intermodal transport has also been spurred by various technological innovations on the railroads, few examples of which are: (Reference for Business) (a) EDI, or electronic data interchange, allows the railways to track goods and trains more closely and quickly. (b) innovations such ISS (Interline Settlement System) and REN (Rate EDI Network), industry-wide standards of computerized data management that would manage revenue sharing among railroads when goods were shipped on more than one line, and speed billing and dispute resolution within the industry.

Thus US railroads thus have gained a substantial amount of traffic from sectors which were hitherto the preserve of the roadways. This has reduced the railroads dependence on transportation of primary products and opened the opportunities for exploring high value transport markets.

This has profound implications for the society too. The gradual shifting of choice of transport of other goods to railroads reduces road congestion, road accidents and deterioration of air quality. The U.S. Environmental Protection Agency estimates that for every ton-mile, a typical truck emits roughly three times more nitrogen oxides and particulates than a locomotive. Related studies suggest that trucks emit six to 12 times more pollutants per ton-mile than do railroads, depending on the pollutant measured. On average, railroads are three or more times more fuel efficient than trucks. (American Association of State Highway and Transportation Officials, 2009)

6. Conclusions

The paper illustrates the enabling factors for the US railroads in terms of advantages offered by the geography of the country, development of complementary leasing and equipment manufacturing industry and its favorable regulatory environment. However, the railroads would not have become

profitable without its proactive measures to reduce costs and augment revenues. Further the paper illustrates the implications of the profitability of railroads which has enabled them to invest in technology to attract non-traditional customers such as express freight and multi-modal traffic.

The question that arises there from is whether the US railroad model is replicable in other countries. While prima facie there appear to be challenges in its implementation in terms of state of competitive environment, development of complementary leasing and equipment manufacturing industry, and setting up of appropriate regulatory structures its utility for implementation on other railroads merits further research.

Acknowledgement: This study was funded by the United States-India Educational Foundation and the Fulbright Commission through Fulbright-Nehru Senior Research Fellowship granted to Prof. Bodhibrata Nag during 2010-11. The author also wishes to thank Dr.Pooja Dewan, General Director Decision Systems of BNSF Railway for hosting the research and providing valuable direction, inputs and comments.

Bibliography:

American Association of State Highway and Transportation Officials. 2009. *The Bottom Line Report*. Washington DC : AASHTO, 2009.

Battelle. 2010. *Identifying and Using Low-Cost and Quickly Implementable Ways to Address Freight-System Mobility Constraints*. Washington DC : Transportation Research Board, 2010.

Cambridge Systematics, Inc. 2007. *National Rail Freight Infrastructure Capacity and Investment Study prepared for Association of American Railroads*. Cambridge, Massachusetts : Cambridge Systematics, Inc., 2007.

Cramer, Barton Emmet. 2007. *North American Freight Rail: regulatory evolution, strategic rejuvenation, and the revival of an ailing industry*. Iowa City : University of Iowa, 2007. PhD Thesis .

—. **2007.** *Rail, North American Freight: regulatory evolution, strategic rejuvenation, and the revival of an ailing industry*. Iowa City : University of Iowa, 2007. PhD Thesis .

—. **May 2007.** *Rail, North American Freight: regulatory evolution, strategic rejuvenation, and the revival of an ailing industry*. Iowa City : PhD Geography Thesis of University of Iowa, May 2007.

E.Hunter Harrison- The master of scheduled railroading: Railroader of the year. **Vantuono, William C. January 2002.** 1, s.l. : Railway Age, January 2002, Railway Age, Vol. 203.

Harvard Business School. 1989. *Burlington Northern*. 9-689-081, Boston : Harvard Business School, 1989.

How CN does it. **Vantuono, William C. May 2001.** 5, s.l. : Railway Age, May 2001, Vol. 202.

Laurits R.Christensen Associates Inc. 2009. *A Study of Competition in the US Freight Railroad Industry and Analysis of Proposals that might enhance competition- Study Report prepared for The Surface Transportation Board*. Madison, WI : Laurits R.Christensen Associates Inc., 2009.

Paul Amos. 2009. *Freight Transport for Development Toolkit: Rail freight.* Washington DC : World Bank Department for International Development Transport Research Support program, 2009.

Reference for Business. Encyclopedia of American Industries. [Online] [Cited: December 17, 2010.] <http://www.referenceforbusiness.com/industries/>.

Strategic Innovations in North American Railroad Management. **Natarajan, Balu, Duncan, Chandler and Simpson, David. 2005.** Washington DC : Transportation Research Board of the National Academies, 2005, Vol. 1924.

The Magnificent 7: Union Pacific steps up to the challenge. **Vantuono, William C. September 2004.** 9, s.l. : Railway Age, September 2004, Vol. 205.

Thompson, Ron Kopicki and Louis S. August 1995. *Best methods of railway restructuring and privatization.* Washington DC : World Bank Cofinancing and Financial Advisory Services(Privatisation Group), August 1995.

U.S. Energy Information Administration. December 2010. *Electric Power Annual 2009.* Washington DC : U.S. Department of Energy, December 2010.

United Nations Conference on Trade & Development. 2010. *Review of Maritime Transport 2010.* New York & Geneva : UNCTAD Secretariat, 2010.

United Nations Department of Economic & Social Affairs Population Division. Urban & Rural Areas 2007. [Online] [Cited: December 23, 2010.] www.unpopulation.org.

White, Thomas. 2003. *Elements of Train Dispatching Vol.I-History & Overview of Train Dispatching and Railroad Operation.* Mountlake Terrace WA : VTD Rail Publishing, 2003.