Impact Of CPEC on Cost & Time of Transportation, And Regional Connectivity in Pakistan

By

Engr. Ehsan Ullah

(Fall 2019 - U&RP 00000320697)

A thesis submitted in partial fulfillment of the
requirements for the degree of

Master of Science

in

Urban and Regional Planning

Department Of Urban & Regional Planning

National Institute of Transportation (NIT)

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National University of Sciences & Technology Islamabad, Pakistan

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This is to certify that the contents and form

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Submitted by

Engr. Ehsan Ullah

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MS Urban and Regional Planning

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Thesis Acceptance Certificate

It is certified that the final MS thesis written by **Engr. Ehsan Ullah** (Registration No. 00000320697), Dept. of Urban & Regional Planning **(SCEE)** has been vetted by undersigned, found complete in all respects as per NUST Statutes / Regulations, is free of plagiarism, errors, and mistakes and is accepted as partial fulfillment for the award of MS/MPhil degree. It is further certified that the necessary amendments, as pointed out by GEC members of the scholar, have also been incorporated in the said thesis.

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Date: 03-08-2023

Signature (**Dean/Principal**): _____

Date: 03 AUG 2023

PROF DR MUHAMMAD IRFAN
Principal & Dean
SCEE, NUST

DEDICATION

I Thankful to the **ALMIGHTY ALLAH**, who gave me healthy life to meet and complete such targets in my life.

This work is dedicated to my Beloved Father **"Ghulam Abbas Gondal** (Late)**"** and specially my **mother** (Ammi G) who supported and encouraged me throughout my study career.

I also dedicate this work to My Thesis Supervisor, **Dr. Abdul Waheed** without whom it was impossible to achieve this milestone.

I also dedicate this work to my **Siblings & Spouse** for support and fulfilling this target.

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EHSAN ULLAH

ABSTRACT

The aim of this study is to examine the impact of the China-Pakistan Economic Corridor (CPEC) and the Motorway route on Pakistan's transportation system. CPEC serves as a means to reduce distances and position Pakistan as a bridge, facilitating sustainable and convenient routes for global connectivity. However, the entire CPEC/Motorway alignment has not been fully constructed. Hence, the study focuses on the completed portion of the Motorway/CPEC route from Burhan (Hassan Abdal) to Sukkur. The research was motivated by the popular belief among citizens that the Motorway route is excessively expensive. The primary objective is to compare the National Highway (N-5) with the CPEC/Motorway alignment, assessing regional connectivity, transportation costs, travel time, and travel quality. The study uses two major road alignments, specifically the network between Burhan (Hasan Abdal) and Sukkur, as case studies. A questionnaire was administered to gather data, consisting of 51 different barriers, which were analyzed using SPSS through t-tests, Reliability, and Factor analysis. The survey targeted travelers who had experience with both routes, ensuring the inclusion of user experiences. Based on the objectives and results, the Motorway/CPEC route demonstrated economic benefits, time savings, and higher travel quality compared to the National Highway (N-5) when traveling from the upper to the lower regions. The findings reveal that safety and infrastructure are the most influential factors impacting sustainable mobility between Hasan Abdal and Sukkur. Consequently, the study recommends the provision of user-friendly and safe infrastructure, along with increased usage, to promote a viable road network.

Keywords: Transportation, CPEC, Motorway, National Highways, Road Network, Alignment, Cost, Time, Quality of travelling, Connectivity.

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CHAPTER 1: INTRODUCTION

Transportation is the activity of transporting organisms and things from one place to other place (Aqeel 2016; Alam, Li et al. 2019; Beverly Thompson Kuhn 2019). It has two main parts. The first part includes modes of transportation that are vehicles which is further categories as human powered and animal powered. Human powered vehicles are bicycle, Motor bikes, Cars, buses, trucks, trains, boats, ships, Helicopters, Airplanes, etc. Whereas animal powered vehicles are Governess (horse drawn) carts, bull carts, etc. The second part includes elements of transportation (Transportation infrastructure) such as Roads, Railways, pipe ways, waterways, airways, and space ways(Aqeel 2016; Alam, Li et al. 2019). Transportation and roads play important role in increase of living standards of community, linking faraway areas with main city centers and also reduce the un-developed areas (Kanwal & Pitafi 2019). The both parts play an important role for deliverables within less time and reasonable cost.

Road Transport means transportation of goods and persons from one point to a destination point using road alignment (Beverly Thompson Kuhn 2019; Times 2021). Road is a carriageway between two points, which is paved structure. It enables the movement of motorized and non-motorized vehicles. Road Transportation infrastructure includes Motorways, Expressways, Highways, Link roads, rural roads. It's mainly used by Land traffic like car, bus, trucks etc. A road is the only infrastructure which gives door to door connectivity between different sectors in the dry area of planet Earth (Beverly Thompson Kuhn 2019; Times 2021).

In the 21st Century, the dynamics of world affairs assumed new turns and shapes by focusing more on geo-economic sides instead geo-political dimensions in bilateral relations. With this strategy The Chinese officials give proposal during his visit in May 2013 that China and Pakistan should emphatically strengthen cooperation in the fields of energy, interconnection

and other infrastructure construction (CPEC-A ; Dr Shahid Rashid 2018; Landry 2021). They emphasized on building an Economic Corridor through Pakistan to open a passage to sea for China's western region (Chen, Joseph et al. 2018).

After the working of officials for 02 years, it was launched on April 20, 2015 and named as **China-Pakistan Economic Corridor (CPEC)**. It is massive bilateral project to improve infrastructure within Pakistan for better trade with China and to further boost the region. At this moment Chinese President and Prime Minister of Pakistan signed 51 agreements and Memorandums of Understanding valued at USD 46 billion (CPEC-A ; Chen, Joseph et al. 2018; Makhdoom, Shah et al. 2018; Kanwal & Pitafi 2019).

CPEC is the part of **One Belt - One Road (OBOR)** (CPEC-A ; Dr Shahid Rashid 2018). Both improving Pakistan's road, rail, air, and energy transportation systems and establishing a road network linking Pakistan's ports of Gwadar and Karachi to China's Xinjiang province are goals of CPEC. Xinjiang is a major and important region of China which shares its borders with the countries of Mongolia, Russia, Kazakhstan, Kyrgyzstan, Tajikistan, Afghanistan, Pakistan, and India. It is highlighted that the ancient Silk Road ran through its territory (Khan, Malik et al. 2016).

Transporting commodities and energy sources like natural gas to China will take less time and be less expensive because to CPEC. Following in 2016, the CPEC-inspired announcement of collaborative space and satellite activities between China and Pakistan was made. CPEC is a component of the larger Belt and Road Initiative, which China unveiled in 2013 and aims to increase connectivity, trade, communication, and collaboration between the nations of Europe and Asia (Landry 2021).

By initiation of CPEC, the economic and social development of both countries has entered into a new phase (Malik 2018). It is an inclusive initiative to develop all provinces and regions across Pakistan and China. It has two major phases one is Short Term Plans (STPs) and other is Long Term Plans (LTPs). STP is also known as early harvest Projects. CPEC is central organ of One Belt One Road project (OBOR) and it gives a sustainable path to whole world's community. CPEC overall reduces distance, so in this Pakistan behaves like a bridge. For making this Pakistan plays an important role for giving sustainability/ease route to whole World.

