REVITALIZATION OF PAKISTAN RAILWAY FREIGHT TRANSPORTATION UNDER CPEC SCENARIO

Final Year Project UG - 2018

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This is to certify that the

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Has been accepted towards the partial fulfilment of the requirement for

BE Civil Engineering Degree

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Dedication

Our beloved instructors for their unquantifiable love and their support,

Our beloved Parents for their unquantifiable love and their support,

and to our Project Advisor for sharing his wisdom and guidance

and encouraging us to complete this project successfully.

Last but not least, to our Institution and home for providing us with a platform.

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First, we would like to thank Almighty Allah because whatever we are, whatever has been achieved by us is solely due to Him and Him alone.

We would like to express our very great appreciation to our supervisor Dr. Muhammad Bilal Khurshid for his valuable and constructive suggestions during the planning and development of this work, as well as his invaluable guidance throughout this Endeavor.

Finally, we wish to thank our parents for their support and encouragement throughout our study, and the love they have shown to us in this life. Without them we would not be here.

All Syndicate members

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ABSTRACT

Freight carrying transport in a country plays an increasing important role in enhancing the competitiveness of economy globally and making an effective system of freight transportation. In Pakistan there are two dominant modes of freight transportation i.e. road and railway. Performance of Pakistan railway has declined manifolds in terms of its freight carrying capacity throughout the years. Pakistan railway's freight share declined from 73% in 1965 to 4% in 2017 [1]. Now as in 2018 with the development of CPEC and Gwadar port it is the dire need of Pakistan that railway shares significant amount of freight with road so as to minimize the deterioration of roads and utilize one of the largest rail networks in the world. CPEC has the potential of bringing political, economic and social dividends to people of Pakistan, so shifting of considerable portion of freight to Railway will decrease the expenditure for maintenance and reconstruction of roads and will increase the life span of a particular road.

Hence it has now become a necessity that in future railway should share significant amount of freight with road sector. Increasing freight load of railway must be coherent with development plans of CPEC i.e. short, medium and long term plans so that Pakistan railway shares 20% of freight load of Pakistan in 2025 as per Pakistan railway vision 2025. The presented project makes an effort to transfer specific percentage of freight share to railway in three distinct phases. Each phase incorporating increased share then previous phase and giving time for capacity building to effectively handle increasing freight. Three phases selected are same as the development plans of CPEC so that changes and plans are in synchronization with CPEC development i.e. short term plan, medium term plan and long term plan targeted till 2021, 2025 and 2030 respectively. In these options when specific percentage will be transferred to railway then the revenue of railway freight sector will increase and maintenance cost of national highways will be reduced. These options will then be analyzed for increase in annual revenue to railway freight sector and reduction in annual maintenance cost in terms of annual cost per truck. At the end all these options will be compared to show cost benefit analysis and cost effectiveness of Pakistan railway for freight transportation.

Chapter 1

1. INTRODUCTION

1.1 Background

In the current economy driven world, transportation sector forms the backbone of any country or state. The transportation industry is proven to be the defining factor of the country's progress. It also raises the quality of human capital which is a key factor for achieving high levels of growth. Transportation industry directly affects the economic growth of a country; it also generates employment opportunities. Pakistan has a reasonably developed transportation infrastructure for 220 million people [2].

1.1.1 Historical Background

Since creation, Pakistan has been revolving in the storm of tremendous amount of problems in almost every industrial sector. Road infrastructure was under developed but Pakistan was gifted with a well-structured rail network. The historical overview of Pakistan transportation sector can be divided into four time frames.

1.1.1.1 British - India period *(up to 1947)*

Back in 1853, the first passenger train started from *Howrah* to *Hooghly*. In 1861, Karachi and Kotri were connected by building main section of railways. While Grand Trunk road was constructed in the era of Sher Shah Suri and was referred to as *Shahrah-e-Azam*. This Road was renovated again in the British era from Calcutta to Peshawar [3].

1.1.1.2 Post Partition Era *(1947 to 1990)*

In this era railway was considered as the most precious vantage to the country and was only available inter-city public transportation. The first 5-year plan from 1955 to 1960 acknowledged the fact and stated railway as the backbone of Pakistan transportation industry. Railway carried 70 % of land transport in

this era. In 1957, National Planning Board gave its plan for development of transportation infrastructure which include development of almost 2000.00 miles of existing roads and 1800.00 miles of new roads, whereas this plan has no future extension of railways (Muhammad Imran, 2010) [4].

1.1.1.3 Developing Era *(1991 to 2012)*

With the increased commuting speed and inculcation of latest trends in automobile industry, a need was felt to improve the standard of roads and construction of Freeways and Motorways. In this era, more emphasis was laid on development of roads infrastructure than that of Railways. During this era, the railway could not get its due share of attention from the authorities, hence resulting in its Malnourishment. Motorway, Coastal Highway, Indus Highway and development of N-5 are the major salient of this era.

1.1.1.4 CPEC *(2013 onwards)*

It is a sum of development projects in different zones currently under construction in Pakistan. Initially, it worth46.00 Bn US$, which has present worth of 62.00 Bn US$. CPEC includes development in both road and railway sectors. Major development in the road sector includes new network of motorways and development of existing roads. Upgradation of ML-1 and construction of new track from Havelian to Khunjraab are the major development projects in railway sector [5].

1.2 Problem Statement

The Population of the World, now in excess of Three Billion persons is growing at about 2% a year, it is faster than at any era of mankind history. Pakistan is world's 6th populated country having weaker economy and infrastructure [6]. This rapid rate of growth in population demands streamlined infrastructure. With this growth in population, the Transportation industry has become more challenging, thus demanding new revolution in existing infrastructure. In modern world, developed countries have upgraded their Railway

network along with the roads infrastructure to accommodate the needs of population growth. While on other hand, Pakistan has laid more emphasis on road transportation rather than railway. Due to which decline in the performance of Pakistan Railway has ensued.

1.2.1 Addition of motor vehicles on roads causes traffic congestion on all Highways.

1.2.2 Swelling frequency of accidents being caused by heavy traffic on road transportation.

1.2.3 Repetitive Maintenance of Roads is challenging due to overloaded heavy traffic.

1.2.4 Inadequate maintenance of inherited Railway system and less emphasis on construction of new tracks, causing the decline in Railway sector.

1.3 Objectives

1.3.1 To determine the freight handling capacity of Pakistan Railway.

1.3.2 To determine annual freight handling capacity of Port qasim, Karachi port and Gwadar port and predict total freight of Pakistan for 2021, 2025 and 2030.

1.3.3 To suggest three options for increasing freight share of Pakistan railway in three phases i.e. in 2021, 2025 and 2030.

1.3.4 To analyze all three options for revenue generated by Pakistan railway and reduced annual maintenance cost to NHA.

1.3.5 To conduct benefit cost analysis for railway for three options that will be given.

1.3.6 Give recommendations to implement these three options and measure to enhance effectiveness of Pakistan railway freight sector.

1.4 Area of Study

The domain of study encompasses extents of Pakistan from its main economic hub KARACHI to PESHAWAR. The focus will be on determining the standing of both Rail and Road networks. The aim of the Study will be compare impact of current poor rail transportation system and its viability after the immersion of CPEC scenario.

1.5 Existing Road and Rail Network

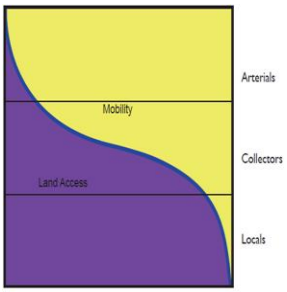
Transport infrastructure is one of the most vital factors for a country's progress. One cannot overstress the importance of transportation than call it the *lifeline* of a nation. It has been established by so many occurrences how transport infrastructure has added swiftness and efficiency to a country's progress. Good physical connectivity in the urban and rural areas is essential for economic growth. Pakistan, with respect to its area stands at the 36thlargest nation with over a quarter billion population, has one of the largest transport sectors. Over the no of progressive years, a well-connected network of Roads and Rail.

1.5.1 Road Map

Roads make an essential contribution to economic development, growth and bring important social paybacks. They are of vibrant importance in order to make a nation nurture and develop. In addition, providing access to employment, social, health and education services makes a road network crucial in fighting against poverty. Roads open up more areas and stimulate economic and social development. The connection to the remote areas provide for the easy access of goods and personnel. For those reasons, road infrastructure is the most important of all public assets. Roads can be functionally classified as following (Highway functional classification definitions, Rhodes state department) [7]:

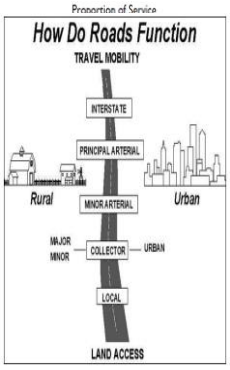
1.5.1.1 Interstates

Interstates are the highest classification of Arterials and were designed and constructed with mobility and long-distance travel in mind. These are the roads with maximum mobility and most controlled accessibility.



1.5.1.2 Freeways / Highways /Expressways

These are divided highway with full control of access and two or more lanes for the exclusive use of traffic in each direction. As there can territorial difference in use of terminologies i.e. ‘freeways’ & ‘express’ ways.



1.5.1.3 Arterials

A street primarily meant for through traffic with fully or partially controlled access.

1.5.1.4 Collectors

A street for collecting and distributing traffic to and from local streets.

Our subject concerns only with the first two categories of the Roads. The total road-network in Pakistan is about 263,415kms. consists of 9,324 kms. (3.53%) of National Highways and 2,280 kms of Motorways (0.87%).Strategic roads and Expressways contribute 262 kms and 100 kms respectively i.e. (0.10%) [8].

Years	Category	Punjab	Sindh	KPK	Balochistan	GB & AJK	TOTAL
2007-08	Total	104,115	80,863	42,369	29,451	1,552	258,350
	Low Type	33,864	26,301	13,781	9,579	505	84,030
	High Type	70,251	54,562	28,588	19,872	1,047	174,320
2008-09	Total	104,114	80,863	42,369	29,452	1,552	258,350
	Low Type	32,949	25,591	13,409	9,321	491	81,761
	High Type	71,165	55,272	28,960	20,131	1,061	176,589
2009-10	Total	105,085	81,618	42,765	29,727	1,565	260,760
	Low Type	32,179	24,993	13,095	9,103	480	79,850
	High Type	72,906	56,625	29,670	20,624	1,085	180,910
2010-11	Total	105,253	80,625	42,550	29,500	1,535	259,463
	Low Type	32,147	24,000	13,000	9,000	450	78,597
	High Type	73,106	56,625	29,550	20,500	1,085	180,866
2011-12	Total	106,455	80,960	42,975	29,625	1,580	261,595
	Low Type	32,590	24,335	13,140	9,125	465	79,655
	High Type	73,865	56,625	29,835	20,500	1,115	181,940
2012-13	Total	107,805	81,385	42,980	29,655	1,590	263,415
	Low Type	33,090	24,685	13,140	9,130	470	80,515
	High Type	74,715	56,700	29,840	20,525	1,120	182,900

Estimated length of roads in all provinces [9]

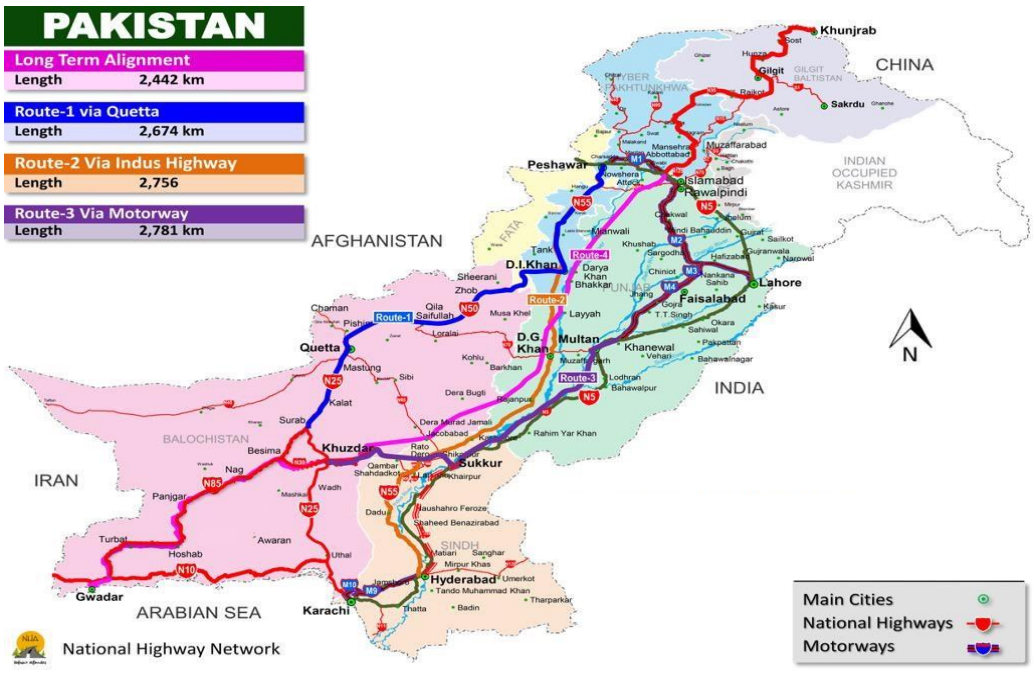


Figure 1.1 *: Network of Roads all over Pakistan*

List of National Highways				
Sign	**Course**	**Length**	**Status**	**Remarks**
	**Karachi – Torkham (N-5 National Highway)**	**1819 km**	**Operational**	**Longest national highway in Pakistan. Continues as Kabul–Torkham Road in Afghanistan.**
	Karachi – Gwadar (N-10 National Highway)	653 km	Operational	Known more popularly as the Makran Coastal Highway.
	Mansehra – Chilas (N-15 National Highway)	240 km	Operational	
	Karachi – Chaman (N-25 National Highway)	813 km	Operational	Continues as Kandahar–Spin Boldak Road in Afghanistan.
	Basima – Khuzdar (N-30 National Highway)	110 km	Operational	
	Hasan Abdal – Khunjerab Pass (N-35 National Highway)	806 km	Operational	Known more popularly as the Karakoram Highway Continues as China National Highway 314 in China  .
	Quetta – Taftan (N-40 National Highway)	610 km	Operational	Continues as Road 84 in Iran  .
	Kuchlak – Dera Ismail Khan (N-50 National Highway)	531 km	Operational	
	**Kotri – Peshawar (N-55 National Highway)**	**1264 km**	**Operational**	**Runs along the length of the Indus**

				River, providing relief to the N-5.
N-65	Sibi – Sukkur (N-65 National Highway)	385 km	Operational	
N-85	Hushab – Surab (N-85 National Highway)	487 km	Operational	
N-90	Khwazakhela – Besham (N-90 National Highway)	64 km	Operational	
N-120	Hyderabad – Khokhrapar (N-120 National Highway)	220 km	Operational	
N-125	Taxila – Haripur (N-125 National Highway)	44 km	Operational	

(List of highways in Pakistan) [10]

List of Motorways				
Name & Sign	**Course**	**Length (km)**	**Status**	**Remarks**
M-1	Peshawar–Islamabad	155	Operational	Hazara Expressway interchange completed in 2018.
M-2	Islamabad–Lahore	367	Operational	Repaved in 2016.
M-3	Lahore–Abdul Hakeem	230	Under Construction	Construction began in December 2015.
M-4	Pindi Bhattian–Multan	309	Sections 1, 2, 5 Operational Sections 3, 4 Under Construction	Construction began in 2009.
M-5	Multan–Sukkur	387	Under Construction	Construction began in May 2016.
M-6	Sukkur–Hyderabad	296	Contract Awarded	Construction begins in 2018.

