INDIAN INSTITUTE OF MANAGEMENT CALCUTTA

WORKING PAPER SERIES

WPS No. 699/ May 2012

The US Railroads- their evolution, structure and operations

by

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Introduction

Both India and the United States of America share a common history of dominant role of railroads in the development of the economy. While the first common carrier of the US, the Baltimore and Ohio Railroad (B&O, now part of CSXT), commenced services on a 13 mile stretch in 1830, railways commenced operations in India in 1853 on the 21 mile Mumbai-Thane stretch (1). While the US railroads expanded westwards over the next fifty years to bridge the American continent, Indian railroads were also being built to connect the vast sub-continent to the major sea-ports albeit at a much slower pace.

Growth of US and Indian Railroads

Year	1830	1840	1850	1860	1870	1880	1890	1900
US railroad miles	23	2,818	9,021	30,635	52,914	93,296	163,597	193,346
Year				1861	1871	1881	1891	1901
Indian railroad miles				1,587	5,074	9,723	16,690	24,185

Sources: (2; 1)

Today the US railroads carry 43% of the nation's freight traffic, while operating at a far lower operating ratio and with much less manpower than the Indian Railways. The US have large populations and economies, the challenges and opportunities for both the US and Indian railroads are similar. Thus a study of the evolution, structure and operations of the US railroads has been undertaken in this paper to examine the possibility of emulation of few practices on the Indian Railways. (4). This paper is organized as follows: the evolution is discussed in Section 2, industry structure in Section 3, regulation in Section 4, freight traffic in Section 5, organization structure in Section 6, operation in Section 7, equipment in Section 8, technology for productivity enhancement in Section 9, followed by discussions on strategic lessons in Section 10 and conclusions in Section 11.

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2. Evolution of US Railroads

The US government has treated the transportation sector similar to any business sector of the free market economy, in tune with the US traditions of competitive liberalism. (5) US railroads were thus mostly constructed and owned by entrepreneurs. Only a few railroads were owned by Government- examples being the Alaska Railroad, Amtrak, Conrail (but subsequently divested). However, the government did play an active role in the railroad development. From 1850 to 1880, the federal government gave around 131 million acres land grants and loans of up to $48,000 for each mile of railroad track built. State governments too invested in the building of railroads through purchases of stocks or bonds or donations to railroad companies. Few states, such as Missouri, North & South Carolina Illinois, Indiana, Michigan, Georgia, Tennessee, Virginia, and Louisiana, also participated in construction of railroads. (2) By 1906, the United States had laid 222,000 miles of track which was 40% of the railway mileage in the world (2).

2.1 Growth and Technological Innovation

Railroad expansion in the US was also promoted by a series of indigenous technological innovations. The first completely American built locomotive “The Best Friend” was made in New York for the Charleston & Hamburg Railroad in 1830. In 1864, George Pullman developed the first Pullman sleeping car. Major Eli Janney invented the Janney coupler in 1868, replacing the dangerous link and pin coupler. George Westinghouse invented the airbrake in 1869, which was patented in 1872 and quickly became an industry standard; later the Federal Railway Safety Appliances Act of 1893 instituted mandatory requirements for automatic air brake systems and automatic couplers. The first refrigerator cars went into operation on the Southern Pacific in 1886, making it possible to deliver perishable fruits and vegetables all across the nation. The General Electric Company built the first Diesel-electric engine prototype in 1917; the American Locomotive Company built the first Diesel-electric locomotive in 1925 which started the process of replacement of steam-powered engines. In 1957, Southern Pacific emerged as the first railroad with only diesel locomotives.