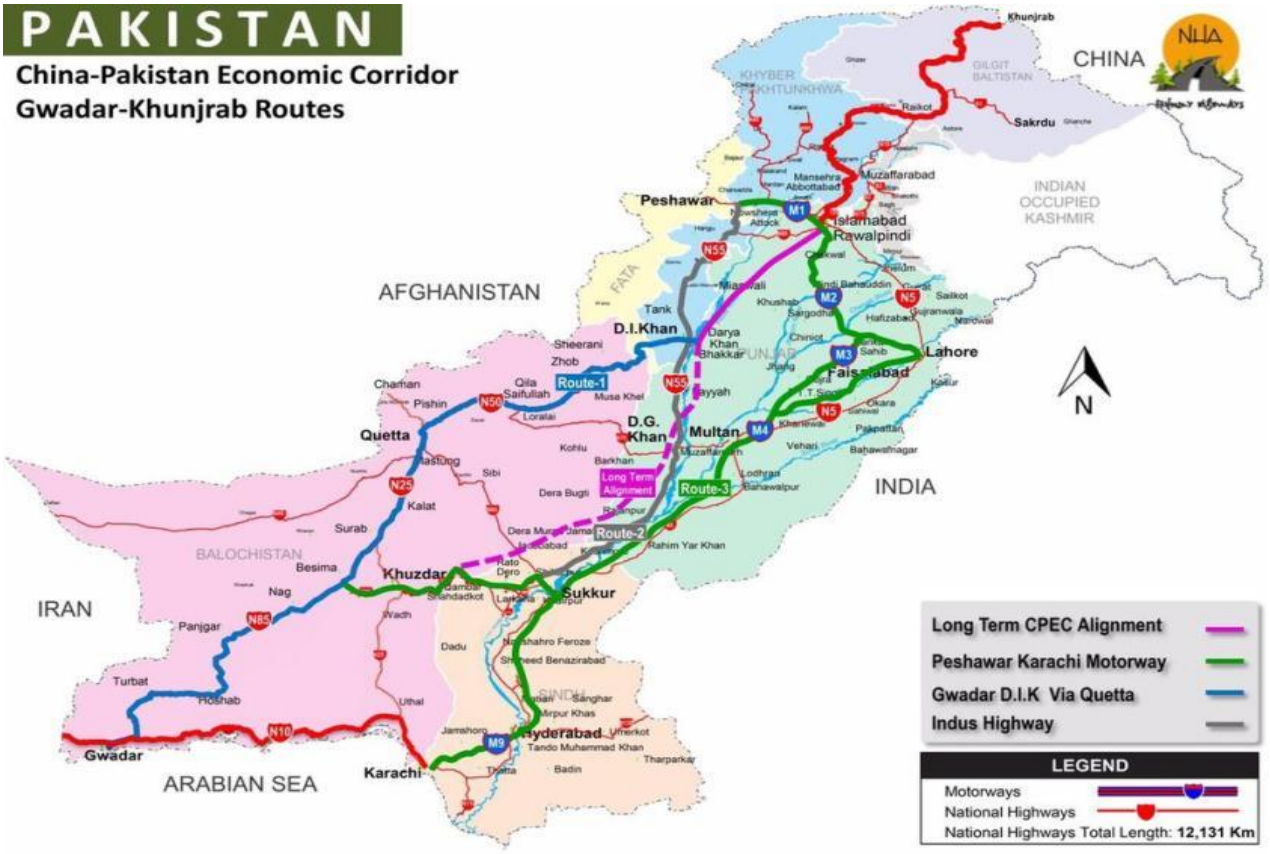


Figure 1: Map of CPEC Routes by National Highway Authority, Pakistan

Transportation accessibility is assumed to be a main driver of urbanization (Kasraian, Maat et al. 2019). This research investigates the impact relationship between the regional connectivity, transportation cost, travel time and quality of travelling due to CPEC Road network

in Pakistan. Regional connectivity is directly linked with regional networks through which we have good connections between different regions. It will improve the flow of traffic and provide better facilities to community. Transportation cost is the cost which is bear by a vehicle while travelling from one place to other. Travel time in terms of transportation is that the time taken for a traveling from one place to another. Quality of travelling is the smoothness of travelling. It gives ease to driver for a movement from starting point to a destination point.

For achieving the objectives of this study, it is needed to collect CPEC Road data from different authorities like Ministry of Planning (MoP), China Pakistan Economic Corridor Authority (CPEC-A), Ministry of Communications (MoC), National Highway Authority (NHA), Frontier Works Organization (FWO), Centre of Excellence CPEC (CoE-CPEC) and regional localities/stakeholders. After data collection from authorities, this research will analyze the data in appropriate detail followed by necessary calculations which will ultimately lead to achievement of objectives of this study.

1.1 RESEARCH GAP

The China Pakistan Economic Corridor is a pilot project under Belt and Road Initiative and a good connection for China Pakistan cooperation. Both Countries have enjoyed the steady development of this bilateral connection. CPEC is an inclusive initiative to develop all provinces and regions across Pakistan. The Eastern Route of CPEC road alignment is about to complete from Khunjerab (Gilgit Baltistan) to Gwadar (Baluchistan). As it is lack of research in this subject.

Major reasons for selection of subject research topic are non-existence of a comprehensive research in Pakistan covering impact of CPEC on cost, time, and quality of

mobility and the regional connectivity in Pakistan. Another reason for selection of subject topic is that many segments of the civil society of Pakistan are still reluctant in believing the importance of CPEC on Pakistan. This research will attempt to present necessary facts & figures in one place in order to determine and showcase the strategic importance and advantages of CPEC in terms of cost, time and regional connectivity.

1.2 PROBLEM STATEMENT

The research on this subject in Pakistan is limited. (Alam, Li et al. 2019) carried out a study on this topic and covered overall CPEC Route. The author admitted that his research was not accurate because at that time the route is not operational / finalized. There is another researcher named Muhammad Aqeel also admit that as project is under construction so it is hard to get exact data about Road alignment of CPEC (Aqeel 2016). Some researchers have tried to measure the Transportation cost, Travel time and Connectivity in other countries on their road network. But no comprehensive study/research in Pakistan apparently exists on this subject. Therefore, research is needed on CPEC Alignment in Pakistan measuring impacts on Transportation/Mobility under CPEC Road alignment in Pakistan.

1.3 RESEARCH QUESTIONS

What is the impact of CPEC route on transportation cost?

What is the effect of CPEC route on transportation/travelling time?

What is the effect of CPEC route on quality of travelling?

Is the new alignment of CPEC having good impacts on regional connectivity within Pakistan?

1.4 OBJECTIVES

The proposed objectives of this research are;

i. To evaluate effect of CPEC route on transportation cost
ii. To determine effect of CPEC route on transportation/travelling time
iii. To investigate the effect of CPEC on regional connectivity
iv. To investigate the effect of CPEC route on quality of travelling
v. To suggest a strategy to improve quality of travelling and regional connectivity in Pakistan under CPEC

1.5 SCOPE OF STUDY

The selection of subject topic is that many segments of the civil society of Pakistan are still reluctant in believing the importance of CPEC on Pakistan. This research will attempt to present necessary facts & figures in one place in order to determine and showcase the strategic importance and advantages of CPEC in terms of cost, time and regional connectivity. It will be beneficial for community to believe the importance. It will show the reduced travel time as well as travelling cost with in Pakistan. It will give opportunity for National/ International investors. It will boost/heavy impact on economy of Pakistan. It will give good, safe, smooth path to local tourists as well as international tourists. With this tourism industry take a boost in Pakistan. After improvement of this industry, it will definitely improve the international image and behavior of Pakistan. It plays important role on the economy of Pakistan due to the alignment used by second economy of world (China).

1.6 STRUCTURE OF THE THESIS

The thesis write-up is divided into five chapters:

1. Chapter 1: This chapter covers the general introduction of research topic, background, problem statement, research questions, significance, objectives, and limitations of the study.
2. Chapter 2: This chapter covers in detail the literature from different reports and research papers that is available in transportation/CPEC Alignments.
3. Chapter 3: This chapter covers the overview of research methodology to carry out the research. The chapter presents the sample size, sampling framework, methods of data collection and techniques to analyze the data.
4. Chapter 4: This chapter comprises of data analysis and interpretation of results and ranking in order of priority according to different stakeholders through quantitative analysis.
5. Chapter 5: In this chapter, the conclusion is drawn from the theoretical results derived in the previous chapter. The results are integrated with the existing literature.
6. Chapter 6: This Chapter includes the recommendations/ outcomes for future studies.
7. References: This section used APA style; it has a list of all references.
8. Appendix: Questionnaire is attached in this section.

CHAPTER 2: LITERATURE REVIEW

2.1 HISTORY OF TRANSPORTATION

The two main modalities that make up the land transportation system are roads and railroads (Rodrigue, Comtois et al. 2016). Since steam rail technology wasn't available until the 18th century, throughout the Industrial Revolution, roads were built first (Shedd 1981). Trails, which were typically utilized to travel from one hunting zone to another, gave rise to the first land highways. Mesopotamia had the first networks of paved roadways by 3,000 BCE, while Babylon had asphalt-paved roads by 625 BC (Rodrigue, Comtois et al. 2016). In the fifth century BC, there were 2,300 kilometers of roads in the Persian Empire. But beginning around 300 BC, the Roman Empire built the first significant road network, primarily for commercial, military, and administrative purposes. It depended on dependable road engineering techniques, such as the setting of foundations and building of bridges. By 100 BC, this was also connected to the development of transcontinental trade networks like the Silk Road, which connected Europe and Asia (Editors 2017).