M-7	Dadu–Hub	270	Proposed	Proposed
M-8	Ratodero–Gwadar	892	Partially Operational Under Construction	Partially operational
M-9	Hyderabad–Karachi	136	Section 1 Partially Operational Under Construction	Construction began in September 2015.
M-10	Karachi Northern Bypass	57	Operational	Proposed 4 lane expansion.
M-14	Hakla–D.I Khan	280	Under Construction	Construction began in May 2016.
HAZARA MOTORWAY	Hasan Abdal–Mansehra	180	Partially Operational Under Construction	Partially operational

(List of motorways in Pakistan, Wikipedia) [10]

1.5.2 Network of Pakistan Railways

Pakistan Railways has a network extending from the ports of Karachi in the south to LandiKotal near the Afghanistan border in the northwest. It extends to Taftan in the west near the Iran border and connects to the Indian border in the East at Wagha near Lahore and Khokrapar in the southeast. There are 456 railway stations on the system. [11]

1.5.2.1 Main Routes

The network, comprising of **7791** route kilometers and **11,881** track kilometers, is divided into three line namely [11]:

1.5.2.1.1 Main Line-1 (ML - 1)

The route mainly originates from Karachi, passing through main landmarks of Rohri, Multan, Lahore, Rawalpindi and extends up to Peshawar. The route also has extension from Taxilla up to Havelian and from Peshawar up to Torkham.

1.5.2.1.2 Main Line-2 (ML -2)

Second Main Line extends from Kotri up to Attock, with the major landmarks of Dadu, Kot Addu and Kotla Jam

1.5.2.1.3 Main Line-3 (ML - 3)

The third Main Line originates from Rohri and extends up to Chaman with the major landmarks of Jacobabad and Quetta. This route also has its extension from Quetta up to Taftan, which is also considered as ML-4

1.5.2.2 Organizational Overview

Pakistan Railways Consists of Eight Divisions [12]:

1.5.2.2.1 Karachi Division

1.5.2.2.2 Lahore Division

1.5.2.2.3 Rawalpindi Division

1.5.2.2.4 Multan Division

1.5.2.2.5 Peshawar Division

1.5.2.2.6 Quetta Division

1.5.2.2.7 Sukkur Division

1.5.2.2.8 Workshop Division

1.5.2.3 Assets owned by Pakistan Railways [13].

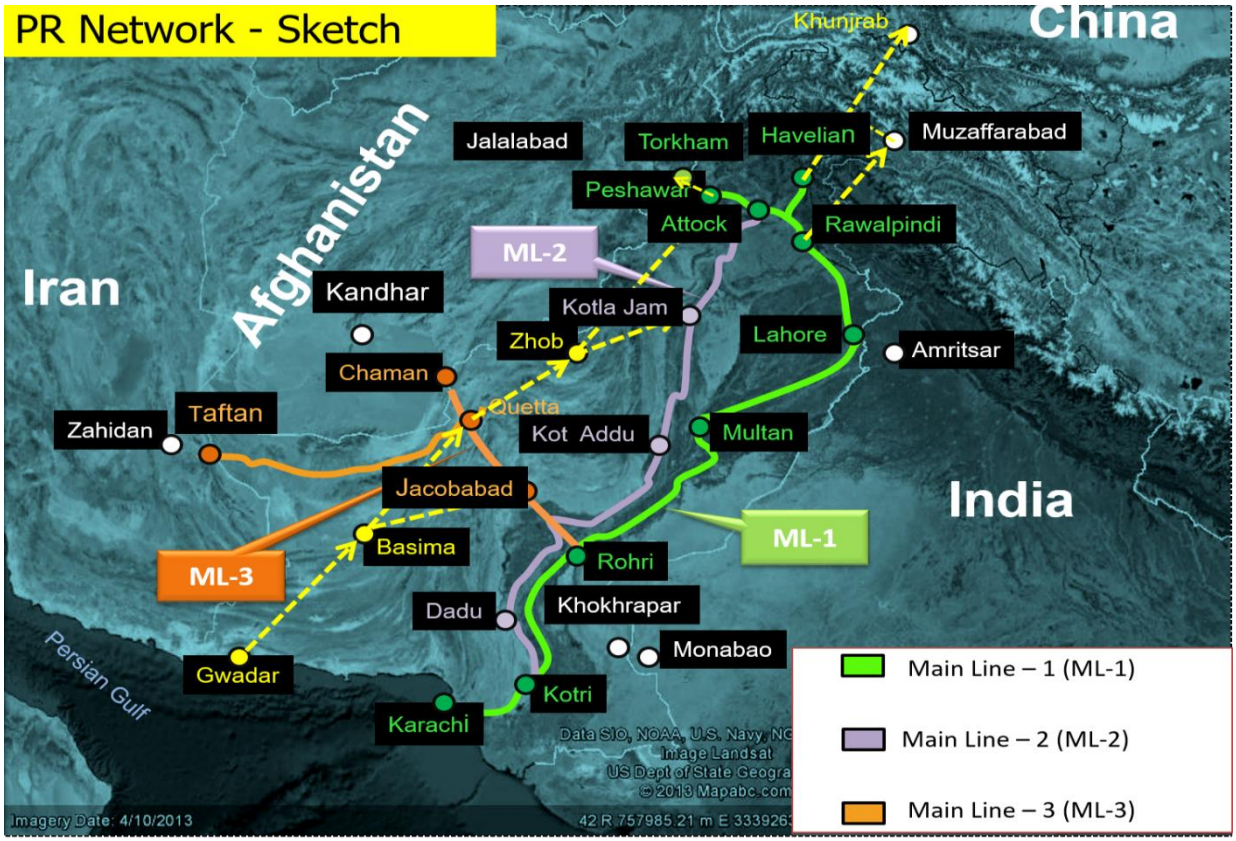
Description	Current Status
Route(km)	7789
Track (km)	11991
Dual Track(km)	1410
Railway Stations	530

Railway Station (Halt)	70
Locomotives	449 (278 functional)
Coaches (passenger)	1,756
Wagons(Goods)	15,220
Total Factories	06
Ports (Dry)	06
Employees(on Roll)	80,060
Strength	96,770
Pensioners	125,500

1.5.2.4 Condition of Assets.

Description	**Total**	**Overage**	**Designed Life (Years)**
Tracks in KM	11786	68%	30
Tracks(Non Fn)	730	-	-
Br	13,871	87%	101
Locomotives	452	59%	21
Coaches (Passengers)	1,715	76%	37
Wagons (Freight) 4 x Wheelers 8 x Wheelers Jambo	 9,879 3,455 1,890	67% 57% 0%	44
Signal and Telecomm	Approx. 90% obsolete		

Condition of assets [13]



Feasibility study of ML-1 (CPEC Centre, Lahore)

Chapter 2

2. LITERATURE REVIEW

Before starting working on project it was necessary to get a clear picture of the contributions previously made on the subject. This involves carrying out the studies of work done in this regard with various countries which have developed their mass transit system over the period of time. One mode alone cannot afford the wheels of entire country, unfortunately no concrete steps have been taken to shift part of cargo from road to rail to avoid congestion of the road and enhance mobility. But due to CPEC huge amount of freight is expected to trade through Pakistan so there was a desperate need to bring Railway infrastructure to share some of the burden of this freight if no half. China due to its trade market all over the world enjoys good terms with almost entire world. Port handling due to massive trade corridor will also be one of the important aspects that need consideration. Sufficient literature has been found in this field that provided directional leads that we should also pay heap to this matter at priority.

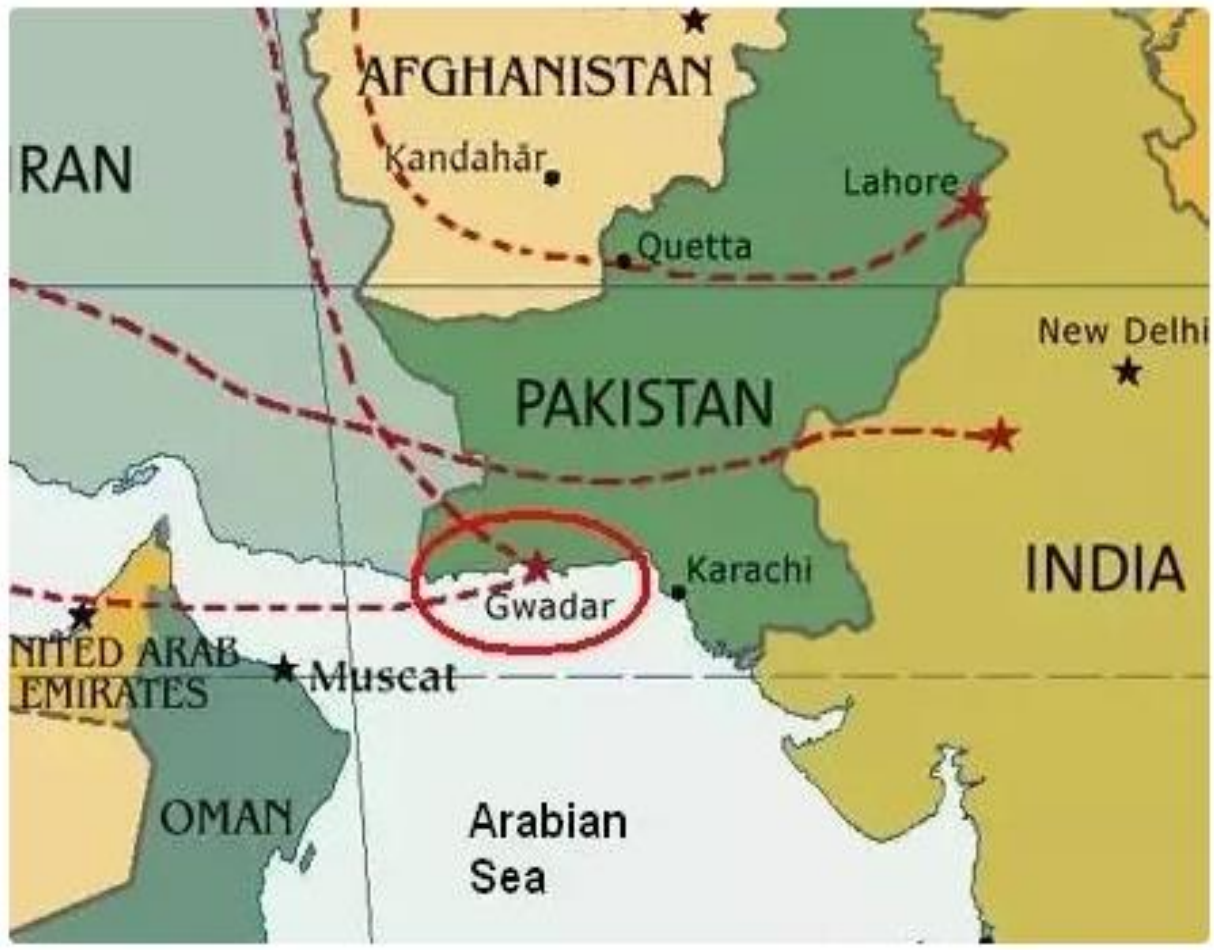
2.1 Gwadar Port

Gwadar port is back bone of CPEC project it provides access of warm water to China and central Asian countries at the shortest distance in terms of route and as well as time. In the modern era of highly updated world where speed and cost effectiveness are pillars of trade, the sea politics has changed to commercial nucleus of economic richness. Gwadar port is the only deep sea with warm water of Pakistan. Geological and strategical location of Gwadar at the mouth of Persian Gulf makes it significant in holding the two third world oil reserves [14]. Pakistan purchased it from Omani Sultanate in US $3 Mn back in 1958 [15]. Early work on development and infrastructure could not be started but it got some of its due attention in its construction phase, from 1988-92 small port was constructed. It was inaugurated by Gen Pervez Musharraf in 2007 [14]. Initially its contract was given to Port Singapore Authority (PSA) but later on it was controlled by China Overseas Port Holding Company (COPHC), since then construction work was done at a faster pace because it has to work as milestone in implementing CPEC. Gwadar port & strengthening of Gwadar city, road and communication infrastructure, Gwadar Power Plants (GPP) and Gwadar International Airport (GIA) are the future development projects [16]. The port was operational in shipment and freight trade but still construction projects are being run to make it functional at design capacity. Gawadar port is considered as a back bone for Pakistan in both strategically and economically. Gawadar port is ranked 3rd important deep sea port of Pakistan after Port Qasim and Karachi sea Port. It is situated near major international sea

shipping and oil trade routes of the world. It can be international a switch to development for Pakistan. Gwadar port would link three major regions, i.e. CARs, South East Asia, South west Asia and Middle East regions. Gawadar port will create new jobs and will help in the uplifting of Baluchistan. Pakistan would expand its bio chemical industry (minerals, hydrocarbons, oil and gas) through exploring resources of CARs. It will act as nucleus for tourism industry and foreign investment. Gawadar port will generate special economic zones(SEZ) and foreign reserves that will soon induce an economic boost and development of Baluchistan and Pakistan [15]. Gawadar port will to increase Pakistan's trade and economic activities which will help in development of Baluchistan province particularly, in this way provincial inferiority complex will be addressed. The Sea Lines of Communications (SLOCs) initiating from Persian Gulf (The Strait of Hormuz) will be controlled by Pakistan [17]. South Asia, Africa, Central Asia, Gulf and Middle East will be the major region connected by the Gawadar port for oil import and export. Strategical location of Gawadar port will provide leverage to Pakistan over India in terms of excess to marine operations. Gwadar port will act as a hub of economic zones and provide new jobs to Pakistan's people. It will gear up ontogeny in Oil and energy sector with other countries. Revenue generated from tourism, Hoteling and trade will increase manifold which will helps in boosting the economic condition of country. Government has declared Gawadar as a tax free zone which will attract large number of foreign investors and national investors to launched new development projects and plans [18].