2.2 Growth and regulation

The unfettered growth of the railroad industry led to companies operating multiple railroad services on major traffic routes. Competition for traffic led to discriminatory pricing behavior and price cutting wars to recover their investment. Initial efforts for regulation were spurred in the 1870s by efforts of an organization of farmers called the “National Grange of Patrons of Husbandry” or the “Grangers” for securing cheaper transportation rates for farmers through regulation of railroads. The federal regulatory agency Interstate Commerce Commission (ICi9Co

Hepburn Railroad Regulation Act prohibited railroads transporting commodities in which it had interests, imposed monetary and prison penalties against rebates and empowered ICC to inspect railroad accounts to uncover rebate abuses and establish rates which were "just, fair and reasonable". (6) The Transportation Act of 1920 increased the powers of the ICC to help 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. Class III railroads should have annual operating

revenue (million USD)					
Total operating expenses (million USD)	10,640 32.5% compensation & benefits 22% fuel expenses 17.5% purchased services[2] 7% equipment rentals[3]	10,751 38% compensation & benefits 16% fuel 15% purchased material & services 11% equipment rents	6,756 39% labor & fringe 13% fuel 6% equipment & rents	6,007 40% compensation & benefits 12% fuel 18% purchased services 5% equipment rents	1212 27% compensation & benefits 16% fuel 14% equipment costs 14% purchased services

Most Class I's railroads have become "wholesalers" of line-haul transportation with preference for unit trains, while the "retail function" of aggregation or disaggregation have gradually been transferred to short-lines, steamship companies, motor carriers, or other third parties. BNSF reported in 2009, that over half of the freight revenues of the Company are covered by contractual agreements of varying durations, while the balance is subject to common carrier. BNSF Railway has also entered into marketing agreements with CSX Transportation, Canadian National Railway Company and Kansas City Southern Railway Company, and 200 shortline railways. CSX Transportation has agreements with 240 short-line and regional railroads.

perform point-to-point service over short distances. Most operate less than 50 miles of road (more than 20 percent operate 15 or fewer miles) and serve a single state. (11)

The regional and short-line railroads are 94.5 percent private and 5.5 percent public-owned. These railroads originate 16 percent of national traffic, generate nine percent of railroad revenue, while operating more than 20 percent of total system mileage. 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), 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. (9)

3.3 Switching and terminal carriers

The fourth group includes Switching and terminal (S&T) carriers, which are railroads, regardless of revenue, that primarily provide switching and/or terminal services. Rather than point-to-point transportation, they perform pick up and delivery services within a specified area for one or more connecting line haul carriers, often in exchange for a flat per-car fee. In some cases, S&T carriers funnel traffic between line haul railroads. Switching establishments, which may or may not be run by the railroads that use them, can use up to 100 track segments on which cars and locomotives are coupled and uncoupled, loaded and unloaded. In 2006, there were 196 S&T carriers. The largest S&T carriers handle hundreds of thousands of carloads per year and earn tens of millions of dollars in revenue. Industry leaders are the Indiana Harbor Belt Railroad Co. of Hammond, Indiana, Belt Railway Company of Chicago, of Bedford Park, Illinois, Missouri-based Terminal Railroad Association of St. Louis, Cuyahoga Valley Railway Company of Peninsula, Ohio, and New York-based South Buffalo Railway Co. (11)

3.4 Trackage and Haulage Contracts

Individual railroad companies combine, coordinate and connect their tracks and facilities to hold down overall costs. Examples are Pair tracks (two railroads have single lines between two points; both use these single lines for up and down directions), Trackage rights (pay toll or “wheelage” charges based on number of cars involved, to use other railroad’s tracks), Joint facilities (jointly owned company responsible for operation of a line), Detouring(railroads have standard detouring agreements with each other, so that trouble spots may be bypassed in emergencies) and Haulage (railroad A pays another railroad B to move its consist over another railroad B’s territory using B’s crew and power). Other examples are alliances such as the one between Canadian National and Kansas Cit5.3(tai.5(a)-8.8(Canad.8(l)-4.koa2)-6.3(ed A)-5.cd

Table: distribution of transport infrastructure, population and the economy in the US