The construction of roads picked up speed in the early 20th century. The creation of the American Interstate highway system is without a doubt the most impressive road transport technical accomplishment of the contemporary era. Its development started in 1956 with the strategic goal of creating a nationwide network of roads serving the American economy as well as being capable of facilitating troop movements and serving as airstrips in an emergency (although the latter two reasons were never utilized). The years of its fastest expansion, from the 1950s to the 1970s, saw the construction of about 56,000 km. Only 15,000 km were added to the system between 1975 and 2006, highlighting rising construction costs and declining profits. A

total of 70,000 km of four- and six-lane highways were built, connecting all significant American cities from coast to coast. In Canada, a project of a similar nature resulted in the 1962 completion of the Trans-Canada highway. Other industrialized nations soon followed. Every modern country had built a national highway network by the 1970s, which in the case of Western Europe led to a pan-European network. As faster road construction is one of the first indications of economic expansion, this tendency is currently seen in many developing economies. In 2017, the length of the Chinese national highway network, which is currently being built, surpassed that of the American Interstate (Rodrigue, Comtois et al. 2016).

2.2 HISTORY OF SILK ROAD

The Silk Road, which was in use for roughly 1,500 years, was the longest-lasting trading route ever created. Although many other goods were sold along the route, its name comes from the highly valuable Chinese textile that traveled from Asia to the Middle East and Europe. The 6,400 km-long Silk Road was made up of a series of roads that caravans traveled through Central Asia. Steppes made travel easier, yet some parched regions, such the Takla Makan and Gobi deserts, had to be avoided. Due to economies of scale, difficult terrain, and security concerns, trade had to be organized into caravans that moved slowly from one stage (town or oasis) to the next (Rodrigue, Comtois et al. 2016).

Although it is suspected that significant trade occurred for about 1,000 years beforehand, the Silk Road opened around 139 BCE once China was unified under the Han dynasty (Rodrigue, Comtois et al. 2016; Editors 2017). It passed through commercial centers like Samarkand and Kashgar on its way from Changan (Xian) to Antioch or Constantinople (Istanbul). Considering that the trading system operated as a chain, it was extremely uncommon for caravans to travel the entire distance. Caravans of traders were transporting goods back and

forth between the trading centers. Gold, jade, tea, and spices were among the principal items exchanged in addition to silk. Luxury goods were the only commodities that could be traded because there was a restricted capacity for transportation across great distances, which was frequently risky. Additionally, the Silk Road promoted the spread of ideologies and faiths (first Buddhism, then Islam), allowing cultures from Europe, the Middle East, and Asia to communicate with one another (UNESCO).

The sea route connecting the Mediterranean basin and India was first used during the Roman era. Ships were able to travel between the Red Sea and India during the first and sixth century thanks to summer monsoon winds. At the Red Sea port town of Berenike, goods were transshipped before being transported by camels upstream to the Nile. The commodities were then transported by riverboat to Alexandria, where trade with the Roman Empire could be conducted. The first pandemics and the spread of illnesses have both benefited from these trading routes. For instance, it is thought that trade routes allowed the Justinian disease of 541 (a type of bubonic disease) to move from its East Asian roots to the Mediterranean (Rodrigue, Comtois et al. 2016).

Beginning in the ninth century, Arab traders' control over marine routes increasingly diminished the significance of the Silk Road (Liu 2010). Larger quantities of products could be traded since ships' carrying capacity was significantly less constrained than that of caravans. Guangzhou was the starting point of the primary maritime route, which traveled across Southeast Asia, the Indian Ocean, the Red Sea, and finally reached Alexandria (Hansen 2012). The "Spice Islands" (Maluku Islands) in modern-day Indonesia received a sizable feeder. They were given that name because nutmeg, mace, and cloves were once only found there (Rodrigue, Comtois et al. 2016).

The Mongol Khans, who promoted trade even though they were brutal conquerors, ruled over China and Central Asia during the Mongolian Empire (13th century), when the Silk Road reached its pinnacle. Following Marco Polo's (1271–1292) expeditions, contacts between Europe and China were revitalized at the same time. The spread of Islam was also aided by trade because the faith contains many principles governing ethics and business (Foltz 1999).

The majority of the Mediterranean trade, which connected to the important trading hubs of Constantinople, Antioch, and Alexandria during the Middle Ages, was governed by the Venetians and Genovese. From the 15th century, when European nations advanced their marine skills, they were able to seize control of this profitable trade route from the Arabs and replace it on their own. By the 16th century, ships' ability to move goods more quickly and affordably contributed to the Silk Road's demise (Rodrigue, Comtois et al. 2016).

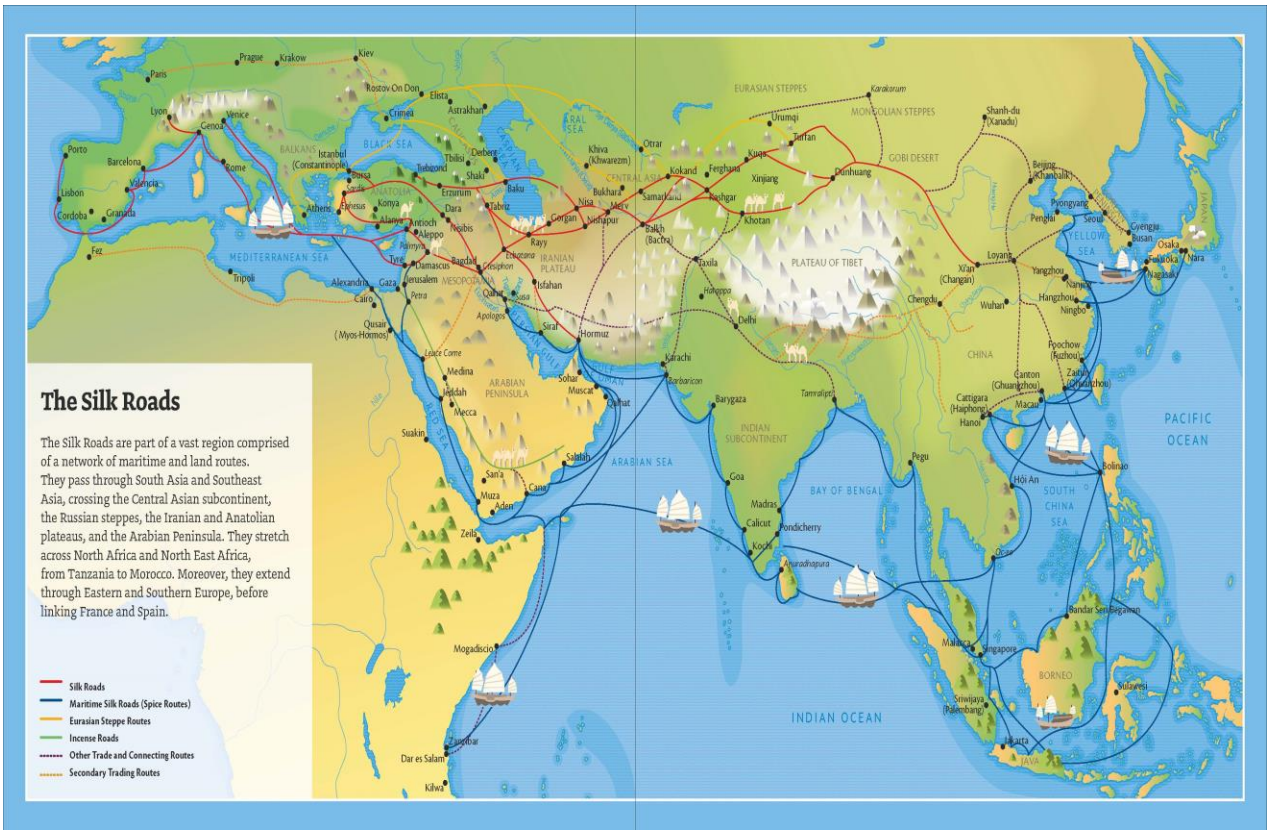


Figure 2: Routes of Silk Roads

2.3 WHAT IS NEW SILK ROAD?

According to (McBride 2020), In 2013, President Xi made the announcement on official trips to Kazakhstan and Indonesia. The Maritime Silk Road and the Overland Silk Road Economic Belt were the two axes of the strategy. (Li, Qian et al. 2015). Initially known as the One Belt, One Road initiative, the two later went by the name Belt and Road Initiative. In Xi's vision, a large network of motorways, energy pipelines, railways, and border crossings would be built that would extend south to Pakistan, India, and the rest of Southeast Asia as well as west across the mountainous former Soviet republics. According to Xi, such a network would "break the bottleneck in Asian connectivity" and increase the renminbi's use abroad (The Asian Development Bank estimated that the region faces a yearly infrastructure financing shortfall of approximately $800 billion).