Continent of Asia has many land locked countries and their approach to sea for trade becomes expensive. These land locked countries looked for shortest possible routes for the trade and to link with other region. Our neighboring country china has a western province Xinjian which was economically deprived and thousand km away from sea ports. CPEC would help china to avail the opportunity of trade through Gwadar port. The Gawadar port will act as a link between Afghanistan and Middle East Countries(MECs). This port will provide an alternate route in case of The Strait of Malacca is stopped by India and it can also provide an alternate route to south china sea routes and Indian ocean [19]. In May 2013 Chinese premier visited Pakistan and declared Gwadar as an 'Economic Corridor'. At present Gawadar port has many concern such as credible infrastructural development, skilled labor and requisite fiscal space. There are other concern of security, round the year functionality of KKH and weather condition which are to be addressed at priority. Currently India is planning all the tactics to stop the CPEC development. India is investing its money valued US $85 Mn to develop Iranian port Chahbahar [20]. When the economic sanction will be lifted from Iran, India will get the maximum of the benefits from Chahbahar .India is trying to reduce the influence of Chinese policies in the region to become a super power

of the region. India is trying to bring down the importance of Gawadar. The construction of roads from Afghanistan to Chahbahar (Zaranj-Delaram) is proof to it. These are the indicators which show the Indian intention for Gawadar port. The security concern has already been raised to its highest level. Pakistan has also on other side keeping a keen eye on the Gawadar development and its security concern.



International trade routes [21]

Located at the entrance of the Persian Gulf and about 460 kms from Karachi, Gwadar has had immense geostrategic significance on many accounts [22]. The continued unstable regional environment in the Persian Gulf in particular as a result of the Iran/Iraq war, the Gulf war and the emergence of the new Central Asian States has added to this importance. Considering the Geo-economic imperative of the regional changes, the Ports Master Plan studies considered an alternate to the Persian Gulf Ports to capture the transit trade of the Central Asian Republic (CAR) as well as the trans-shipment trade of the region.

It's miraculous that tomorrow's small fishing village 'Gwadar' is fast emerging as a Deep Sea Port today. This is important to note that the Government of Pakistan, keeping in view its utmost significance in the area, has declared 'Gwadar' as a Duty Free Port and a Free Economic Zone. In relations to the business connections with other renowned countries (Persian Gulf, East Africa, United Arab Emirates and North Western India and CARs) Gawadar deep sea port has a 3rd place of Pakistan.

2.2 Rail Freight Solutions to Roadway Congestion-Final Report and Guidebook

When rail and other means of freight movement are pitched against each other the issue of planning for transport planners is aggravated. For rail freight movements matters like safety and flexibility have declination effect on market shares. In different circumstances like, environmental conservation, power, movability, overcrowding and security problems, point the planner to think about rail rather than highway. It is the dire need of time to consider the impacts and good fortune for public interest in rail freight capacity to help in reducing roadway overcrowding. Overcrowding in urban and intercity connection roads is increasing day by day. Heavy traffic has become a serious contributor to road overcrowding and disintegration of road framework. In addition, planners think rail is an inappropriate mean of mobility if utilized in its full extent can lead to increase transport of both road and rail. increasing the chance to shift freight by rail could help in decreasing disintegration of road framework and have a positive effect on environmental conservation, power, mobility, overcrowding and security problems. Transportation planners in cities should take bold steps to evolve a better scheme, which include expenditure sharing in development and operation of expected facilities of future that introduce rail as a mandatory element of transportation corridors which decreases the load of freight transportation.

An investigation squad headed by Joe Bryan of international vision, developed a handbook to help determining the potential for rail freight quick fixes to decrease roadway overcrowding and in a result increasing in mobility under NCHRP Project 08-42 [23]. If rail shares the load with road freight mobility it will also upgrade the development of road transportation.

The study had a number of constituents, a complete analysis of concerning literature and unfinished case studies and researches where rail freight quick fixes have been applied to reduce highway overcrowding, and a complete analysis of circumstances leading to the choice of freight shipping mean and short and long-term tendencies that affects freight flow pattern. The report gives guideline on the convenient sources of data that are helpful for evaluating rail freight problems and evolving framework for handling that data to gauge the relative prices, profits, and usefulness of rail freight finances. The concluding report includes a help book that assimilates the research results into a methods and set of tools for transportation planners to consult when it can be useful to invest in solutions that converts freight vehicles to rail from highway.

2.3 Rail and General Freight Economics

A logistics achievement acts as a heart of any country. Mobility is an important factor of logistics. Overcrowding can reduce mobility, in result reducing in logistics performance and achievements.

2.4 Freight Transportation Segments

The sectors of freight play a vital role in choosing the modes of the mobility. price, mobility, framework and freedom are prime sectors which influences the selection of modes. Railway has benefits on all the circumstances than road mobility.

2.5 Service Capability

Service is one of the touchstones which provide the solid footing for the selection of modes. Railway with central administration and amenities leads in this view than road mobility. Service has chief importance in conditions of client pleasure.

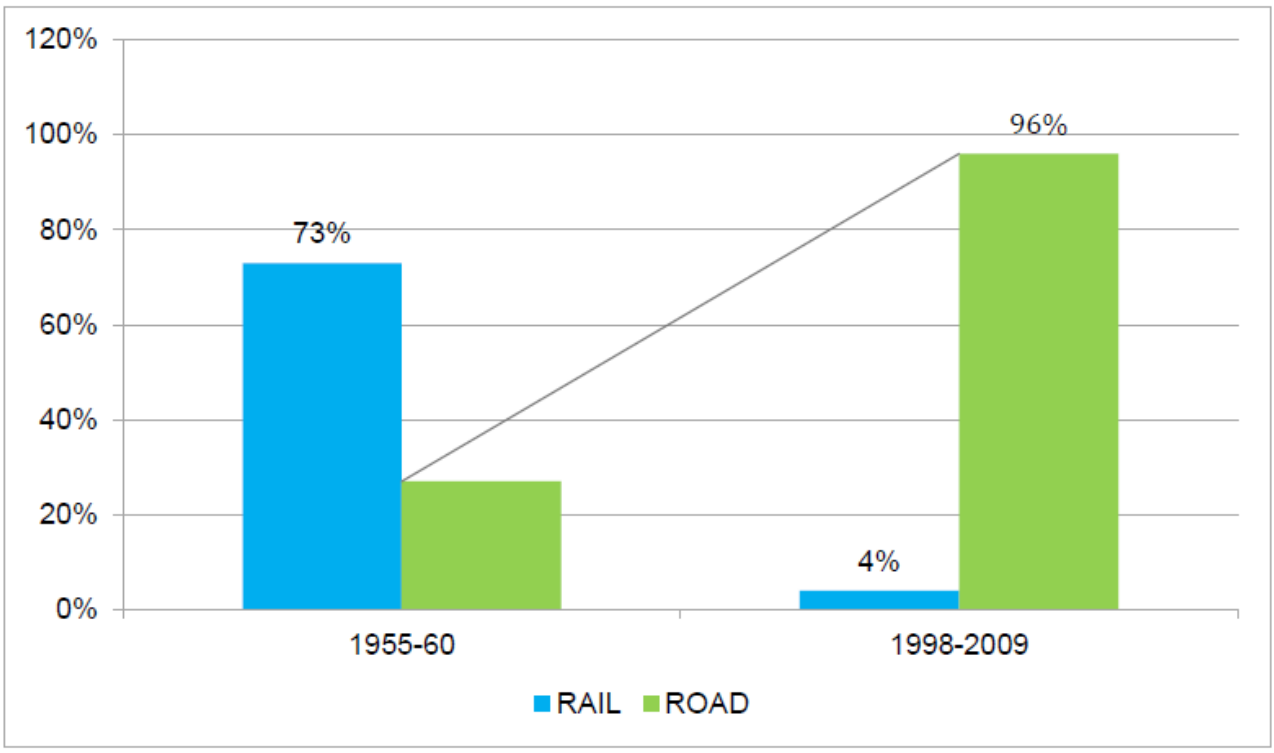
2.6 Benefit Cost Analysis.

Customer’s profit and benefit to cost is one of imperious characteristic in selection of mode of mobility.

2.7 Competitive Dynamics of Emerging Transportation Sector & Road Freight.

2.7.1 Pakistan Railways (PR) - Natural Competitor of Road Freight

Railways have an edge in long distance and massive goods mobility and passengers over the world. In until 1970s, it was the vital mode of transport in Pakistan. Due to the consideration shifting of planners towards road framework railway faces a great failure. Budgetary expenses on railways were only PKR 45.5 billion and for highways it was at PKR 155 billion, during 2005-10 [1]. Today railways' share of internal traffic for cargo traffic has decreased from 73 % in the 70's to 4 % [1].

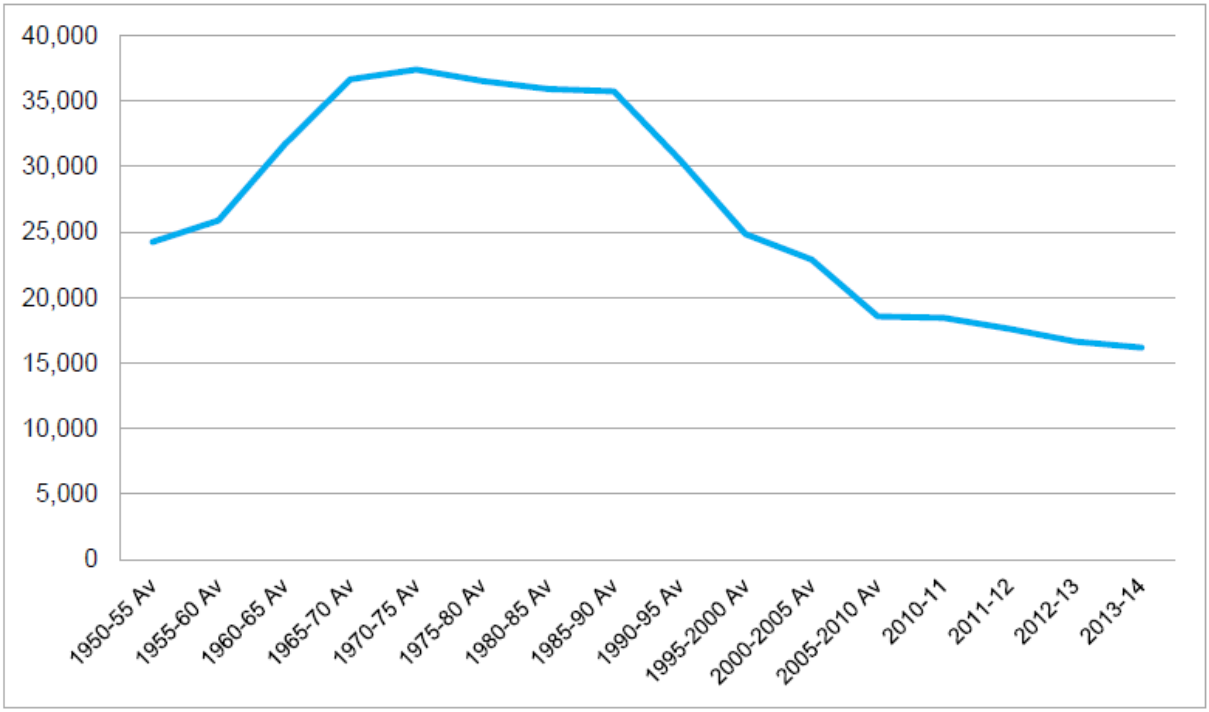


Source: World Bank, 2011

Evolution of road and railway transport[1]

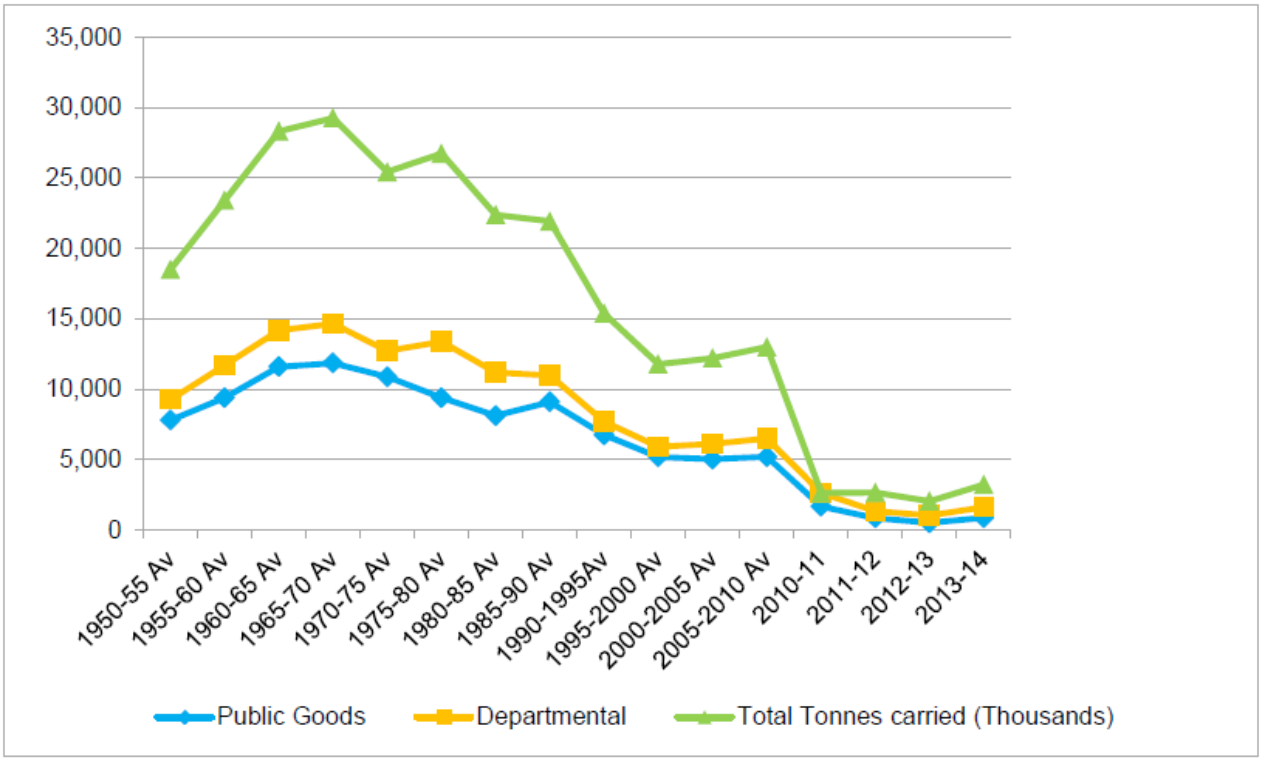
2.8 Freight Fleet of PR

At the end of the year 2013-14, the figure of Freight fleet kept by the Pakistan Railways were 16200 encompasses as 4500 wagons, 4560 open wagons(OW), 530special type wagon(STW).630 departmental wagons(DW), 1745containers, 3800 tank wagons(TW), and 400 brake-vans(BV) [1]. Out of these 10,900 wagons 5590 are four wheelers and 5290 are eight wheelers. A turn down has been observed in freight fleet from last many years.