	Northeast[4]	Midwest	South	West	Others
Area	5%	22%	24%	31%	18%
Population	19%	23%	35%	22%	1%
GDP	21%	21%	34%	23%	1%
Interstate Road	11%	27%	34%	25%	3%
Railroads	9%	36%	36%	19%	-

The Midwest rail hubs, of which Chicago is the largest, serves as interchange points for coast-to-coast traffic, where the West Coast Class I's must interchange with the East Coast Class I's. This costly exercise involves switching railcars from one system to another, one crew to another, and in some cases, the transshipment using dray containers from one yard to another. Class I railroads are trying to reduce this exercise through marketing agreements, trackage and haulage arrangements, and operating coordination, to enable "run through" services. (9)

3.7 Government funding support

Even though the railroads are entirely in the private sector, federal funding is available for the railroads programs such as 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, Transportation and Community and System Preservation Pilot Program (TCSP) and Transportation Enhancements (TE) .

3.8 Pat

4.1 Federal Railroad Administration

The Federal Railroad Administration (FRA) is the principal US Department of Transportation agency concerned with railroads. The FRA has three principal offices : Office of Policy and invested in railroads is at least as great as that earned on capital invested in other industries), allows flexibility in setting of rail rates in response to differing circumstances and protects shippers from the exercise of market power by railroads.

The STB determines whether the degree to which the markup of differential pricing for captive traffic above the LRMC (long-run marginal cost) is reasonable, in case rates are challenged by shippers. (13) STB is also responsible for resolving disputes between Amtrak with freight railways over access rights and payments.

The Stagger's Act made it regulatory for the ICC/STB to make an annual determination of the revenue adequacy of each railroad- the relationship of ROI to the cost of capital. The STB also uses the rail cost recovery index or rail cost adjustment factor (RCAF) as a measure of inflation; this is designed to allow railroads to adjust rates commensurate with inflation without potential for challenge by rail customers.

4.3 National Transportation Safety Board

The National Transportation Safety Board (NTSB) investigates serious individual substantially greater rights than the National Labor Relations Act (NLRA) that governs industrial relations for private-sector employees elsewhere in the economy. The Act empowers either party to disputes to request the services of the National Mediation Board. Minor disputes regarding grievances or the interpretation or application of an agreement are handled through a prescribed arbitration process and employees cannot strike over such issues. (10)

iv. The Federal Employers Liability Act (FELA), is a unique “no-fault” workers' on-the-job injuries and occupational health problems compensation system for most employees of interstate railroads; liability is based on the negligence of the employer railroad, its

Interchange Rules containing technical standards required to be met for rail cars to be acceptable for nationwide operations.

AAR has established a subsidiary, Railinc Corporation, to provide data services to the freight railroads, including 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. The payment systems are used for sharing freight revenue in compliance with agreed contracts, making car hire and demurrage payments applicable when a freight car is not on the owning railroad's property, making freight car repair payments, and other similar functions.

AAR has also established the Transportation Technology Center Inc(TTCI) to manage the FRA owned Transportation Test Center (located at Pueblo, Colorado), 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, crashworthiness tests for FRA and Volpe Center). AAR provides quality assurance services to manufacturers of safety critical freight car components, such as wheels axles, bearings, truck frames, and brakes. The American Public Transportation Association (APTA), which is the industry association for all modes of local and regional public transportation, including commuter rail, performs functions similar to AAR. (10)

4.5.2 American Railway Engineering and Maintenance-of-Way Association (AREMA)

The AREMA is a professional association for individuals interested in all aspects of railroad infrastructure engineering, including railroad track, structures, and signal and train control systems. AREMA's members are professionals working with railroads, rail transit systems, research and academic institutions, consultants, suppliers, and others. AREMA publishes the Manual for Railway Engineering and Communications and Signaling Manual, which are