Initially dubbed to as the One Belt, One Road plan, the two later adopted the Belt and Road plan. In Xi's vision, there would be a massive network of motorways, pipelines for energy, railways, and border crossings that would be more efficient, extending south to Pakistan, India, and the rest of Southeast Asia as well as west across the mountainous former Soviet republics. According to Xi, such a network would "break the bottleneck in Asian connectivity" and increase the usage of the yuan, the Chinese currency, on a global scale. (Li, Qian et al. 2015). At the Association of Southeast Asian Nations (ASEAN) meeting in 2013, Xi subsequently unveiled plans for the 21st Century Maritime Silk Road in Indonesia. China would invest in port construction around the Indian Ocean, from Southeast Asia all the way to East Africa and parts of Europe, to accommodate growing maritime trade flow. China's total BRI aim is astounding (McBride 2015).

There are six economic corridors of the BRI (Belt 2018; Malik 2018). China's growth plan places a lot of emphasis on thinking about development in terms of economic corridors. The Belt and Road Initiative's six economic corridors span a huge area of the world that is resource-rich, energetic, and home to a river of knowledge (Li, Qian et al. 2015; Malik 2018):

1. China, Mongolia, Russia Economic Corridor (CMREC): including rail links and the steppe road, this will link with the land bridge.
2. New Eurasia Land Bridge (NELB): involving rail to Europe via Kazakhstan, Russia, Belarus, and Poland.
3. China, Central Asia, West Asia Economic Corridor (CCAEC): linking to Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan, Iran, and Turkey.
4. **China, Pakistan Economic Corridor (CPEC)**: Xinjiang Province will be most affected. This important project links Kashgar city (free economic zone) in landlocked Xinjiang with the Pakistan port of Gwadar, a deep-water port used for commercial and military purposes.
5. BCIMEC This is likely to move more slowly due to mistrust over security issues between India and China.
6. CIPEC Viet Nam, Thailand, Lao People’s Democratic Republic, Cambodia, Myanmar, and Malaysia.

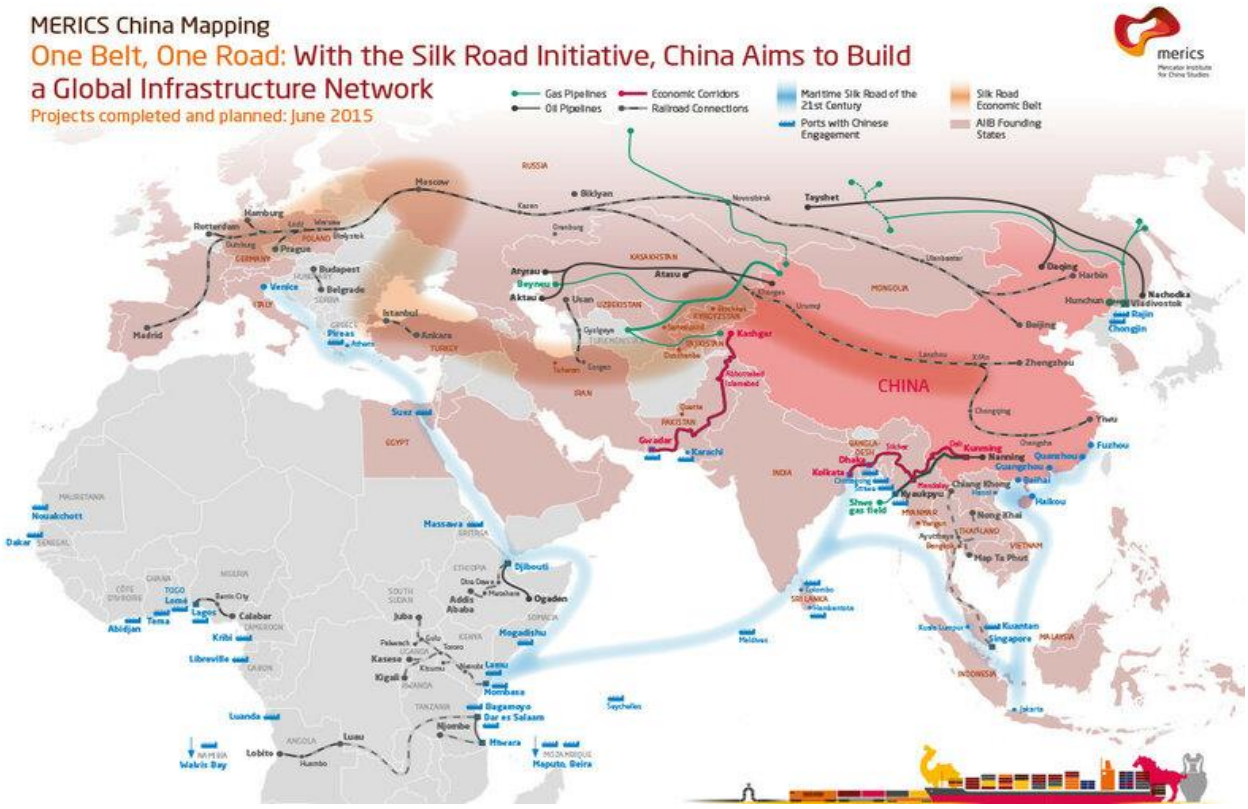


Figure 3: Routes of One Belt, One Road by MERICS 2015

More than 60 nations, or around two-thirds of the world's population, have so far agreed to participate in initiatives or expressed interest in doing so. The highest thus far, according to analysts, is thought to be around $60 billion. The China-Pakistan Economic Corridor is a network of initiatives linking Pakistan's Gwadar Port on the Arabian Sea with China's Kashgar (McBride 2015).

2.4 CHINA PAKISTAN ECONOMIC CORRIDOR

The dynamics of international affairs have changed in the 21st century as a result of bilateral ties focusing more on geo-economic aspects than geo-political ones (PRC 2021). With this approach During his visit to China in May 2013, Chinese authorities made the suggestion that China and Pakistan should vehemently increase their cooperation in the areas of energy,

connectivity, and other infrastructure building (Malik 2018). They placed a strong emphasis on constructing an Economic Corridor via Pakistan to provide western China with access to the sea. (PRC 2021).

CPEC-Authority defines CPEC as “The CPEC is a growth axis and a development belt featuring complementary advantages, collaboration, mutual benefits and common prosperity. With the comprehensive transportation corridor and industrial cooperation between China and Pakistan as the main axis, and with concrete economic and trade cooperation, and people to-people exchange and cultural communications as the engine, CPEC is based on major collaborative projects for infrastructure construction, industrial development and livelihood improvement, aimed at socio economic development, prosperity and security in regions along it”(CPEC-LTP 2017).

It was officially launched on April 20, 2015, under the moniker China-Pakistan Economic Corridor (CPEC), after officials had been working on it for two years. It is a significant bilateral project to upgrade Pakistan's infrastructure for better trade with China and to enhance the region's growth (Makhdoom, Shah et al. 2018). At that moment, the Pakistani Prime Minister and the President of China have signed 51 agreements and memorandums of understanding, which are estimated to be worth USD 46 billion. (CPEC-A ; Chen, Joseph et al. 2018; Makhdoom, Shah et al. 2018; Adnan and Fatimais 2020). The division of Chinese investment in 2015 is as shown in figure below:

Figure 4: CPEC Routes showing investments by Government of Pakistan

CPEC is the part of **One Belt - One Road (OBOR)** (CPEC-A ; Malik 2018). The CPEC project aims to connect the Pakistani ports of Gwadar and Karachi to China's Xinjiang province via road networks as well as revolutionize Pakistan's economy by modernizing its rail, air, and energy transportation systems. China's Xinjiang region, which borders Mongolia, Russia, Kazakhstan, Kyrgyzstan, Tajikistan, Afghanistan, Pakistan, and India, is a significant and vital part of the world. It is emphasized that its land was part of the old Silk Road.