Source: Ministry of Railways, Government of Pakistan

Figure 2.3:Evolution of Pakistan Railways total freight carried [1]



Source: Ministry of Railways, Government of Pakistan

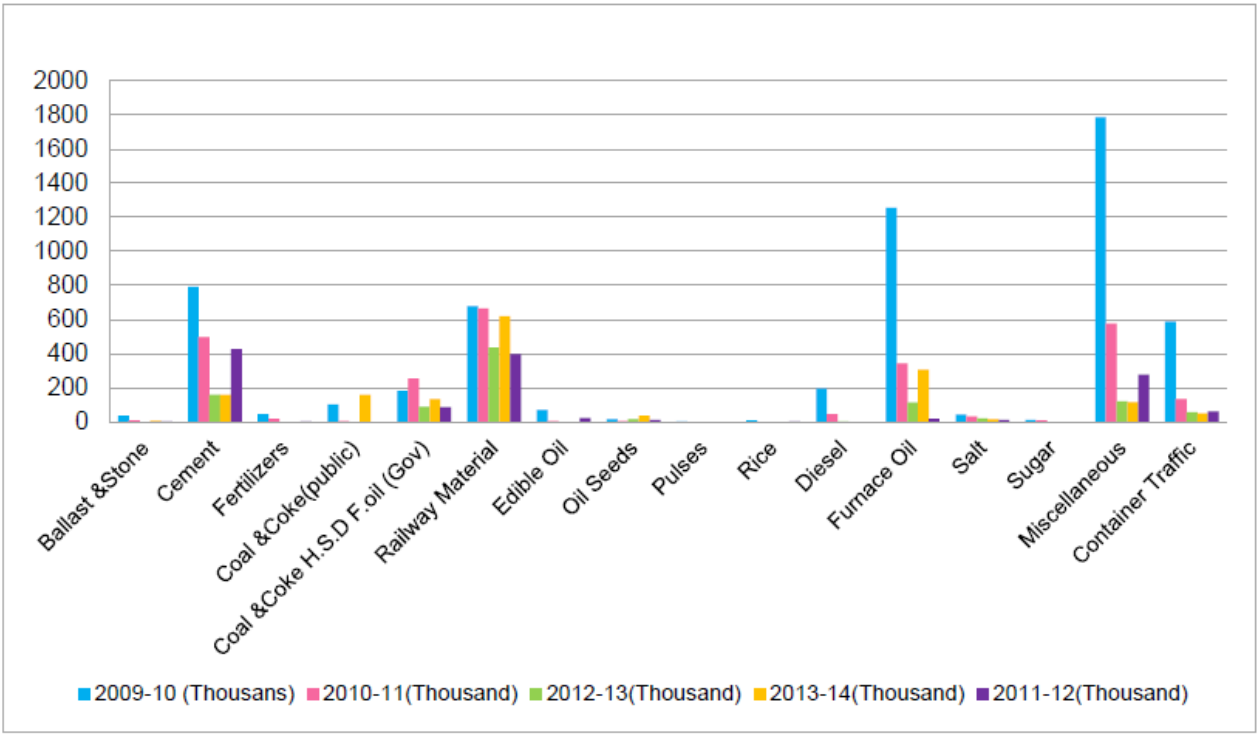
Figure2.4: Total Pakistan Railways freight fleet [1]

The above number shows that the freight affairs of Pakistan Railways have been on an extreme deterioration, there has been a little progress from 2012-13 in which total tons of freight was 1,165,000 while in 2013-2014 it is progressed to 11,611,000tons [1].

2.9 Type of Commodities Carried by Freight Operations of PR

By examination and determination of freight carried by PR commodity it can be stressed that only few commodities emerge in the PR Freight affairs that are cement, coal, diesel, furnace oil and miscellaneous.

PR is not very energetic in transporting container traffic which makes a reasonable segment of freight traffic. The container traffic saw a sharp turn down from 2009 onwards from 587,000 tons in 2009-10 to 50,000 tons in 2013-14 [1]. The facts are also evocative of the fact that PR does not carry agro-products (wheat, grains, pulses, rice, sugar, Cotton raw, un-pressed and full pressed) to its potential. Freight of all commodities is on a turn down in PR; on the other hand, it is not a best choice of mobility for farmers of unpreserved agro-products like fresh fruits and vegetables and even non-perishable agro-products. By planned and efficient PR, it should have been first choice of farmers to transport their agro- products in the country.



Source: Ministry of Railways, Government of Pakistan

Figure2.5: Pakistan railways Commodity wise freight carried (tons) [1]

2.10 Reasons for Losing Ground to Road Freight

Pakistan Railways have serious opposition from road transport framework. It is an opposition in which PR has a genetic loss due to government's main concern is to develop roads ignoring rail transport. Budgetary expenses on railways were only PKR 45.5 billion but for highways it set at PKR 155 billion during 2005 to 2010. Another reason for PR's incompetency to race is its deprived authority. Whole track length has also reduced from 8,775 to 7,791 km, since 1990 – 91 [1]. In aggregate freight 40% reduce from 7.7 to 4.6 million ton in 2011 [1]. Furthermore, only 1/3 of the whole rail framework is used for important profitable desires.

PR is a multifaceted unit and has numerous reasons leading to its failure. on the other hand, one of the chief factors is principal establishment of passenger traffic. PR's major centered focus is assisting passengers over freight services knowing the fact that freight is more cost-effective.

2.11 PR to Overcome its Financial Problems

PR transports 58.97 million passengers but only 4.6 million tons of freight in 2009 - 2010. The average freight revenue is much higher than passenger transportation revenue but government gives priority to passenger service. Priority is not given to freight over passenger transportation resulted in a constant decrease in the freight volumes both in tons and kilo - ton. This is due to less investment in vehicles, wagons, and remodeling track ability and quality, have clearly decrease PR's capacity to afford steadfast freight services and uphold the previous business standing of 70's era. Freight division in-capabilities are estimate the financial system about PKR 150 billion/year, and low down quality service is threatening Pakistan's provincial competitiveness: the efficiency of PR freight services is approximately 1/8 of Chinese Railways, 1/3 of Indian Railways, and 1/2 of Thai Railways [1].

Year	Freight Ton	Ton-Kilometer
1980-85	11.2	7,380
1985-90	11.0	7,940
1990-95	7.7	5,890
1995-2000	5.9	4,370
2000-2005	6.1	4,744
2005-2010	6.2	5,285

Table 1.1: Evolution of Pakistan Railway Freight Transportation [1]

2.11.1 Time Taken

Currently it takes 21 to 28 days for PR to deliver upcountry at a distance of 1800 kilometers which is 4-7 times slower than in United States and in China [1].

2.12 Governing Factors

Literature reviews are rail freight transport has been widely attributed for a numeral of profits, some of which are:

2.12.1 Efficient Energy Consumption

Regularly, rail is supposedly more fuel efficient than other ground means of mobility. More particularly, the rail mobility is 4 times more fuel efficient than road vehicle transport and rail fuel efficiency has kept on developing over the years according to Association of American Railroads surveys.

2.12.2 Massive Carriage Capacity

Rail transport unquestionably has the capability to carry huge freight at any time at better transport than roads. 1 fully used freight train can swap hundreds of vehicles (trucks), in return, clears up lots of space on the small roads and highways, which could be used by other automobilist as per analyzed report by Association of American Railroads.

2.12.3 Increased Choice

Different types of vehicles may be used to take different types of cargos, together with sensitive goods. For transporting many different types of cargo different types of wagons are used e.g.; refrigerated cars, tank rail wagons, gondola rail cars, domestic animals rail cars and many more but rail can carry many types of cargo in one carriage.

2.12.4 Environmentally Friendly and Sustainable

According to a survey report of Alessandrini et al. 2012 Association of American Railroads 2016; Pan, Ballot & Fontane 2013, Rail mobilization is possibly one of the greenest and coolest forms of land mobility. Noteworthy amounts of hazardous removal of fumes and smoke are decreased when mobilizing freight by rail carriages as compared to road vehicles.

2.12.5 Exclusive Railway Routes

Railway paths are very limited only permitting the rail wagons to move this enhances greater transport and safety of freight. In Pakistan various systems were surveyed which will act as a principle guideline to transfer segment of cargo from road to rail.

2.13 American Freight Rail Industry

It is made done by the staggers act of 1980, which allow rail efficiency to deluge. This lead to decrease cost that permitted freight rail to fight against other means of mobility and attracted massive volumes of new vehicles at less cost and larger transport. The resurgent rail paths speed up fast expansion in intermodal freight trains, which make possible an extraordinary jump in U.S. trade in many industries. America holds a title of world's largest railway track. It is not countrywide but joins most part of it. In 2016 its length was 257722 km [24].

In USA, freight rail framework is largely considered as one of the active most freight network all over the world [25]. The 60 billion productions consist of seven Class I railroads which is managed by140, 000 rail miles, 21 provincial rail tracks, and 510 central rail framework [25]. Not only transporting freight, it also provides 221,000 jobs and many public advantages including lessening in road overcrowding, roads damage, fuel utilization and organic gases, logistics prices, and local damage maintenance and improvement charges. The USA freight rail frame works are classified associations that are in charge for their own damage maintenance and improvement schemes. In Comparison with many other chief industries, U.S associates invest maximum scale of incomes to improve, add capacity and mountainous of their rail systems. The mainstream of this cost investment is for ensuring an improvement and good maintenance at the same time as 15 – 20 % investments are mainly used to improve capacity.

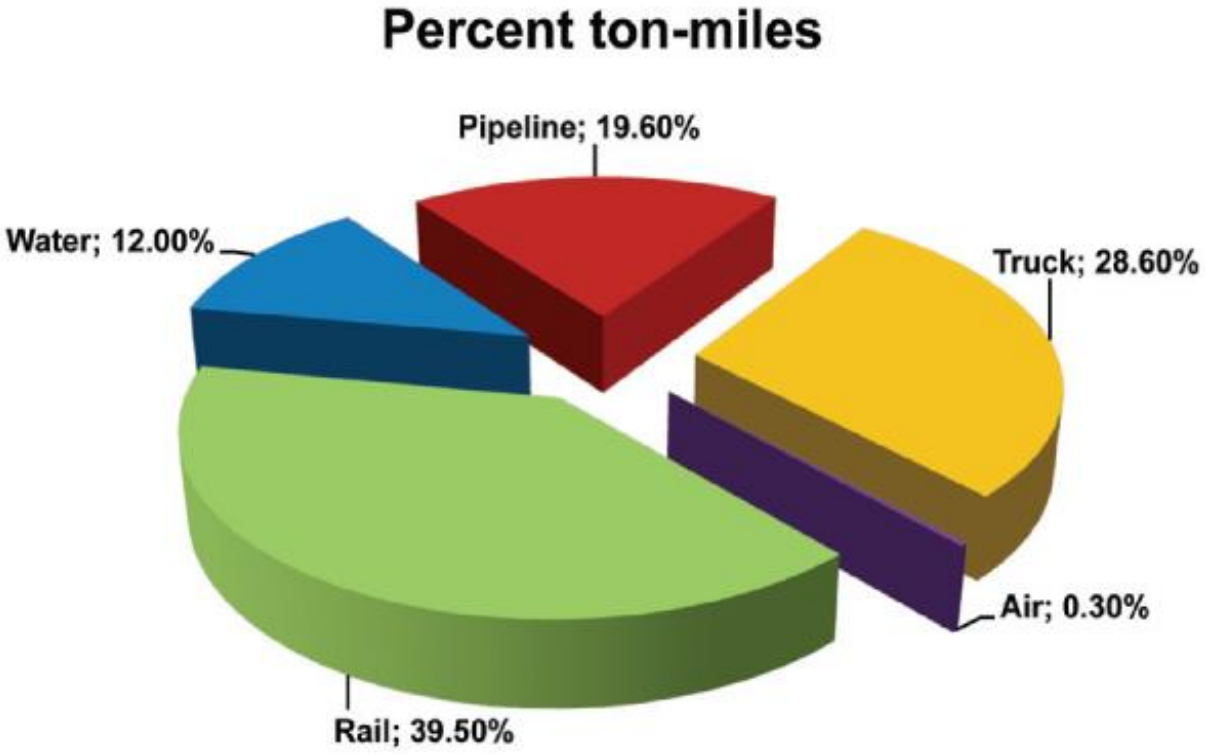


Figure2.6: Percent Ton Miles [25]

Due to effectiveness of freight frameworks of USA, about 185,000 people have railway and millions in manufacturing industries jobs that's how USA gives an immense competition in international economy. Simultaneously with rail tracks now reports roughly around 40 % of inner-city freight rail and work the most well-organized and well-trusted freight rail frame in the world. By any calculation, in 1980 the authoritarian reforms approved have profited rail tracks, transporters, shippers and the better economy.