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charges the BOL is “prepaid”; if consignee is to pay freight charge, the BOL is marked “collect”. After receipt of BOL from X, the EWR rating system will rate the shipment (after checking appropriate tariff documents) and generate a waybill (containing information on car number, waybill number/date, origin, name of shipper, consignee, destination, route of car travel, STB code for the commodity, physical description of articles, weight of shipment, applicable rate, total freight charges, prepaid or collect). The waybill is a contract between railways moving the shipment; the junction stations indicated will determine the sharing of revenue between railroads. The last handling carrier is responsible for collection of freight charges and distribution amongst handling lines; this is tracked electronically by all handlers through AAR procedure known as Interchange Settlement System(ISS) effected in 1996. Each railroad has the opportunity to approve or question its share electronically; all objections must be settled within a fixed time frame by negotiations or it will be settled arbitrarily.

After the waybill is generated, a switch crew goes to X’s siding, picks up the car and takes it to the classification yard for switching the car into the proper outbound train. Cars are assembled into blocks for individual destinations. Each block has a destination that represents the next processing yard for the cars in that block. Blocks are combined into trains for the line haul. Trains may directly leave from the classification yard or sent to departure yard for mandatory pre-departure mechanical and air brake tests. All the waybill data for a particular train are compiled in a “wheel report” for the train conductor. The train consist data is also fed to the central computer.

Before the train departure, the crew call system identifies the crew members to be called by the crew caller, locomotive is prepared by the locomotive dispatcher and service track foreman and cars made ready by yardmaster and mechanical crews. If operating on CTC, the CTC dispatcher sets up the meets and overtakes consistent with the train’s priority relative to other trains. A train may set out or pick up blocks of traffic or both en route.

In order to send X’s consignment to AA, it will have to be turned over to the SW&AA Railroad at city G. Before the train reaches G, the EWR yardmaster in G has already received the consist report from the computer. Using this report, he makes up a switch list for his switching crews. Once a new train is formed after switching at G, EWR personnel will enter a interchange delivery report in the computer confirming handing over to SW&AA Railroad. Once the SW&AA train reaches AA, the consignee is notified that the car from X has arrived. A freight bill is prepared for the consignee (on basis of waybill information), unless the charges have been prepaid.

After unloading, the car is returned back to the railroad. The equipment distributors decides its next trip and directs the railroad to send the empty to a different location. However the railroad decides how the empty reaches the location, through decision on the series of trains that the car gets attached to. One of the major problems arise when cars originate in one railroad and terminate in another. Efficient strategies are required to position the empty cars properly; an estimator of the proper positioning is the ratio of empty-to-loaded car miles.

According to current system, cars are grouped into four categories- general service, general service pools, special service and private cars; there are norms laid down by AAR for empty movement of each of each categories . (43) In order to decide the empty equipment distribution, various railroads use software. Examples are Dynamic Car Planning System (DCP) developed by Princeton Transportation Consulting Group (now part of the Sabre Group) for CSXT in 1995-97 and the Equipment Distribution Optimization system (EDO) developed internally by BNSF between 1998 and 2000. (44)

7.2 Train Scheduling

Scheduling consists of establishing a time and place where rail vehicles, operators and freight to be carried are matched. Scheduling is important since capacity associated with infrastructure, personnel and equipment are limited. In absence of CTC or feedback from stations enroute, trains were run on US railroads to schedules prepared days in advance of actual train departure. Since 1980s, with advent of CTC, prepared schedules are no longer in use. Train schedulers operate the rolling stock on the infrastructure (track, signals, stations) using a “software” based on the system of operating rules and procedures.

About 4000 train dispatchers schedule trains through train orders and signaling system, as well as coordinate with yards and maintenance staff. Dispatchers typically use timetables, train sheets (station vs time graphs), track diagrams/track chart/condensed profile (showing road crossing, signals, signaling system, operating rules in effect, type/size/age of rail, last ballast maintenance, culverts, grade, elevation, alignment/curves, signal location, turnout size, speed limits, track maintenance gang), tonnage table (haulage capacity of locomotives) and train order book (record of instructions issued with date/time). Other aspects could be Handling Procedures for Hazardous Materials and Labor Rules.