Transporting commodities and energy sources like natural gas to China will take less time and be less expensive because to CPEC. Following in 2016, the CPEC-inspired announcement of collaborative space and satellite activities between China and Pakistan was

made. CPEC is a component of the larger Belt and Road Initiative, which China unveiled in 2013 and aims to increase connectivity, trade, communication, and collaboration between the nations of Europe and Asia (Chen, Joseph et al. 2018). The distance between Gwadar and Khunjerab is 2688 kilometers overall. The distance encompasses areas that are mountainous, undulating, and flat (Aqeel 2016). Two (02) to Six (06) lanes, each 3.65 meters wide, have been suggested for the CPEC. The CPEC route's design speed ranges from roughly 70 kph to 120 kph. By initiation of CPEC, the economic and social development of both countries has entered into a new phase (Chen, Joseph et al. 2018). It is an inclusive initiative to develop all provinces and regions across Pakistan and China. It has two major phases one is Short Term Plans (STPs) and other is Long Term Plans (LTPs). STP is also known as early harvest Projects. CPEC is central organ of One Belt One Road project (OBOR) and it gives a sustainable path to whole world's community. CPEC overall reduces distance, so in this Pakistan behaves like a bridge. For making this Pakistan plays an important role for giving sustainability/ease route to whole World. CPEC spans Xinjiang Uygur Autonomous Region and whole Pakistan in spatial range. CPEC has a spatial layout of "One Belt, Three Alignments, Two Axes and Five Functional Zones" (MoPD&R 2016).

The term "One Belt" refers to the northeast-southwest strip area running through China and Pakistan along a major traffic artery that begins in Kashgar, travels through Tashghorgan, Khunjerab Pass, Islamabad, and Lahore, and ends in Sukkur, where it is split into two routes that lead to Karachi and Gwadar on the Arabian Sea coast. (Chen, Joseph et al. 2018). "One Belt" is the core area of the China Pakistan Economic Corridor and the economic cluster area of industries, population and cities.

"Three Passages" refer to the east, central and west traffic passages in the core area from Islamabad to Karachi and Gwadar, each of which consists of several trunk railways and highways (CPEC-A ; Aqeel 2016; MoPD&R 2016; Chen, Joseph et al. 2018).

- The Eastern Passage is the main thoroughfare of the Corridor, connecting Islamabad to Karachi through Lahore, Faisalabad, Multan, Sukkur, and Hyderabad.
- The Central Passage begins in Islamabad and travels through Darya Khan, Jacobabad, and Khuzdar on the N25 or to Gwadar on the M8 to reach Karachi. This passage's construction hasn't been finished altogether, and certain sections are still being built.
- The Western Passage begins in the northern city of Islamabad and travels to Gwadar via D.I. Khan, Quetta, Basima, and Hoshab.

Two East-West development axes in the China Pakistan Economic Corridor, namely the Lahore-Islamabad-Peshawar and Karachi-Gwadar development axes, are referred to as the "Two Axes" in this sentence. (MoPD&R 2016). The locations of the "Two Axes" are in very different geographic regions with very different economic development levels. They are crucial areas for enhancing regional connectivity and fostering coordinated regional development throughout the construction of the Corridor.

The "Five Functional Zones" According to the level of regional development, industrial structure, resource and environmental bearing capability, and growth potential, the Corridor is divided into five functional zones. These locations include significant nodal cities, thoroughfares, and industrial clusters. (MoPD&R 2016). These are:

1. Southern Xinjiang Route (Kashgar-Atushi-Tumshug-Khunjerab)

2. Northern Pakistan Route (Khunjerab-Islamabad)
3. Eastern Pakistan Route (Islamabad-Pindibhatian-Faisalabad-Khanewal-Multan-Sukkur-Hyderabad-Karachi-Gwadar)
4. Central Pakistan Route (Khunjerab-Islamabad-Multan-Sukkur-Gwadar)
5. Western Pakistan Route (Khunjerab-Hakla-DI Khan-Quetta-Gwadar)

The road map of CPEC is shown in the following map.

Figure 5: CPEC Alignments by MoPDR, Pakistan

2.5 TRANSPORTATION

Transportation is the activity of transporting organisms and things from one place to other place (Aqeel 2016; Alam, Li et al. 2019; Beverly Thompson Kuhn 2019). Transportation

and roads play important role in increase of living standards of community, linking faraway areas with main city centers and also reduce the un-developed areas (Kanwal & Pitafi 2019). Transportation has two main parts. The both parts play an important role for deliverables within less time and reasonable cost.

The first part includes modes of transportation that are vehicles which is further categories as human powered and animal powered. Human powered vehicles are bicycle, Motor bikes, Cars, buses, trucks, trains, boats, ships, Helicopters, Airplanes, etc. Whereas animal powered vehicles are Governess (horse drawn) carts, bull carts, etc. The second part includes elements of transportation (Transportation infrastructure) such as Roads, Railways, pipe ways, waterways, airways, and space ways (Aqeel 2016; Alam, Li et al. 2019).

2.5.1 ROAD TRANSPORTATION

Road Transport means transportation of goods and persons from one point to a destination point using road alignment (Beverly Thompson Kuhn 2019; Times 2021). Road is a carriageway between two points, which is paved structure. It enables the movement of motorized and non-motorized vehicles. Road Transportation infrastructure includes Motorways, Expressways, Highways, Link roads, rural roads. It's mainly used by Land traffic like car, bus, trucks etc. A road is the only infrastructure which gives door to door connectivity between different sectors in the dry area of planet Earth (Beverly Thompson Kuhn 2019; Times 2021).

Road and transportation play an important role in the development of business and economic growth of the country (Ali, Mi et al. 2017; Chauvet and Baptiste 2019; Kanwal & Pitafi 2019). Road and transportation also help to increase the living standard of the local community, remove poverty by linking remote areas and individuals with main business centers

and city markets, and also minimize the development gap in the region (Bhattacharyay, Kawai et al. 2012; Kanwal & Pitafi 2019).

2.6 TRAVEL TIME

Travel time reliability is a measure of the consistency, timeliness, predictability, and dependability of a trip (Transportation 2019). Travel time is one of the important categories of transport, and time savings are often claimed to be the greatest benefit of transport projects such as new and expanded roadways, and public transit improvements. Factors such as traveler comfort and travel reliability can be quantified by adjusting travel time values. (Litman 2009).

Primary-user benefits (in terms of travel time reductions and operator cost savings) have been regarded as more significant than indirect benefits (Bryan, Hill et al. 1997). A classic study by (Becker 1965) regards the study of the allocation of time as an area of consumer economics in which time value is assessed in relation to working and non-working hours, related respectively to people's role as "producers" and "consumers" of commodities. Travel time is the period of length taken by a traveler from start point to a destination point.

2.7 TRAVEL COST

Costs associated with transportation are expenses that service providers for transportation internally bear. Depending on numerous factors such as geography, infrastructure, administrative hurdles, energy, and how passengers and freight are transported, they come as fixed (infrastructure) and variable (operational) expenses. Transport costs are influenced by three main factors: transactions, shipments, and the friction of distance. (Rodrigue, Comtois et al. 2016).

The role of general infrastructure in regional development comes to the conclusion that while economic theory suggests that providing infrastructure lowers the cost of directly

productive activities, there is much less clarity regarding the strategies for providing infrastructure to achieve economic development, i.e. whether economic development occurs via provision of additional infrastructure capacity or is constrained by infrastructure shortages (Bryan, Hill et al. 1997). Travel cost is the expenditure bared by a vehicle while travelling from one point to another like fuel cost, wear and tear of vehicle parts etc.

2.8 QUALITY OF TRAVELLING

Quality of travelling is experience of commuter while travelling on any road alignment. It is overall behavior and services provided on road alignment. Roads are the most used means of transport. Thus, regular maintenance of the roads is required for safety and convenience of the people.