2.14 Indian Railway system

In the world India has 4th principal rail framework that joins all areas of India with 67368 kilometers lengthy railway line [26]. After separation India, as measures up to Pakistan, extended its rail network tracks to lay railway all over the state. As per Indian culture, public is more likely to travel by railway. Rail is one of the chief modes of mobility in India, their business and farming is dependent on rail to notable amount. Indian Railways is a chief and busiest railway framework. It operates nine thousand public rails and mobilizes almost 18 million people daily. The Indian Rail tracks utilize around 1.4 million citizens. In 1851, 1st train trip was made between Piran Kaliyar and Roorkee for mobilizing massive amount of soil to Rorkee. In India, between Bori Bunder, Thane and Bombay, 1st public rail trip became functional, covering up an area of 21 miles, this is the official birth of the railway framework. The Indian Rail connects the public, economic and cultural threads which cover up the complete country lessening the distance hurdle for public. Rail connects all cities together producing a feeling of union among Indian nation. India has an aim to give connectivity to all capitals of region by taking the rail to Himalaya ranges by activating a rail b/w Naharlagun and Dibrugarh (Northeast Frontier Railway). Arunachal Pradesh is very needy for rail track connectivity. As per media statements, Naharlagun, is a capital of Itanagar, is a part of rail map of India state. In April 2014 fully operated and functional line between Harmuti and Naharlagun was started in 1997 which improves connectivity to Northeast.

2.14.1 Indian Railways is divided into 16 zones [27]:

2.14.1.1 Northern Railway (NR)

2.14.1.2 North Eastern Railway (NER)

2.14.1.3 Northeast Frontier Railway (NFR)

2.14.1.4 Western Railway (WR)

2.14.1.5 Southern Railway (SR)

2.14.1.6 South Central Railway (SCR)

2.14.1.7 South Eastern Railway (SER)

2.14.1.8 Eastern Railway (ER)

2.14.1.9 Central Railway (CR)

2.14.1.10 South Western Railway (SWR)

2.14.1.11 North Western Railway (NWR)

2.14.1.12 West Central Railway (WCR)

2.14.1.13 North Central Railway (NCR)

2.14.1.14 South East Central Railway (SECR)

2.14.1.15 East Coast Railway (ECoR)

2.14.1.16 East Central Railway (ECR)

2.14.2 Freight Corridors [27].

DEVELOPMENT	CORRIDOR	LENGTH
PLANNING STAGE	East- West Corridor	2328 km
	North-South Corridor	2328 km
	East-Coast Corridor	1115 km
	Southern Corridor	892 km
UNDER CONSTRUCTION	Eastern Corridor	1318 km
	Western Corridor	1482 km

2.14.3 Trains

Indian Railway runs more than 7,500 freight trains carrying three million tons of freight every day. It has 239,300 cargo cars, 59,852 public wagons and 9,556 locomotives. Indian Rail tract is the world's tallest constructed rail overpass [27]. It is almost 5 times the Qutub Minar's height and 35 m higher than Eiffel Tower. After separation, Indian railways transport 90 percent of freight and 75 percent of public.

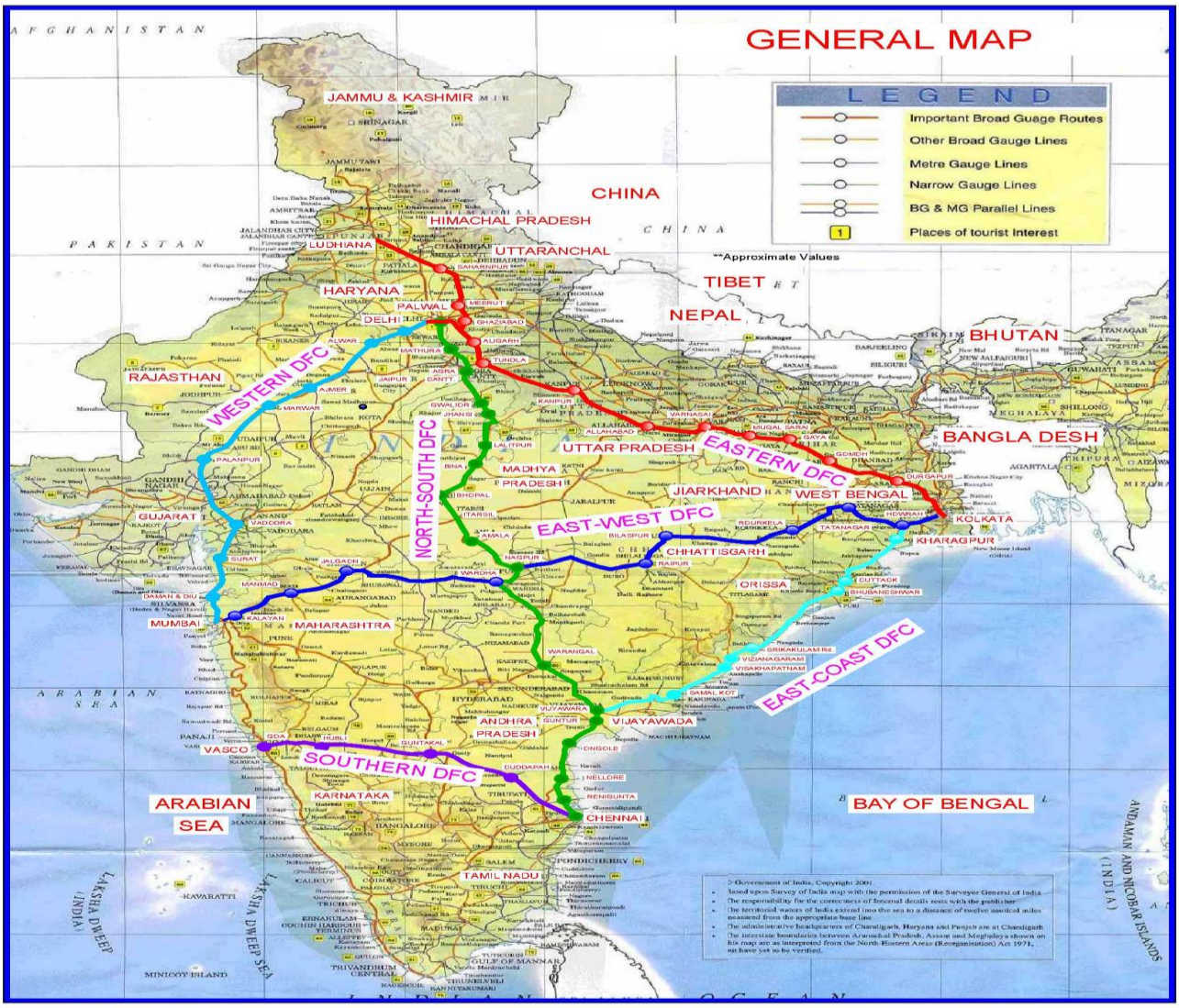


Figure2.7: Indian Railway System [28]

2.15 Chinese Railway System

In china, railway is one of the chief mean of mobility. According to the survey reports in 2015, China have a 2nd largest railway framework in the world has 121000 kilometers lengthy rail track [29]. China has a fastest rail moving with the speed of 19000 Km. One of the main mean of freight mobility of China is via railway. More than ½ of the freight mobility is coal by rail framework. According to 2013, 2.322 billion massive tons of Chinese coal cargo is mobilized through rail carriages. About 58 % cargo is mobilized through railway and Chinese is also preparing them to connect their railway tracks to neighboring countries

by expanding railway framework [29]. This bold step of Chinese nation can boost up trade and as a result improvement in economy. CPEC joins China internationally by means of land. One Belt One Road plan is also aimed to improve financial system and trade through railway and road to Europe, Africa and central Asia.

Chapter 3

3. METHODOLOGY

3.1 Steps Involved

The methodology used in this project is explained in the form of flow chart as below: -

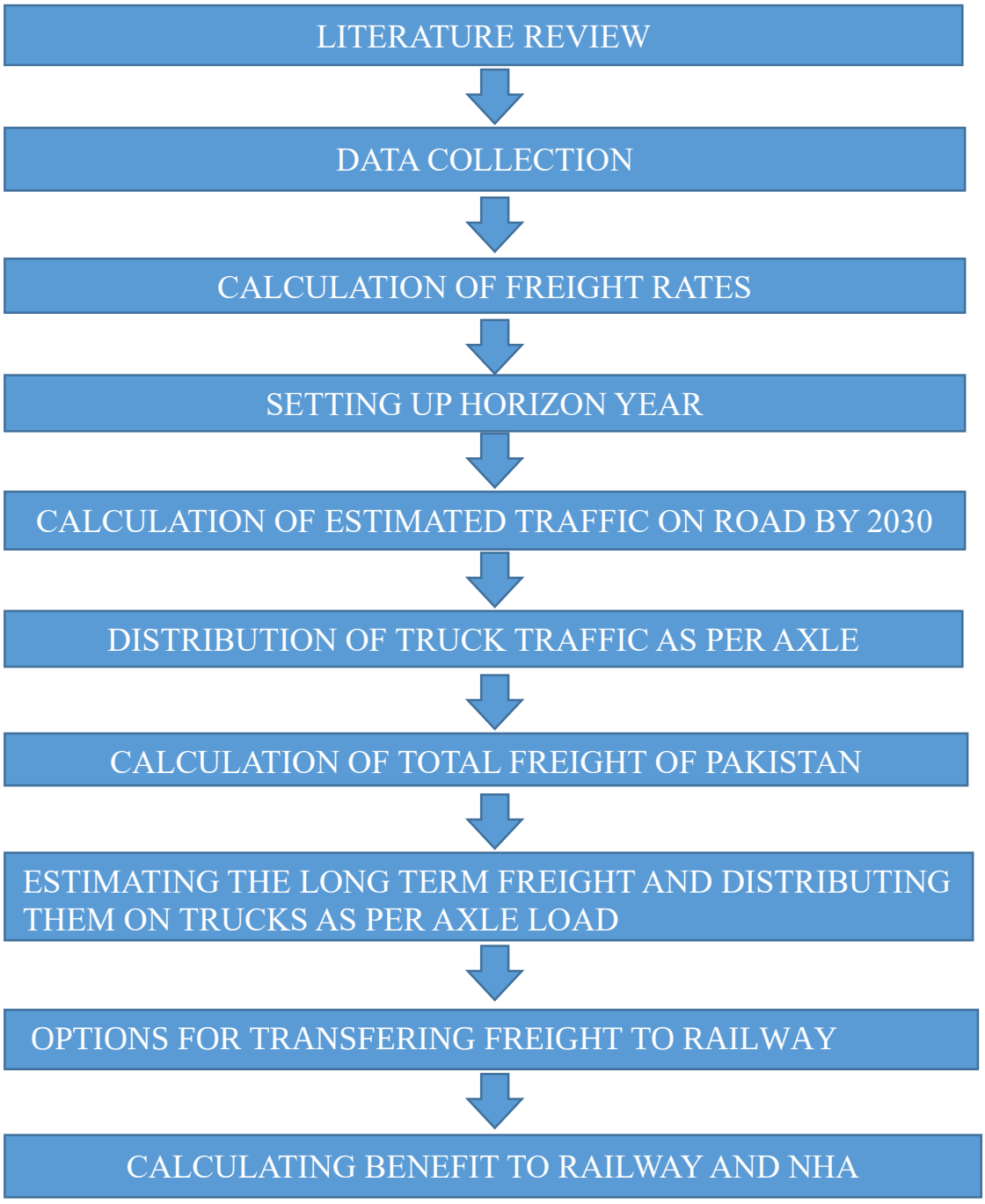


Figure 3.1: Steps involved in Methodology

3.2 Literature Review

Literature review is the previous studies which have been undertaken on the subject. They also include the articles which have been written on the subject. In our particular project we have divided the literature review in two part first part includes the comparative study of our region and the freight transport system in the developed countries of the world. This part also aims at getting an insight freight transportation system of these three following countries with distribution of freight on their respective transportation systems i.e. road and railway.

3.3 Data Collection

In order to properly evaluate the advantages and disadvantages of road and railway and railway freight sector and further implement it on the CPEC we need to gather several types of data which was as below: -

3.3.1 Data regarding complete CPEC projects.

3.3.2 Data regarding Pakistan railway freight transportation sector.

3.3.3 Comprehensive data related to long term and short term CPEC projects for railway and roads.

3.3.4 Data regarding feasibility study of railway tracks.

3.3.5 Data regarding improvements of railway tracks.

3.3.6 Capacity enhancement of PR freight transportation sector in terms of freight carrying wagons and Improvement to existing railway tracks and wagons.

3.3.7 Data regarding Gwadar port and its development in terms of import and export cargo.

3.3.8 Data regarding existing freight rates of road and railway.

3.3.9 Data from NHA regarding annual road maintenance cost of complete N-5 from HRTC Burhan.

3.3.10 Existing revenue per month being generated by railway from freight.

3.3.11 Average 24 hours trucking count of different sections of N-5 from RAMD.

Total Cargo handled per annum in Pakistan Data from above subjects was used in calculation and different procedures and will be described in upcoming paragraphs.

3.4 Calculation of Freight Rates

Freight rates for five most commonly transported commodities was calculated for railway and then a generalized rate was developed by taking average of these rate. the procedure adopted for calculation of freight rates for railway and road is as under: -

3.4.1 Freight Rates of Railway

The freight rates of railway were calculated with the help of Pakistan railway goods tariff books. Two books were used for calculation of freight rates of these commodities. The route selected was from Karachi to Rawalpindi on railway track and for road National Highway N-5 was selected. The rate of all these commodities was converted into per ton km for having same unit of loads for road and railway. The commodities selected are: -

3.4.1.1 Coal

3.4.1.2 Wheat

3.4.1.3 Petroleum

3.4.1.4 Cement

3.4.1.5 Gravel

First of all, in railway tariff book distance was matched against commodity and a factor was obtained this factor was multiplied to already set rate and then this factor was multiplied to existing rate to obtain per ton rate of commodity for that particular route. We divided per ton rate by total distance of the route to obtain per ton

per kilometer rate for that particular commodity. Following table shows the rate calculation

COMMODITY	ROUTE	DISTANCE	RATE/ TON	RATE/ TON KM
COAL	KHI-PSC	1794 KM	2000	1.12
WHEAT	KHI-PSC	1794 KM	2100	1.17
PETROLEUM	KHI-PSC	1794 KM	4985	2.77
CEMENT	KHI-PSC	1794 KM	2030	1.13
GRAVEL	KHI-PSC	1794 KM	2090	1.16

Table 2.1: Rate calculation for Commodities

Now for calculation of generalized rate average of above rate was taken and generalized rate came as 1.47 rupees per ton per kilometer for railway freight transportation.