7.3 Centralized Traffic Control(CTC)

Under the centralized systems of traffic control operating on a few Class I US rail roads, the dispatching of trains over the entire territory is controlled at a centralized location, usually the corporate headquarters of the railroad.

BNSF’s James J Hill Network Operations Center (NOC) at Fort Worth provides tactical

Union Pacific consolidated its dispatching operations at its Omaha facility in 1988. The Harriman Dispatching Center (HDC), located in Omaha,Nebraska, is Union Pacific's primary dispatching facility. It is linked to regional dispatching and locomotive management facilities at various locations along the network. The HDC moves locomotives and trains,manages traffic on the network, and coordinates interchanges with other railroads. It employs Computer-Aided Dispatching (CAD) System; Using auto-routing, dispatchers assign an identity and priority to each train; the computer then takes over and routes trains according to priority, while also automatically determining the meeting and passing of trains on single-track sections. The CAD system is based on prioritized rules used by dispatchers in handling meets and passes. There are 30 dispatch centers with keyboards to enable CTC control by dispatchers. (30)

In order to diffuse the benefits of CAD, the American Rail Dispatching Center (ARDC), a wholly owned subsidiary of RailAmerica, began operation in 2003. The center controls rail traffic for both short line and Class I railroads in 19 states.

Kansas City Southern (KCS) implemented Management Control System (MCS), developed by Infosys(India), as a planning tool for transportation management from customer order entry to shipment delivery. The system is also tied with an Automatic Equipment Identification (AEI) network to keep managers informed of what happened to shipments after the service plan and schedule are prepared according to customer requirements. It also incorporates a web-based component KCSR Online Transaction for online entry of car orders and waybill data. Other components are the Locomotive Management System and Interline Service Management (ISM) (which exchanges data on shipment status and estimated time of arrival with that of other railroads through the rail industry's Railine IT base). (31)

Typical software used for CTC is the Big Picture Tools developed by DigiCon. This tool allows real-time geographical display of trains and equipment and provides views that zoom from an entire railroad to a train or station, along with details of surrounding cities or towns and major roads. Users can easily identify trains with exceptions such as running behind schedule, crew hours of service nearing completion, or failed locomotives. Clicking on any train gives details of its manifest. This tool allows analysis of operations showing capacity utilizations. Another software is the Active Traffic Management software which incorporates information of terminal and maintenance operations to generate an integrated movement plan, based on real time traffic conditions, slow orders, train schedules, crew hours and maintenance windows. It allows dispatchers to schedule meets and[5] passes and integrate real time planning between multiple railroads. Terminals are also benefitted with recently developed Optimizing Traffic Planner (OTP, by US&S) for UP optimizes movement of trains across a network to satisfy complex logistics and operation needs as well as business objectives; it considers aspects such as train schedule deviation, cost of lateness and cost of fuel; its “problem solving engine” can generate multiple train movement plans continuously, select the best one for execution, and generate revised plans based on information received from field. Domain Operations Control (DOC) carries out yard management, which includes

US railroads employ four main types of diesel power: (1) end cab switcher, 5% of fleet (2) four axle road switcher, 1500-3200 hp, 20% of fleet (3)six axle medium horsepower road switcher, 2400-4000 hp, 15% of fleet and (4) high horsepower six axle road switcher, 3800-6000 hp. The main suppliers of locomotives are EMD and General Electric for high-power diesel-electric freight locomotives.

In-depth inspections of locomotives are generally conducted every 92 days, planned maintenance every 184 days and major overhaul every 6 years. All locomotives are equipped with air-conditioned “comfort cab” with carefully designed features (such as positioning of chairs, controls and displays, cab lighting, etc. design) selected through a joint committee including train crew members. The locomotive is manned by an engineer and a conductor; the engineer controls the engine throttle, brake and whistle, while the conductor monitors signals. If the train is switching out loaded or empty freight cars at customer facilities, a brakeman assists the engineer and conductor. Many locomotives are equipped with Automatic Engine Start Stop (AESS) which turns off the engine if it idles more than 10 minutes.