2.9 CPEC INITIATIVES IN PAKISTAN

To improve the lives of people of Pakistan and China by building an economic corridor promoting bilateral connectivity, construction, explore potential bilateral investment, economic and trade, logistics and people to people contact for regional connectivity (CPEC-A ; Dr Shahid Rashid 2018; Makhdoom, Shah et al. 2018). It includes:

- Transport & IT systems including Rail, Ports, Roads, Air and Communication
- Energy
- Layout, Zones, Industries and Industrial Hubs
- Agricultural
- Socio-Eco Development
- Tourism Cooperation & Person to Person Communication
- Cooperation in Livelihood Areas

- Financial Cooperation
- HR Development

For achieving all mentioned goals, first, we have to make Infrastructure and Energy sector very strong in Pakistan. We have different projects in Pakistan which are in the umbrella of CPEC. In which we have Energy projects, Health care facilities, Special Economic Zones (SEZ's) and projects of Communications. We have approximately twenty (20) different projects of energy sector in CPEC umbrella (CPEC-A ; Dr Shahid Rashid 2018; Makhdoom, Shah et al. 2018). Some major energy projects are listed below:

- Sahiwal Coal-fired Power Plant
- Coal-fired Power Plants, Karachi
- HUBCO Coal Power Project
- Engro Thar Coal Power Project
- Quaid-e-Azam Solar Park, Bahawalpur
- Suki Kinari Hydropower Station
- Thar Mine Mouth Oracle Power Plant & surface mine

We have nine (09) SEZ's in CPEC umbrella (CPEC-A ; Chen, Joseph et al. 2018; Dr Shahid Rashid 2018; Makhdoom, Shah et al. 2018)

Which are listed below:

- Bostan Industrial Zone
- Industrial City, Faisalabad
- Islamabad Capital Territory Model Industrial Zone, Islamabad
- Rashakai Economic Zone
- Dhabeji Special Economic Zone

- Industrial Park Pakistan Steel Mills Port Qasim
- Industrial Zone Mirpur
- Marble City Mohmand
- Moqpondass SEZ, GB, Pakistan

In the eye of communication different projects under CPEC (CPEC-A ; Dr Shahid Rashid 2018; Makhdoom, Shah et al. 2018). Major projects are listed below:

Air transport infrastructure

- Gwadar International Airport

Sea and Dry ports infrastructure

- Mater Plan of Gwadar Smart Port City
- Havelian Dry port

Railway infrastructure

- ML-1 Expansion and reconstruction

Data communication

- CPEC Fiber Optic Project (Khunjerab-Rawalpindi)

Road infrastructure

For making efficient connectivity in between all above interlinked things, this will play important role in making the CPEC. For strong and time-consuming connectivity there is a need of new road alignments in Pakistan. In keeping it view the planning/execution of Road Infrastructure is on priority. In road infrastructure four major Alignments includes (CPEC-A): **Northern Alignment** (Khunjerab-Thakot-Havalian-Burhan/ Hassan Abdal), **Eastern Alignment** (Khunjerab-Islamabad-Pindibhatian-Faisalabad-Khanewal-Multan-Sukkur-Hyderabad-Karachi-

Gwadar), **Central Alignment** (Khunjerab-Islamabad-Multan-Sukkur-Gwadar), **Western Alignment** (Khunjerab-Hakla-DI Khan-Quetta-Gwadar)

These all alignments connect the upper region with lower region of Pakistan. In making all alignments some portions are used from existing road infrastructure and some new portions constructed. This will make safer, time and cost consuming and put its best for strong connectivity between different regions of Pakistan.

2.9.1 NORTHERN ALIGNMENT

The term Northern Alignment of CPEC refers to roadway projects. The maximum portion of this alignment is located in KPK province. It starts from Khunjerab Pass and connects Punjab province through Hazara Interchange near Hassan Abdal (Dr Shahid Rashid 2018). As part of the Northern Alignment, a 450 km long expressway/motorway that has 4 to 6 lanes of controlled access and is intended for travel at speeds of up to 80 to 100 km/h (NHA) will link Pakistan's higher portion the Northern Areas with the Plain area of Punjab, Rawalpindi Division/Islamabad. Several Chinese state-owned banks will disburse funding for the entire project.

2.9.2 EASTERN ALIGNMENT

The CPEC's Eastern Alignment refers to road construction projects in the provinces of Sindh and Punjab, some of which were first conceived in 1991. A 1,152 km long motorway, part of the Eastern Alignment, will link Karachi and Lahore, the two largest cities in Pakistan, with a 4 to 6-lane controlled access highway built for top speeds of 120 kph (NHA). The total project cost was about $6.6 billion, with several state-owned institutions in China providing the majority of the finance (CPEC-A).

The M9 Motorway, which runs 136 kilometers between Karachi and Hyderabad, a 296-kilometer section between Hyderabad and Sukkur, a 387-kilometer section between Sukkur and Multan, and a 333-kilometer section between Multan and Lahore via the town of Abdul Hakeem make up the entire Eastern Alignment motorway project.

2.10 IMPACTS OF ROAD INFRASTRUCTURE

New road infrastructure could improve prospects for a regional economy and its constituent firms and organizations (Bryan, Hill et al. 1997). New roads give access to goods and factor markets, and hence, play an important role in industrial location decisions (Bryan, Hill et al. 1997). The building of new roads typically results in social and economic benefits as it provides access to different areas thereby facilitating mobility and trade (Co). Provided some UK evidence of the significance of road infrastructure in the location decisions of inward investors (Hill and Munday 1994). By lowering transaction costs and accelerating delivery times, road connectivity at its peak would significantly boost the competitiveness of goods and services (Hussain 2017).

The development of highways, a railroad line between Gwadar and Kashgar, as well as mass transit systems in major cities, would be of advantage to Pakistan. Since the majority of the freight is currently transported by trucking fleet, the rehabilitation and upgrading of Main Railway Line with High Speed Trains would alleviate businesses of the high cost of domestic transportation of goods to and from Karachi (Hussain 2017). The road infrastructure has great effects on Socio Economic, Trade and industry, regional connectivity, and Urban development of a region. Through New Road alignment (CPEC Alignment) Pakistan will get positive impacts of a regional development.

2.11 SUMMARY OF LITERATURE REVIEW

The China Pakistan Economic Corridor is a pilot project under Belt and Road Initiative and a good connection for China Pakistan cooperation. Both Countries have enjoyed the steady development of this bilateral connection. CPEC is an inclusive initiative to develop all provinces and regions across Pakistan. The Eastern Route of CPEC road alignment is about to complete from Khunjerab (Gilgit Baltistan) to Gwadar (Baluchistan). As it is lack of research in this subject. Major reasons for selection of subject research topic is non-existence of a comprehensive research in Pakistan covering impact of CPEC on cost, time, and quality of mobility and the regional connectivity in Pakistan. Another reason for selection of subject topic is that many segments of the civil society of Pakistan are still reluctant in believing the importance of CPEC on Pakistan. This research will attempt to present necessary facts & figures in one place in order to determine and showcase the strategic importance and advantages of CPEC in terms of cost, time and regional connectivity.

The research on this subject in Pakistan is limited. (Alam, Li et al. 2019) carried out a study on this topic and covered overall CPEC Route. The author admitted that his research was not accurate because at that time the route is not operational / finalized. There is another researcher named Muhammad Aqeel also admit that as project is under construction so it is hard to get exact data about Road alignment of CPEC (Aqeel 2016). Some researchers have tried to measure the Transportation cost, Travel time and Connectivity in other countries on their road network. But no comprehensive study/research in Pakistan apparently exists on this subject. Likewise, how Quality of Travelling will be affected is another area needs to be explored in due to this new alignment in Pakistan. Therefore, research is needed on CPEC Alignment in Pakistan measuring impacts on Transportation/Mobility under CPEC Road alignment in Pakistan.

CHAPTER 3: METHODOLOGY

This chapter covers all the methods and materials used in this study. It describes the research design, data collection method, and types, sample size, research methodology briefly to conduct the research, and different data analysis techniques used in this research to achieve the objectives of this research. Statistical Package for the Social Sciences (SPSS), was used to evaluate the questionnaires attained from the respondents while surveying study areas.

The research design employed in this study is a quantitative research design, which allows for the measurement and analysis of the impact of the China-Pakistan Economic Corridor (CPEC) route on transportation variables and regional connectivity within Pakistan. This design is chosen to provide a systematic and rigorous approach to addressing the research objectives. By utilizing both primary and secondary data sources, the study aims to ensure a comprehensive analysis of the research objectives and obtain a holistic understanding of the impact of CPEC.