3.4.2 Freight Rates of Road

Freight rate for road has been taken from a study of World Bank. Road Freight rates in Pakistan are among the lowest in the world, with an average cost of USD 0.015 to USD 0.021 per ton kilometer (World Bank, 2006) retrieved from http://trtapakistan.org/wp-content/uploads/2016/01/Road-freight-transport-sector-and-emerging-competitive-dynamics_final.pdf. Hence the road freight is 2.088 rupees per ton per kilometer.

3.5 Setting up Horizon Year

As our project involves around CPEC and further expands itself to detailed projects of railway and road for CPEC. Hence we needed to select a horizon year which would have incorporated completion of major projects of both transportation sectors. So we have selected 2030 as our horizon year because of following reasons: -

3.5.1 Long term projects of CPEC are targeted till 2030 for both road and railway.

3.5.2 Railway and road are in sync with the long term objectives time till 2030.

SECTIONS	**2 (Axle)**	**3 (Axle)**	**4 (Axle)**	**5 (Axle)**	**6 (Axle)**	**TOTAL**
KARACHI-HYDERABAD	748	572	88	19	104	1531
HYDERABAD-SUKKHUR	1917	1788	2507	265	1104	7581
SUKKHUR-RYK	1900	1900	2962	257	909	7928
RYK-MULTAN	1519	1316	1867	222	784	5708
MULTAN-LAHORE	1758	1288	1352	161	414	4973

LAHORE-RAWALPINDI	1656	1365	283	53	91	3448
RAWALPINDI-PESHAWAR	1649	2271	257	51	287	4515

3.5.3 As it is now 2018, calculations will be of 2030 approx. 12 years from now when CPEC will be fully developed.

3.5.4 Gwadar port which will be the major provider of freight in future would be fully functional by 2030

All of the above reasons justify selecting 2030 as our horizon year and making our calculations with reference to 2030.

3.6 Calculation of Estimated Truck Traffic On Road by 2030

As earlier mentioned we have selected National Highway N-5 as comparison to Karachi to Peshawar route of railway so we had to determine truck count on different section of N-5. For calculations to be performed till 2030 estimated trucking traffic has to be estimated by the year 2030. Existing average 24 hours trucking data for year 2013-2014 was obtained from Road asset and data management (RAMD), National highway authority (NHA). Data was in the form of average truck count on different sections of N-5 as per axle type. Table below is the data of truck count for year 2013-2014.

Now this trucking count was extrapolated till 2030 using a truck growth factor of 4 % using following formula

$$\text{Future Volume} = \text{Past Volume} \cdot (1 + \text{Growth Rate})^{N}$$

where N = Future Year – Past Year

Hence for us N = 2030-2014 = 16 and growth rate = 4%, after calculating we got above data of trucks as per axle on different sections of N-5 in 2030.

SECTIONS	2-Axle	3-Axle	4-Axle	5-Axle	6-Axle	Total
KARACHI-HYDERABAD	1401	1071	164.8	35.59	194.8	2868
HYDERABAD-SUKKHUR	3591	3349	4696	496.3	2068	14199
SUKKHUR-RYK	3559	3559	5548	481.4	1703	14849
RYK-MULTAN	2845	2465	3497	415.8	1468	10691
MULTAN-LAHORE	3293	2412	2532	301.5	775.4	9314
LAHORE-ISLAMABAD	3102	2557	530.1	99.27	170.4	6458
ISLAMABAD-PESHAWAR	3089	4254	481.4	95.52	537.5	8457
Total	**20878**	**19666**	**17449**	**1925**	**6917**	

3.7 Distribution of Truck Traffic as Per Axle Percentage

After we calculated the trucking count for 2030 as per axle, there was a need that we distribute these trucks as per axle percentage. E.g. how many 2 axle trucks will be there in 2030, how many 3 axle trucks and how many 5 and 6 axle trucks will be there in 2030? After calculating these we would distribute the total freight of Pakistan in tons as per percentage of axle. No of registered trucks in Pakistan in 2011 was 212000, using a growth factor of 4% we can calculate approx. no of registered trucks on road by 2030. Finding out percentage

composition of trucks by axle from previous 24 hrs data table we can divide now calculated amount of registered trucks as per percentage as in table below:

	2 Axle	**3 Axle**	**4 Axle**	**5 Axle**	**6 Axle**
Numbers	20878	19666	17449	1925	6917
24 hr trucks on N-5 in 2030	66835	66835	66835	66835	66835
Percentage	31.2	29.4	26.2	2.8	10.4
Total Est trucks in 2030	447285	447285	447285	447285	447285
No of trucks in year 2030 as per Axle	139553	131502	117189	12524	46518

3.8 Current Yearly Freight of Pakistan

Pakistan statistical year book 2015-2016 was used to obtain data of current yearly freight traffic of Pakistan. There are basically three main sources of freight in Pakistan.

3.8.1 Karachi port

3.8.2 Port Qasim Karachi

3.8.3 Gwadar port

As Gwadar port has not been fully established so current data is of port Qasim and Karachi port only. Total cargo of Pakistan is as under: -

TOTAL CARGO HANDLED AT SEA PORTS 2015-2016 [31]					
	Karachi Port		Port Qasim		Total (tons)
	Import	Export	Import	Export	
CARGO HANDLED AT SEA PORTS	26687000	12143000	17819000	7041000	70941000
CONTAINER CARGO	12546686	7367570			19914256
		Grand total			90855256

3.9 Estimating The Long Term Freight and Distributing Them On Trucks as Per Axle Load

The freight is calculated for all three major ports of Pakistan i.e.

3.9.1 Karachi Port

3.9.2 Qasim Port

3.9.3 Gwadar Port

It has been divided into three different phase to calculate the freight and their distribution on truck as per axle load. Phases are as follows

3.9.4 2018 to 2021

By the end of 2021 the expected the total expected cargo and from the sea will be 160030000 tons. This load will further be distributed to the trucks on load axel classification.

Port	Cargo handled
Karachi port	82910000 Tons
Port Qasim	20000000 “
Gwadar	57120000 “
Total	**160030000 “**

	2 Axle	3 Axle	4 Axle	5 Axle	6 Axle
PERCENTAGE BY AXLE IN 2021	65	23.5	9.5	1	1
SHARE OF LOAD ON N-5 AS PER AXLE PERCENTAGE (TONS)	51926534.4	18773439.36	7589262.72	798869.76	798869.76
NO OF TRUCKS AS PER AXLE IN 2021	204266.66	73850.16	29854.32	3142.56	3142.56
LOAD ACRRIED BY EACH TRUCK IN 2021 (TONS)	254.20	254.20	254.209	254.209	254.209

Table3.2: ExpExpected Cargo(per annum) handled by sea ports in 2021 – Load as per Truck Distribution [31]

3.9.5 2021 to 2025

By the end of 2025 the expected the total expected cargo and from the sea will be 224151200 tons. This load will further be distributed to the trucks on load axel classification

Ports	Cargo Handled
Karachi port	89911200 Tons
Port Qasim	20000000 “
Gwadar	114240000 “
Total	**224151200 “**

	2 Axle	**3 Axle**	**4 Axle**	**5 Axle**	**6 Axle**
PERCENTAGE BY AXLE IN 2025	65	23.5	11.5	1.5	1.5
SHARE OF LOAD ON N-5 AS PER AXLE PERCENTAGE (TONS)	62149058.32	23556497.91	11527647.91	1503606.25	1503606.25

NO OF TRUCKS AS PER AXLE IN 2025	265075.92	100472.32	49167.30	6413.12	6413.12
LOAD CARRIED BY EACH TRUCK IN 2025 (TONS)	234.45	234.45	234.45	234.45	234.45

Table 3.3:Expected Cargo/annum handled by sea ports in 2025 – Load as per Truck Distribution

3.9.6 2025 to 2030

By the end of 2025 the expected the total expected cargo and from the sea will be 299,400,000 tons. This load will further be distributed to the trucks on load axel classification.

Ports	**Cargo Handled**
Karachi port	93760000 Tons
Port Qasim	20000000 Tons
Gwadar	185640000 Tons
Total	299400000 Tons

	2 axle	3axle	4axle	5axle	6axle
PERCENTAGE BY AXLE IN 2030	60	24	12	2	2
SHARE OF LOAD ON N-5 AS PER AXLE PERCENTAGE (TONS)	74730240	29892096	14946048	2491008	2491008
NO OF TRUCKS AS PER AXLE IN 2030	322505.5334	122240.0006	59819.57475	7802.553228	7802.553228
LOAD ACRRIED BY EACH TRUCK IN 2030 (TONS)	231.7176986	244.5361245	249.8521272	319.2554959	319.2554959

Table 3.4:Expected Cargo/annum handled by sea ports in 2030 – Load as per Truck Distribution

3.10 Options for Transferring Freight to Railway

Railway is always being a better source of economic boost for a country. It always provides an inexpensive transferring of freight to the different location in between as well as out of the country. All the developed countries have a well-developed and established infrastructure of Railway. After CPEC the railway sector in Pakistan has also being getting upgraded and it is improving his quantity as well as quality. By the end of year 2021 approximately 14 % of the total load will be share by the railway which will further increase to 20 % by 2025 and 25 % by the end of 2030.

	2Axle	**3Axle**	**4Axle**	**5 Axle**	**6 Axle**
Load Carried By Road	51926534	18773439	7589263	798870	798870
Total load	160030000				
Load Carried By Railway	6401200				
Reduction in load	11423837	3379219	1062497	79887	79887
Sum	16025327				
Railway new	22426527 14.01395 %				
Load on roads after shifting road to Railway	137603472.7				
Load carried by NH	110082778.1				
Load carried by N-5	71553805.79				

Table 3.5: Option for year 2021

	2 Axle	3 Axle	4 Axle	5 Axle	6Axle
Load carried by Road	62149058	23556498	11527648	1503606	1503606
Total load	224151200				
Load carried by railway	31381168				
Reduction in load	9943849.28	2826779.76	922211.84	60144.24	60144.24
Sum	13813129.36				
Railway new	45194297.36 20.16 %				
Load on roads after shifting road to Railway	178956902.6				
Load carried by NH	143165522.1				
Load carried by N-5	93057589.37				
load carried by Railway	45194297.36				

Table 3.6: Option for year 2025

	2 Axle	3 Axle	4 Axle	5 Axle	6 Axle
Load carried by Road	74730240	29892096	14946048	2491008	2491008
Total load	299400000				
Load carried by Railway	59880000				
Reduction in load	10462233.6	2989209.6	1195683.84	149460.48	149460.4
Sum	14946048				

Railway new	74826048 24.992%
Load on Roads after shifting road to Railway	224573952
Load carried by NH	179659161.6
Load carried by N-5	116778455
Load carried by Railway	74826048

Table3.7: Option for year 2030

3.11 Calculating Benefit to Railway and NHA

At the times of independence, in 1947 the total roads were 50,367 Km, with no motorways/Highways and the road density was 0.06 Km/sq. But with the increase vehicles and the population the road density also increases which somehow managed by constructing new roads and motorways but on the other hand the railways system was not given required importance due to which heavy portion of the freight was shifted to roads.

As the no of trucks was lesser and freight quantity in more trucks are made over loaded which cause early damaged to the road and roads are always in the need of maintenance. CPEC gives a deliberate plan to overcome unequal sharing of freight on road and railways. By the end of 2021 the 14 % of freight will be transferred to railways which will not only increase the revenue generation of the railways but will also drop-off the road maintenance cost. Same will further increase and decrease in subsequent phases as 2025 and 2030 by 20% and 25% subsequently.

Earning per wagon(Mn)2017	0.05712023
earning per wagon 2021(Mn)	720.5717063

Table 3.8: Benefit for year 2021

Earning per wagon(Mn)2021	0.057120174
earning per wagon 2025(Mn)	1344.534441

Table 3.9: Benefit for year 2025.

Earning per wagon(Mn)2025	0.057119249
earning per wagon 2030(Mn)	1958.920178

Table 3.10: Benefit for year 2030

Chapter 4

4. ANALYSIS

Pakistan is among in those very few countries that have less proportion dedicated to railway in comparison to road. The inbuilt infrastructure of railway makes it more convenient to lessen the maintenance and operation cost once capital cost is invested. Unfortunately, Pakistan couldn't expand its inherited portion of railway after partition than our rival country that has developed her railway infrastructure to burden their transportation share via road and railway nearing balancing and cutting congestion on roads to some extent. Pakistan in this regard has yet to take special measures to ensure that railway also shoulder the share of our transport sector especially of freight transport. If ratio of road transportation freight is reduced from 96% to 10- 20 % and same share if given to railway it will not only reduce congestion on roads but also will lessen the repair and maintenance cost to significant value.

National Highway alone cannot sustain the freight expected to pass through Pakistan especially after the inclusion of CPEC. Existing road infrastructure along with new planned projects if made sufficient to this freight carrying capability even then the repair maintenance and operation cost per year to retain these roads capable of such capability would not be economically suitable. Need of the hour is to give a certain proportion of these freight expected to pass through Pakistan beforehand to railway so that road infrastructure can be preserved and retain operational in better way.

Due to massive freight involved in CPEC along with capacity building of our roads railway has to burden freight share with road. By 2025 railway is expected to share freight share of Pakistan to 20% of overall freight which is at the moment is at 4%. And by 2030 railway would share freight burden of Pakistan to 25%. This increase which seems massive due to current status of share carried by railway if successfully done will make it to only 25% in a decade.