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. (14)

8.3 Track

cars to smaller shippers who could not afford to maintain their own fleets. Some shippers who owned small specialty fleets chose to enter sale-leaseback agreements. By selling their cars to an operating lessor and leasing them back under an operating lease, the shipper transferred all maintenance responsibility to the lessor and shed a business that was usually cumbersome to manage and unrelated to principal revenue-generating operation.

Railcar leasing companies are intermediaries in the transportation industry. Leasing of equipment by railroad companies are guided by corporate tax implications, especially in terms of assets owned and book depreciation. Leasing companies offer two basic leasing options: capital leases and operating leases. A capital lease bestows all the economic benefits and risks of the leased property on the lessee. These contracts usually cannot be canceled and the lessee is responsible for the upkeep of the equipment. Capital leases usually amortize the value of the equipment over the life of the lease. An operating lease, also called a service lease, is written for less than the life of the equipment and the lessor handles all the maintenance and service. The operating lease usually can be canceled if the equipment becomes obsolete or unnecessary. Most railcar leasing companies are either operating or capital leasing companies, though some of the larger companies have separate operations offering both types of leases.

The largest lessor is Chicago-based General Electric Railcar Services Corp., a wholly owned subsidiary of GE Capital. A merger with Itel in 1992 left GE Railcar with a fleet of 140,000 freight cars, the largest and most diversified fleet in the industry. The company also had the most extensive repair network with 11 railcar repair facilities, 9 mobile repair facilities, and 6 wheel shops in the United States and Canada. Despite the size and diversification of its fleet, GE is best known for its boxcars. In second place is TTX Company, also of Chicago. TTX specializes in intermodal cars. In third place is GATX Financial Corp. of Chicago, the largest lessor in the specialized market of tank cars. (39)

TTX, established in 1955, is jointly owned by a number of railroads, including the seven Class I railroads. TTX also designs and modifies cars to suit customer needs, research and testing (such as conducting field trials, instrumented track testing, impact testing) TTX railcars are serviced by three maintenance divisions in Florida, California, and South Carolina (42). Thirty one Field Maintenance Operations (FMOs) also provide inspection and repair services onsite.

Cars requiring heavy repairs, are repaired by TTX shops and Field Maintenance Operations (FMO). The shops are strategically located throughout the country for Scheduled maintenance and inspections(based on car mileage), Heavy Repairs (such as Wreck repairs, Program maintenance and modifications, Car dimensioning and cambering, rebuilding, Flipping/Turning of railcars, Car scrapping, Sand blasting, painting, and re-stenciling) and Light Repairs(such as running repairs, Warranty repairs, Wheelset replacement, Truck maintenance, Brake system testing and maintenance , Articulated car maintenance, Mobile truck capability). FMOs are light repair locations equipped for Light Repairs(such as piston travel adjustment, Grating platform maintenance, side bearing adjustments and replacement, wheelset replacement, safety appliance maintenance, running gear maintenance, lading equipment maintenance), Modifications and Component Upgrades and Car and Load Inspections(such as Pre-Trip inspections for preventative maintenance, Measuring high and wide loads, Brake system testing using computerized single car test devices). Few FMOs validate load securement (Tie down configurations), and measure loads (High and Wide load measurement) for dimensional moves. TTX operates mobile repair capabilities (mobile repair trucks with various welding, cutting, and material handling capabilities) from all of the shops and many of the Field Maintenance locations to make light running repairs, without having to direct a car to a shop. Cars requiring small repairs, are handled by railroads and TTX mechanically generates audit packages that provide a comprehensive audit based on current AAR Rules and historical trending. TTX operates a technical hotline to assist railroads in car maintenance procedures; TTX also provides training facilities for car inspection and procedures and responsibility rules. The pricing of parts and repairs is determined by AAR Office Manual.