Quantitative research involves the collection and analysis of numerical data, which allows for statistical analysis and objective measurement of variables. This approach enables the researchers to draw meaningful conclusions and make evidence-based assessments of the impact of the CPEC route on transportation cost, travel time, quality of traveling, and regional connectivity. To achieve the research objectives, the study combines primary and secondary data sources. Primary data collection involves conducting structured surveys, interviews, and field observations. Interviews are conducted with government officials and key stakeholders to gain insights into regional connectivity and the impact of the new alignment of CPEC. Field observations are carried out to collect real-time data on transportation activities along the CPEC route.

Additionally, secondary data is collected from government reports, academic journals, reputable sources, and existing datasets related to transportation infrastructure, regional connectivity, and the CPEC project. This secondary data provides a broader context for the analysis and complements the primary data. By employing a quantitative research design and utilizing both primary and secondary data sources, this study aims to provide a robust and comprehensive analysis of the impact of the CPEC route on transportation cost, travel time, quality of traveling, and regional connectivity. The research design ensures the collection of reliable and valid data, allowing for rigorous statistical analysis and the derivation of meaningful insights.

3.1 CASE STUDY

To fulfill the necessity of collecting data from commuters, data was collected from different points such as service areas and Entry Exit Toll plazas of N-5 (Grand Trunk Road), Motorways (E-35, M-1, M-2, M-3, M-4, and M-5) with this Government officials from transportation related departments were approached. The travelers/commuters of these roads were asked to fill the Questionnaires which were used as a tool of research project with the assistance of informed consent. Additionally, they were assured about the confidentiality of their provided data.

N-5 is old artery in Road network of Pakistan. It commonly known as Grand Trunk Road. It starts from Peshawar and ends at Karachi. It mainly connects Peshawar, Attock, Taxila, Rawalpindi/Islamabad, Jhelum, Gujrat, Gujranwala, Lahore, Okara, Chichawatni, Khanewal, Multan, Ahmedpur, Sadiqabad, Dahraki, PanoAqil, Rohri, Shahpur, Hyderabad, Thata, Karachi.

M1 is connecting Peshawar and Islamabad with the major cities Peshawar, Charsada, Risalpur, Mardan, Attock, Taxila, and Islamabad. **M2** connects Islamabad and Lahore with

major touchups like Islamabad, Chakwal, Jhelum, Sargodha, Mandi Bahauddin, Pindi Bhattian, Hafizabad, Gujranwala, Sheikhupura, and Lahore. **M3** joins Lahore and Abdul Hakeem with majorly connects Lahore, Sharaqpur, Nankana Sahib, Jaranwala, Samundri, Pir Mahal, and Abdul Hakeem. **M4** is connecting Pindi Bhattian, Faisalabad and Multan. It connecting the cities Faisalabad, Toba Tek Singh, Shorkot, Abdul Hakeem, Khanewal and Multan. **M5** is connecting two provinces of Pakistan via major connections Multan and Sukkur. It connects Multan, Jalalpur, Peerwala, Ahmed Pur, Sadiqabad, East Ubaro, Ghotki, Pano Aqil and end at Sukkur.

3.2 STUDY DESIGN

It was hybrid research which included both the primary and secondary data. To attain more reliable information and to make our research more authentic, both ways of data collection were included.

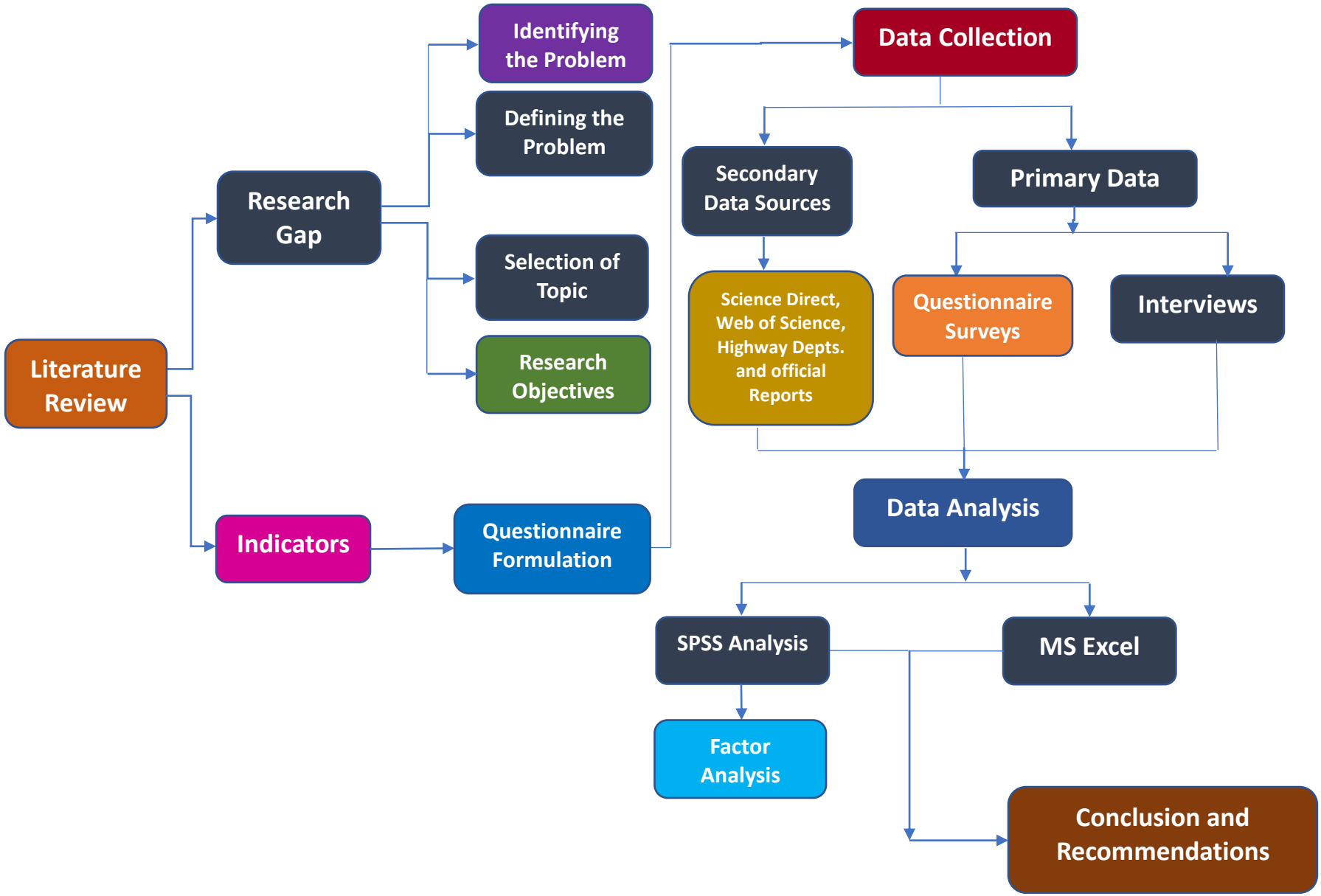
3.2.1 PRIMARY DATA

Data collected through the field survey which were conducted at certain places of National highway and Motorways. For that purpose, the tool which was used is a Questionnaire, which was consisted of 51 items, and those items were related to the required content regarding people's different experiences of travelling at both types of roads.

3.2.2 SECONDARY DATA

Secondary data was the backbone of this research. Data collected through online sources like published reports, research articles, policy papers, official reports, and publications which were previously researched by different well-known researchers at required topic of CPEC and connectivity in Pakistan. The links of those resources are provided in the references at end.

Detailed Methodology Flow Chart



3.3 QUESTIONNAIRE FORMULATION

The passengers of Service areas and Entry Exit Toll plazas of Grand Trunk Road, Motorway 1, Motorway 2, Motorway 3 and Motorway 5 with this Government officials from transportation related departments were approached to fulfill the questionnaires. Firstly total 70 indicators were selected, and after a detailed literature and discussion with experts 41 indicators was selected for questionnaire. After filling from few, some good points were high lightened which are good for research. Then that questionnaire was updated with more indicators and new questionnaire was formulated which contains 51 indicators. Then the final questionnaire was distributed to those travelers who have experience of journey on both types of roads. Only commuters/travelers were asked into our sample which were willing and interested to participate in this research.

3.3.1 SAMPLE SIZE

Almost 400 questionnaires were distributed among the travelers and commuters at service areas and Entry Exit Toll plazas of Grand Trunk, Road, Motorway 1, Motorway 2, Motorway 3 and Motorway 5. Overall, 300 questionnaires were successfully gathered from provided sample. Therefore, we can say that ultimately 75% of given data were collected back successfully. There were approximately 27% of those which interviewed individually through face-to-face communication and there were included both drivers and general public in the interviews.