4.1 Option 1 - 86% Road & 14% Railway

An endeavor has been made to plan some options and their expected economic viability as in short term projects of CPEC. By 2021 it is expected that alongside addition of further freight of CPEC and existing freight railway will contribute its share from 4% to 14%. Total

no of truck by 2018 will be 279372.32 & by 2021 is expected to be 314256 their further distribution with regard to axle as:

Axle	2	3	4	5	6
%	31.23	29.42	26.10	2.88	10.34

According to this proportion the % age of these trucks in 2018 with regard to their axle will be as:

Axle	2	3	4	5	6
Trucks	184385.7	64255.63	25143.5	2793.72	2793.7

4.1.1 Total Freight Handled On Sea Ports

As Per 2015-16 Data, total freight handled on Sea Ports is as Under:

TOTAL CARGO HANDLED AT SEA PORTS 2015-2016					
	KARACHI PORT		PORT QASIM		Total
	IMPORT	EXPORT	import	export	
CARGO HANDLED AT SEA PORTS	26687000	12143000	17819000	7041000	70941000
	import	export			
CONTAINER CARGO	12546686	7367570			19914256
			Grand total		90855256

By using this expected freight in 2018 is to be 109950000 tons. However, no concrete shifting of share to railway has taken place however efforts are in way so in 2018 share of road vs rail remains 96% and 4% respectively. So 96% of this freight (2018) that is expected to be shared by road is 105552000 tons.80% share of road is carried by National Highway so by 2018 National highway will carry 84441600 tons.

N5 being the one of the major constituent of National highway carried 65% of the total freight of NHA, therefore the expected freight on N5 in 2018 is 54887040 tons.

4.1.2 Repair and Maintenance

The repair and maintenance cost of N5 as per Annual Maintenance Plan 2015-16 of NHA is as under:

4.1.2.1 Northern Punjab

	MILLION
PUNJAB NORTH REGION	
Func overlay	
N5 N&S	134.787
N5S	250.093
Structural overlay	
N5 N&S	321.809
N5N	344.795
N80	234.504
Rehab	
N5S&N	850
Routine Maint	
N5	174.648
TOTAL	1988.827

4.1.2.2 Southern Punjab

PUNJAB SOUTHERN REGION	
FUNCTIONAL OVERLAY	
N5	161.745
STRUCTURAL OVERLAY	
N5S	1682.643
ROUTINE MAINT	390.27
TOTAL	2234.658
SINDH NORTH REGION	
FUNCTIONAL OVERLAY	579.585
STRUCTURAL OVERLAY	649.042
PREVENTIVE MAINTANCE	75
ROUTINE MAINTANCE	104.852
TOTAL	1408.479
SINDH SOUTH REGION	
FUNCTIONAL OVERLAY	283.053
STRUCTURAL OVERLAY	209.197
HIGHWAY SAFETY	150
ROUTINE MAINTANCE	347.772
TOTAL	990.022

4.1.2.3 Khyber Pakhtunkhuwa

KPK REGION	
STRUCTURAL OVERLAY	1024.392
ROUTINE MAINTANCE	76.055
TOTAL	1100.447
GRAND TOTAL	7722.433

By using this data, the expected repair and maintenance cost in 2018 is 8031.32 Million. NHA studies have revealed that 70% of the damage is caused by overloading of 2 axle and 3 axle whereas 30% of the damage is caused by higher than 3 axle trucks.2 and 3 axles trucks are assumed to be 70% overloaded thereby causing damage and higher than 4 axles are assumed to be 40% overloaded.

Axle	2	3	4	5	6
Overloaded trucks each axle	129070	44978	10057	1117.4	1117.48
overloaded truck each axle	129070.01	44978.94	10057.4	1117.489	1117.489
cost as per axle type	2810.9645	2810.965	795.1014	795.1014	819.1954
each overloaded trucks damage cost	0.0217786	0.062495	0.079056	0.711507	0.733068

Total damage caused by one truck each of 2 –Axle, 3 –Axle, 4 –Axle, 5 -Axle& 6 -Axle is 1.607 million. With the inclusion of CPEC huge amount of freight is expected to pass through Pakistan so need of the hour is to channelize this freight into all the modes of transportation so that road alone shouldn't be major consumption of finance. Currently Karachi Port and Port Qasim are major handlers of freight entrance and exit however the deep sea port Gawadar is planned to be act as a main pillar of CPEC. Currently the freight handled by Karachi Port and Port Qasim as of 2015-16 data is as:

TOTAL CARGO HANDLED AT SEA PORTS 2015-2016					
	KARACHI PORT		PORT QASIM		Total
	IMPORT	EXPORT	import	export	
CARGO HANDLED AT SEA PORTS	26687000	12143000	17819000	7041000	70941000
	import	export			
CONTAINER CARGO	12546686	7367570			19914256
			Grand total		90855256
LOAD CARRIED BY RLY		3634210			
LOAD CARRIED BY ROAD		87221046			
LOAD CARRIED BY NATIONAL HIGHWAY		69776837			
LOAD CARRIED BY NATIONAL HIGHWAY		55821469			

4.1.3 Expected Freight

Expected freight that will be handled by the ports by 2021 is as under:

	Tons
Karachi Port	82910000
Port Qasim	20000000
Gwadar	57120000
Total	160030000

Distribution of this freight as of existing infrastructure (96% road & 4% Railway) is as under

Ld on rd	153628800
Ld on rly	6401200
Ld on NH	122903040
Ld on N-5	79886976

This 96% of the freight that in current situation if travels by road then it likely composition as per axle is as under

	Load as per truck distribution				
	2 axle	3axle	4axle	5axle	6axle
Percentage by axle in 2k21	65	23.5	9.5	1	1
Share of load on N-5 as per axle percentage	51926534	18773439	7589263	798869.8	798869.8
No of trucks as per axle in 2k21	204266.7	73850.16	29854.32	3142.56	3142.56
Load acrried by each truck in 2021	254.2095	254.2099	254.2099	254.2099	254.2099

The expected freight carried by road with regard to truck axle is as under:

	2axle	3axle	4axle	5axle	6AXLE
Ld carriedby RD	51926534	18773439	7589263	798870	798870
TOTAL LOAD	160030000				

This amount to 96% of the total freight of 2021 and 4% of this freight to railway amounts 6401200 tons. However, the CPEC short term projects & plan and Pakistan vision 2025 shows that railway is expected to share 22.4 Million Ton of freight. This amount approximately 14% of freight that is expected to travel through and within Pakistan by 2021.

% freight of Railway by 2021 = (22.4x1000000/160030000) x100 = 14%

So by 2021 railway will share 14% of the total freight which now is at approximately 4% so we need to alter our calculations to share the burden of roads. This increase in railway freight will automatically reduce portion of railway freight by same amount.

The reduction on road freight with regard to truck axle load can be estimated to as under:

Truck axle	Reduction in Ld
2	22%
3	18%
4	14%
5	10%
6	10%

Table 3.1: Reduction in Load

So by reducing load of road to 14% the reduced truck axle load is as under:

	2 axle	3 axle	4 axle	5 axle	6 axle
Reduction in load	11423837	3379219	1062497	79887	79887

The above calculation shows that 16025327 tons of freight is expected to be transferred from road to railway thereby increasing the railway freight to 22426527 tons.

Load on rds after shifting road to rly	137603472.7
Load carried by NH	110082778.1
Ld carried by N-5	71553805.79

Even this proportion of road and railway is not justified but considering the current status it is expected in times to come more and more endeavor will be put through to consider shifting of bulk of the cargo/freight to railway. This can be done through capacity building of railway as well as drastic improvement in its infrastructure to sustain the freight that will be shifted from road to railway.

As per 2016-17 data no of wagons that operated were 4167 and their earning was 238 Mn.

Month	Total wagons	Earning(Mn)
July-16	238	14.102
August-16	328	22.5
September-16	360	19.16
October-16	235	16.77
November-16	457	21.53
December-16	583	32.74
January-17	763	35.47
Februrary-17	292	24.71
March	317	13.24
April	287	20.24
May	307	17.62
Total	4167	238.082

As per this data 4167 wagons were required to shoulder the freight of 6401200 tons where as anticipated 22426527 tons' freight of 2021, 12615 wagons will be required

Earning per wagon(Mn)2017	0.05712023
Earning per wagon 2021(Mn)	720.5717063

Now the after applying all these calculations reduction of load on road and each overload truck damage caused cost will be as under

	2axle	3axle	4axle	5axle	6axle
Trucks as per axle 2021	204266.4	73850.16	29854.3	3142.56	3142.56
Ld on n-5	71553806				
Ld carried by truck type	46509974	16815144	6797612	715538	715538
check	71553806				
Load carried by each truck per annum in 2021	227.6927	227.6927	227.693	227.693	227.693
Repair and maintenance cost N-5(Mn)	7722.43				
Distr as per 70 & 30	5405.701	2316.729			
Overloaded trucks each axle	142986.5	51695.11	11941.7	1257.02	1257.02
Cost distribution as per axle	2702.851	2702.851	764.521	764.521	787.688
Each overloaded truck damage cost	0.018903	0.052284	0.06402	0.6082	0.62663

Above calculations shows reductions in damaged cost in 2021 after the reduction of road freight to 14% that is much lower than the reduction as of 96% share of road freight keeping in view growth factor with regard to CPEC freight.

4.2 OPTION 2 - Road 80 % & Rail 20%

Now we will analyze if further freight is reduced from road and shift it to railway what additional benefits can be saved in this regard. The same ratio is visualized by Pakistan Railway and Pakistan Vision 2025 as well as CPEC short term projects. Most of the guideline in this regard has been taken from above mentioned departments.This option would lead ahead from 2021 as proposed option 1

4.2.1 Expected Cargo/annum handled by sea ports in 2025

	Tons
karachi Port	89911200
Port Qasim	20000000
Gwadar	114240000
Total	224151200

224,151,200 tons of freight as expected by 2025 is further divided as 86% on road 14% on rail. 80% of the freight on road will be transported by National Highway whereas 65 % of this freight will travel on N5

	TONS
Ld on rd	192770032
Ld on rly	31381168
Ld on NH	154216025.6
Ld on n-5	100240416.6

Total trucks to be estimated by 2025 in Pakistan are 427541.Their further distribution is as under

	Load as per truck distribution				
	2 axle	3axle	4axle	5axle	6axle
Percentage by axle in 2k25	62	23.5	11.5	1.5	1.5
Load on N-5 as per axle percent	62149058	23556498	11527648	1503606	1503606
No of trucks as per axle in 2k25	265075.9	100472.3	49167.31	6413.13	6413.13
Load acrried by each truck in 2021	234.4576	234.4576	234.4576	234.458	234.458

The load carried by road in regard to each axle is as under

	2axle	3axle	4axle	5axle	6AXLE
Ld carried BY RD	62149058	23556498	11527648	1503606	1503606

As total load expected in 2025 is 224151200 tons 14% of which if shifted to railway then freight carried by railway will be 31381168 tons. According to 2025 vision Pakistan railway will shoulder 20% of freight so we need to make some reduction in road freight that is as under

	2 Axle	3 Axle	4 Axle	5 Axle	6 Axle
Reduction in load	9943849	2826780	922211.8	60144.2	60144.2

The reduction amounts to 13813129 tons. The same amount of freight can be given to railway to increase its share to 20% thereby making 20% of railway share to 45194291 tons.

Load on rds after shifting road to rly	178956902.6
Load carried by NH	143165522.1
Ld carried by N-5	93057589.37
Load carried by rly	45194297.36

Now no wagons and their anticipated load as of 2021 and 2025 as 14% and 20% of total freight

No of wagons used in 2021	12615
Load in 2021	22446527
Earning in 2021	720.571
Load in 2025	45194297
No of wagons in 2025	23538.7

Cost per wagons 2021	0.057120174
Earning in 2025	1344.534441

After applying all these calculations each truck overloaded damage cost can be estimated as under

	2axle	3axle	4axle	5axle	6axle
Truck as per axle in 2025	265076	100472.9	49167	6413.1	6413.1
Load on N-5	93057589				
Repair and maintenance cost 2025	7722.5				
Distr as per 70 & 30	5405.7	2316.747			
Overloaded trucks	185553	70331.03	19667	2565.3	2565.3
Cost distr as per axle	2702.9	2702.8715	764.53	764.53	787.69
Each overloaded trcuk costs	0.0146	0.0384307	0.0389	0.298	0.3071

Comparison of 14% railway freight vs 20% railway freight in regard to consequent reduction in damaged cost of road is as under

Axle	14% Railway Freight Overload Truck damaged cost(MN)	20% Railway Freight Overload Truck damaged cost (MN)
2	0.018903	0.0146
3	0.052284	0.0384307
4	0.06402	0.0389
5	0.6082	0.298
6	.62663	0.3071

The above analysis shows significant reduction in damage caused by each truck when more freight is shifted from road to rail. However, in this reduction no of trucks are not constant as no of trucks in 2025 is much more as that of 2021 even then reduction in cost reduces significantly.

4.3 OPTION 3 - ROAD 75% & RAIL 25%

As CPEC midterm projects and Pakistan Vision 2030 states rail to shoulder 25% portion of total freight of Pakistan. So option 3 envisages the same ratio and freight expected in 2030.