BNSF uses technology to improve maintenance productivity. BNSF defines World Class Maintenance as “Know and track your assets. Predict and identify your work. Plan and execute the work. Report, measure and adjust”. Examples of this philosophy are the 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 histor

Other technologies being deployed by NS include Operating Plan Developer (OPD) for providing “what-if” analysis, Thoroughbred Yard Enterprise System (TYES) for assisting classification yard personnel in execution of mainline plans, Operating Plan Adherence (OPA) to measure train connection and blocking performance, Local Operating Plan Adherence (LOPA) to measure schedule car pickups and deliveries against plan, web based Commodity Transportation Management System (CTMS) for tracking and tracing cars by coal and grain customers and web based eFreight Bill and eDemurrage to allow customers to access their receivable accounts along with inquiries into freight and demurrage bills. NS has also automated its car rejection data acquisition process, allowing swift transfer of cars to maintenance facilities. (29)

Weather Forecasting for train operations: Railroads in the US operate under severe weather conditions. Typical hazards include blizzards, flash flooding, hurricanes and tropical storms. Wind speeds greater than 55 kph, might impact merchandise and intermodal traffic. Flash flood warnings require speed restrictions to be imposed, along with intensive track inspections. BNSF and CN works with a private contractor Weather Data to monitor adverse weather conditions that might impact operations. Data, customized to track locations, are sent directly to the concerned dispatcher who sets in motion activities according to protocols. Weather Data uses data from BNSF’s trackside wind detectors and temperature indicators along with other data. NS works with another contractor Weather Bank for changing weather patterns. Similarly UP works with Meteorologix. (17)

10. Strategic Lessons from US Railroads

The US railroads have evolved to the present state under a unique set of circumstances, a few of which are listed below:

a. Railroads in the US have had to battle for survival. Its primary competitors were road transport, which had the benefits of excellent road infrastructure, inherent last-mile advantages and lower investments since roadways do not have to build and maintain the road infrastructure in contrast to the railroads.
b. The US railroads have evolved in the US environment of entrepreneurship, free market economy and minimal government support. There had been government support in the initial stages of growth through land grants though. Latter instances of government support were through funding for specdl a234c0v7a4 4lA.8(e)8.4(dtuoad)-5d5.4

ton (ii) dispatch system replays (iii) marketing forecast information (iv) identifying available alternate train routings (iv) Train Performance Calculators (v) Train Dispatching Simulators. BNSF follows the following guidelines for augmentation of parallel tracks (8): (a) Single track with sidings about every 10 mile for less than 60 trains per day (b) Double track with CTC at or above this traffic level of average 60 trains and peak 75 trains per day (c) Double crossovers rated for 40mph every 10 - 20 miles at or above this traffic level of average 85 trains and peak 100 trains per day (d) Crossover spacing tightened to every 2 - 8 miles at or above this traffic level of average 70 trains and peak 85 trains per day (e) Triple-track any steep gradients or other slow sections at or above this traffic level of average 100 trains and peak 115 trains per day (f) Triple track selected low-gradient sections at or above this traffic level of average 120 trains and peak 135 trains per day.

The common packages used for rail capacity analysis on the railroads are the Rail Traffic

11. Conclusions

The strategic actions that are recommended for the Indian Railways in the light of the US experiences can be broadly classified as either efficiency or capacity enhancing measures. Switching to centralized trafficontrol, marketing oriented organizations and service design could be classified as efficiency enhancing measures. Increasing capacity of freight cars, increasing train lengths or increasing speeds could be classified as capacity enhancing measures.

Further in order to enable the Indian Railways to pro-actively serve the freight market, it is essential to institute reliable freight forecasting procedures along with network capacity modeling to identify and correct capacity constraints at the earliest.

Acknowledgement: This study was funded by the United States-India Educational Foundation and the Fulbright Commission through Fulbright-Nehru Senior Research Fellowship granted to the author.

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