4.3.1 Expected Cargo/annum handled by sea ports in 2030

	Tons
karachi port	93760000
Port qasim	20000000
Gwadar	185640000
Total	299400000

These 299,400,000 tons of freight expected by 2030 if further be divided as 80% on road 20% on rail. 80% of freight that will travel on road 80% of it will be shoulder by National Highway and 65% of this freight will further travel on N5. (As option 2)

Ld on rd	239520000
Ld on rly	59880000
Ld on NH	191616000
Ld on n-5	124550400

Total trucks estimated to travel on roads are 520170. So freight on these truck will further be distributed as:

	Load as per truck distribution				
	2 axle	3axle	4axle	5axle	6axle
Percentage by axle in 2030	60	24	12	2	2
Load on N-5 as per axle percentage	74730240	29892096	14946048	2491008	2491008
No of trucks as per axle in 2030	322505.5	122240	59819.57	7802.55	7802.55
Load acrried by each truck in 2030	231.7177	244.5361	249.8521	319.255	319.255

Now as in option 3 we are shifting 25% of this freight to railway and 75% to road so we need to make some alterations in above calculations

	2axle	3axle	4axle	5axle	6AXLE
Load carried BY RD	74730240	29892096	14946048	2491008	2491008
Reduction in load	10462234	2989210	1195684	149461	149461

This total reduction amounts to 14946048 tons. If same amount is shifted to railway, then railway new freight will be 74826048 tons that is 25% of total freight. Now new freight after these calculations will be as

Load on rds after shifting road to rly	224573952
Load carried by NH	179659161.6
Load carried by N-5	116778455
Load carried by rly	74826048

Comparison of no of wagons used in 2025 vs 2030 and their expected freight is as under:

No of wagons used in 2025	23539
Load in 2025	45194297
Earning in 2025	1344.53
Load in 2030	74826048
No of wagons in 2030	34295.27
Earning in 2030	1958.92

4.3.2 Final summary of option 3

	2axle	3axle	4axle	5axle	6axle
Truck as per axle in 2030	322506	122240	59819.6	319.255	319.255
Load on N-5	124550400				
Repair and maintenance cost 2025	12364				
Distr as per 70 & 30	8654.77	3709.187			
Overloaded trucks	225754	85568	23927.8	127.702	127.702
Cost distr as per axle	4327.38	4327.384	1224.03	1224.03	1261.12
Each overloaded trcuk costs	0.01917	0.050572	0.05116	9.58506	9.87552

Comparison of 2025 and 2030 each overload truck cost when proportion to railway was 20% and 25% is as under

Axle	**20% Railway Freight** Overload Truck damaged cost(MN)	**25% Railway Freight** Overload Truck damaged cost (MN)
2	0.0146	0.011917
3	0.0384307	0.050572
4	0.0389	0.05116
5	0.298	9.58506
6	0.3071	9.87552

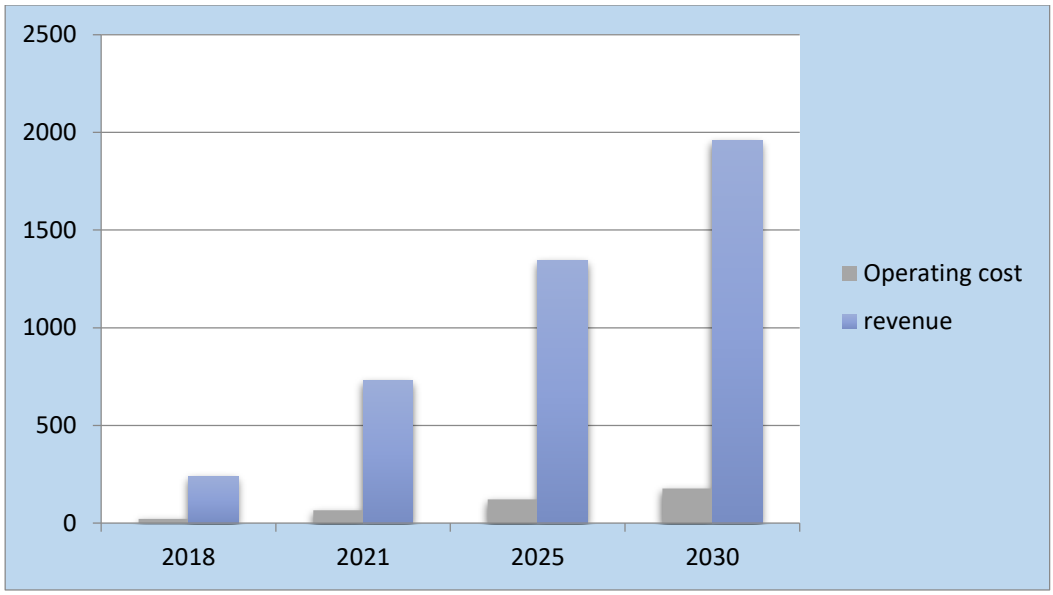
Option 3 as compared to option 2 has more cost of each overload truck however it should also be considered that no of trucks in 2030 as compared to 2025 is much more.

Calculations clearly show how increasing freight proportion on railway reduces the maintenance and operational cost of roads. If proportion is balanced 50% each to rail and road, then not only the maintenance and operation cost can be reducing significantly but railway revenue can also be increased.

4.4 Cost Benefit Analysis

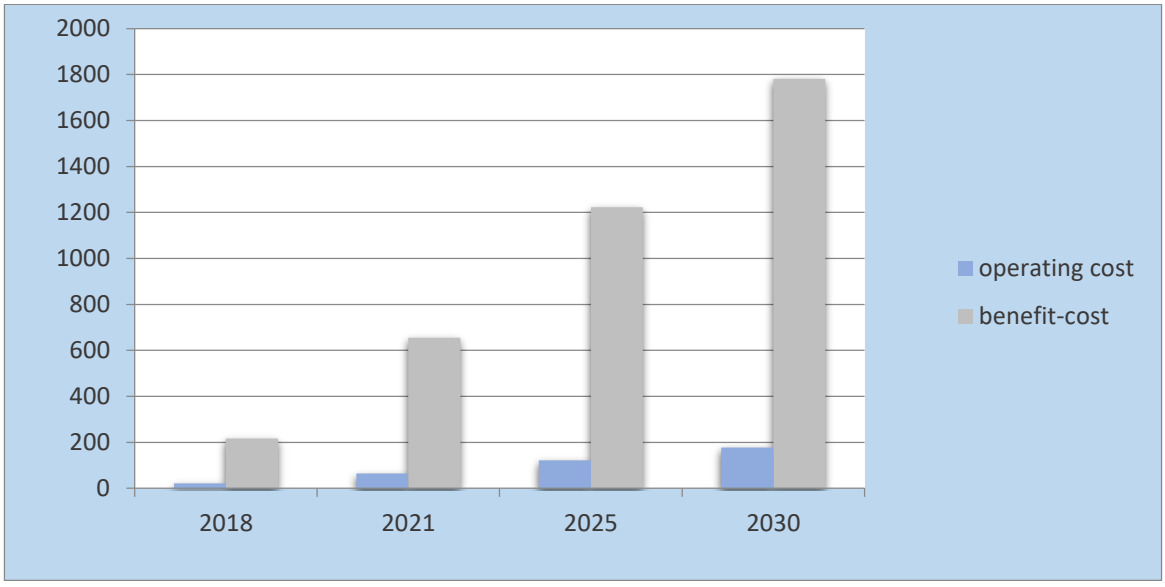
Operating expenses of Pakistan railway is 42 million in 2017 and operating expense includes repair and maintenance cost and fuel cost [47]. About 50% of this cost is expanded in freight sector which amounts to 21.525 million. Annual earnings from freight sector is expected to be 238 million. Similarly, for 2021, 2025 and 2030 earnings and operating costs were calculated and a graph was drawn between them. At the end benefits-costs were calculated and a graph was drawn between them to know the annual benefits due to increase portion of freight.

	Earning	Operating Cost	Benefit-Cost
2018	238	21.52	216.475
2021	720	65.16	654.836
2025	1344	121.59	1222.407
2030	1958	177.58	1780.841



Bar graph : Operating Cost vs Revenue Generated

Now we can see that the operating cost is decreasing annually with the revenue being generated, hence making the railway freight section more profitable. With every year with increasing operating cost revenue generated also increases. Now for benefit-cost analysis we will draw a graph between annual operating cost and benefit –cost.



Bar Graph : Operating Cost vs Benefit-Cost

Hence both graphs show increasing revenue with increased load sharing by the railway. This would lead to economic prosperity and sharing significant amount of freight with road sector.

Chapter 5

5. CONCLUSION AND RECOMMENDATIONS

5.1 Summary

As the analysis portion shows that by shifting of load to railway from road significant increase in railway revenue has been increased. The developments of CPEC for railway and road are in synchronization with each other. As mentioned previously short term projects are planned till 2021, midterm till 2025 and long term till 2030. Our research period covers time till 2030. Projects after 2030 are termed as beyond long termed projects. Initially the revenue generated by railway in 2018 with a freight percentage of 4% was 238.3 million but after shifting the load to railway in 2021 for a freight of 14% railway revenue jumped to 720 million which is due to completion of ML-1 short term projects. The revenue of 720 Million is more than triple the revenue railway was earning three years back and is a huge landmark for commercial section of Pakistan railway. Similarly, as the share of railway increased the load on roads reduced comparatively as compared to a load of 96% its share dropped to 86% which resulted in lower maintenance cost of N-5 in 2021 as compared to 2018. Maintenance and rehabilitation cost was lowered as compared to what it was previously. For the analysis of 2025 and 2030 railway shared a portion of 25 and 30 percent respectively of total freight of Pakistan. In 2025 revenue of railway doubled to almost 1350 million per year with only 20% load of the country. The huge increase in freight is due to functioning of Port Qasim and Karachi port up to their full capacity and yearly increasing freight of Gwadar port. Similarly, by 2030 Pakistan railway would earn up to 1850 million from freight per annum. Increase in revenue of Pakistan railway is not only aspect now due to decreased load on roads maintenance cost and load per truck is also considerably reduced. CPEC has also played a pivotal road in increasing freight load of Pakistan railway to make freight carrying side of Pakistan railway function able. Due to CPEC there was a dire need to increase the freight carrying capacity of Pakistan railway which is what was researched by us. In short if the same pace carried on by 2045-2050 when Gwadar starts full functioning Pakistan railway

would be able to share 50 percent of total freight of Pakistan with road sector. Secondly to reduce the rush on road and allow smooth passage on freight and passenger traffic on roads considerable portion of Pakistan railway should start functioning to reduce rush on roads and decrease their deterioration.

5.2 Conclusion

We have concluded through our analysis that Pakistan railway will share 25% of the freight load of Pakistan by 2030. CPEC with its different projects i.e. long term, short term and Midterm have been fully incorporated in the project. Pakistan Railway if going with the same pace will share approximately 50% of total freight of Pakistan by 2045.Similarly these calculations for road freight will also influence road freight sector positively as their maintenance and rehabilitation cost is reduced and considerable share of freight has been shifted to railway. Railway and road freight are two prime movers for handling a country's freight traffic. If both can be utilized properly and Railway is developed as shown in our project, Pakistan's freight sector would be at par with the rest of world in times to come.

5.3 Recommendations

5.3.1 Currently Pakistan's railway freight operations are 1/3 and 1/8 of India and china respectively. Measures should be taken to bring railway freight operations in line with rest of the countries in the region.

5.3.2 PR vision 2025 envisages 20% of freight share of total freight of Pakistan. New freight wagons and engines must be procured to ensure compliance with the vision 2025.

5.3.3 Railway must take its share of load as in other countries so as to reduce the strenuous loads on trucking industry and to reduce the deterioration of national highways.

5.3.4 Although PR has not competed road freight sector in reality but it is a spontaneous challenger. Measure should be taken now to make railway as competitive freight sector as road freight sector.

5.3.5 With the advent of CPEC and completion of Gwadar port, more freight load will have to be carried out by PR. Railway should upgrade its main lines in order to effectively the expected freight load due to CPEC and Gwadar port.

5.3.6 Ongoing projects for ML-1 and other railway lines must be completed in stipulated time frame so as to carry load as given by studies of CPEC.

5.3.7 After up gradation ML-1 must be able to operate required number of train pairs and freight trains per day as per the feasibility study conducted.

5.3.8 After shifting the load from road to railway, road sector must also consider some serious penalty for over loaded trucks and increase in toll tax so as to curb the habit of overloading. More over if over loading is reduced it will cause significant reduction in maintenance and rehabilitation funds per year.

5.3.9 Aim must be to return the freight share of PR to 73 % of total freight of Pakistan as in 1970. This would not only create passage on roads for passengers but also clear considerable space on national highways occupied by trucking sector.

5.3.10 Railway and road are two piers of a well-managed transport system. Both must be well coordinated and planned to meet the future requirements of freight in our country. If railway is not properly managed in upcoming years, road freight sector will not be able to handle the load affectively thereby causing difficulty for travelers and transporters.

REFRENCES

1. Article “Trade related technical assistance program, road freight sector and emerging competitive dynamics”. http://trtapakistan.org/wp-content/uploads/2016/01/Road-freight-transport-sector-and-emerging-competitive-dynamics_final.pdf.
2. Pakistan economic survey, “transport and communications” chapter 14, 2007-2008.
3. Wikipedia “ East India railway company” https://en.wikipedia.org/wiki/East_Indian_Railway_Company.
4. Muhammad Imran, “Public transport in Pakistan critical overview” Massey university New Zealand, 2009.
5. Wikipedia “ China Pakistan economic corridor ”
6. Wikipedia “ Pakistan ” https://en.wikipedia.org/wiki/Pakistan.
7. “Highway functional classification” state of Rhodes department of administration.
8. “Pakistan transportation overview” https://zalodoc.com/download-pdf-pakistan-transportation-view.html.
9. “Pakistan’s road network” logistic capacity assessment.pdf.
10. Wikipedia: “National highways of Pakistan”, 1988.
11. Wikipedia: “Railway Lines in Pakistan”.
12. IPFS “Pakistan Railway”. https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Pakistan_Railways.html
13. Wikipedia “Pakistan Railway”.
14. Article “Significance of Gwadar port” Islamabad police research institute, Aug 2015.
15. Wikipedia “Gwadar port” https://en.wikipedia.org/wiki/Gwadar
16. CPEC official website http://cpec.gov.pk/project-details/33.
17. Article “China’s access to Gwadar port, strategic implications for india” http://cimsec.org/waters-black-gold-strait-hormuz-pt-1/32390
18. Article “Gwadar port declared tax free zone for 20 years” Dawn news , November 2008.
19. Wikipedia “China Pakistan Economic Corridor”.
20. Article “India Iran cooperation at chabahar port-choppy waters” 18 April 2018.

21. Wikipedia “International trade routes”
22. Article by Muhammad Alamgir “Strategic importance of Gawwada-Kasghar economic zones” November, 2011.
23. Rail freight solutions to road congestion NCHRP project 8-42.
24. Article “world’s ten longest railway networks” by Anushka Gupta , February 2014.
25. Freight rail overview “US department of transportation” https://www.fra.dot.gov/Page/P0362
26. Indian railways year book 2016-17.
27. Wikipedia “Zones and Divisions of Indian railway”
28. Indian railway network map “https://www.google.com/search?q=indian+railway+network+map
29. Wikipedia “Rail transport in china”
30. Pakistan Railway year book 2016-17.
31. Pakistan statistical year book 2015-16.