3.4 DATA ANALYSIS TECHNIQUES

In this study SPSS was used for analyzing the data. Qualitative and quantitative, both types of data were analyzed in this research. The method used to analyze the qualitative data was

by Likert scale with a proper definition of the scale and weightage given to all criteria in the Likert scale. The Likert scale is interpreted on a five-scale parameter. Here value one (01) represented very poor, which showed the poorest condition, value two (02) represented poor, which showed the poor condition, whereas the value three (03) stood for average, which represented the moderate condition, or gives the respondents the option in case either they don't know about that specific questions or indicator or do not to reply to that question. Good was given the value of for (04), which showed the good condition. Whereas very good was given the highest value of five (05), which showed the best condition of the relevant questions.

Table 1: Interpretation of Likert Scale

Response	Value	Interpretation
Very Poor	1	Poorest Condition
Poor	2	Poor Condition
Average	3	Moderate Or Unclear
Good	4	Good Condition
Very Good	5	Best Condition

3.4.1 T-TEST

T test is a statistical test that is used to compare the means of two groups. We used it for the testing hypotheses to find whether two roads are different from one another and which one of them has greater positive influences for passengers according to their opinions. To test null hypothesis, t- test compared sample means and when the t- test produces a t-value of 0 or nearer to 0 but less than 0.5 then the sample data equals the null hypothesis precisely. Likewise, when the absolute value of t increases from 0.5, the sample data become progressively dissimilar from the null hypothesis.

3.4.2 FACTOR ANALYSIS

Factor analysis was performed on the barriers data collected from the expert survey. This analysis is done for better understanding and interpretation of the barrier as factor analysis helps in discovering and grouping the large set of data variables into comparatively small but meaningful factors to describe a certain perspective (Tucker 1958). These small numbers of factors retrieved from factor analysis give the view of all the variables within these small factors. While in SPSS, the Principal components method was applied in the factor analysis as the principal component's method identifies and computes the composite scores for the under-study variables or factors (Neill 2008).

3.5 ETHICAL REQUIREMENTS

As this survey/ research done from the commuters/ travelers of National Highways and Motorways/CPEC Route of Pakistan. Some ethical points were taken in practice while filling the questionnaires like: Respect of time, Parking of vehicle, Permission of face-to-face interaction, Permission of entering into office of Highway Experts, Give time to respondents at their ease, etc. Only voluntary participation was considered no participant was forced to be part of this survey. During this survey only relevant components were assessed. Moreover, all the participants of the research were ensured about the confidentiality and anonymity regarding the information that taken from them. No one was harmed or threatened physically or psychologically (distress or discomfort) in any way during this survey. Respect of each individual that has taken part in this research was considered as respectful as he/she should be. The rule of Professionalism was concerned while conducting this research. Furthermore, honesty and fidelity regarding data collection and analyses were also one of the major concerns of this study.

CHAPTER 4: RESULTS AND DISCUSSION

The objective of this research was to identify the factors which may act as a driver or barrier in using the Road network in Pakistan. This chapter presents the data collected from the questionnaire of stakeholders and interviews with field experts. The first two objectives of this study are done by responses of travelers and data of actual roads taken by the concerned Government department of Pakistan. The objective concerning Quality of travelling has been calculated by gathered statistic from questionnaires. It was inserted into SPSS software to generate output in tabular form. The analysis was performed on the collected data through questionnaires such as descriptive analysis, T-test, regression analysis, Reliability test, and factor analysis to conclude the results. The last objective of this study was determined by Arc GIS. The findings and results are presented in this chapter below.

4.1 SOCIO-DEMOGRAPHICS OF THE RESPONDENTS

The study revealed the demographic variables of 300 participants of the study with 78% male and 22% female and the frequency of each group is mentioned in the below table. The education of the sample was categorized as inter/ matric 1.7%, bachelor 40.7%, master/ higher education 57.7%. Moreover, the participants of the present study were belonged to various provinces of Pakistan where 52.6% who belonged to Punjab, similarly 1.7% belonged to Gilgit Baltistan, 24% belonged to KPK, 13.3% belonged to Capital, 3.7% belonged to Balochistan and 4.7% belonged to Sindh as well. Furthermore, the sample owned 76.3 % cars, 5.7% Jeeps/4WD and 18% Buses.

Table 2: Sociodemographic Characteristics of the Sample

Characteristics	*N*	%
Gender		
Male	235	78.3%
Female	65	21.7%
Education		
Master/ HE	107	35.7%
Bachelors	122	40.6%
Inter/matric	71	23.7%
Province		
Punjab	158	52.6%
Gilgit Baltistan	5	1.7%
KPK	72	24%
Capital	40	13.3%
Balochistan	11	3.7%
Sindh	14	4.7%
Vehicle		
Car	229	76.3%
Jeep/4WD	17	5.7%
Bus	54	18%

4.2 TRAVEL COST

In this study travel cost includes Fuel cost consumption by a vehicle. It also includes the toll rates of respective route. Both of these costs sum the total travel cost of a vehicle. This study was done on National Highway Peshawar to Karachi and CPEC/ Motorway alignment Khunjerab to Gwadar. As per this study, the start points for calculating the cost is Burhan (Hasan Abdal) which is junction point of E-35 and M1. The major play of this point is because it is the point where both routes is joining parallel. If we talk about Motorway/ CPEC route it includes Taxila,

Fateh Jang, Islamabad M1 Entry/Exit, M2 Islamabad Entry/Exit, Chakri, KallarKhar, Sargodha, Hafizabad, Pindi Bhattian, Faisalabad, Toba Tek Singh, Shorkot, Abdul Hakim, Khanewal, Multan, Bahawalpur, Rahim Yar Khan, Ghotki, and Rohri/Sukkur which is End point of this study.

Likewise, if we say about National Highway of this region which is commonly known as GT Road / N-5. It includes Burhan, Taxila, Sang Jani, Rawalpindi, Rawat, Gujar Khan, Sohawa, Jhelum, Gujrat, Gujranwala, Lahore, Sahiwal, Khanewal, Multan, Dunyapur, Lodhran, Ahmedpur East, Zahir peer, Sadiqabad, and Sukkur. In these calculations only Car, Jeep/4WD and Bus included. In which Car is further divided into three types like 660 CC, 1000 CC and 1500CC. Furthermore, includes Jeep/4WD like Toyota Fortuner / Revo/ Vigo having 2700 CC engine capacity and Bus is included having Approx. 11000 CC.

For a calculation of road transport cost for a Car having Engine Capacity 660 CC, 1000CC, and 1500CC. It is calculated, by taken an average milage achieved by a Vehicle for a route. According to NHA Interactive Map National Highway 05 (N-5) Torkham (Peshawar) to Karachi, but this study just uses the patch of Burhan to Sukkur (Rohri) having approximately route distance is 1115 KM’s.

Eastern Alignment of Motorway/CPEC Khunjerab to Gwadar but this study only done in between Burhan (Hassan Abdal) and Sukkur having an approximately distance of 960 KM’s. As per OGRA Jun,2023 fuel price for a Petrol is 262/Litre. By calculation, the approximately Average Fuel cost per kilometer for car 660 CC, 1000CC and 1500CC for traveling on National Highway (N-5) is 13.78 PKR, 15.4 PKR and 18.7 PKR respectively.

Table 3: Calculations of Travel Cost of Car

Route	National Highways			CPEC / Motorways		
Mode of Travel	CAR			CAR		
Engine Capacity (CC)	660	1000	1500	660	1000	1500
Distance (KM's)	1115	1115	1115	960	960	960
Average per KM Fuel Cost (PKR)	14	15	19	13	15	17
Total Fuel Cost	15375	17184	20866	12576	13973	16768
Toll Cost	630	630	630	1790	1790	1790
Total Travel Cost	16005	17814	21496	14366	15763	18558

As per CPEC/Motorway a vehicle achieved good milage against a One Litre fuel. After calculating, a user of car 660CC, 1000CC and 1500CC beard cost (PKR) per Kilometer is 13.1 PKR, 14.55 PKR and 17.46 PKR respectively. As per tolls, the route of National Highway having very less tolls as compared to Motorways. The other factors of travelling expenses are neglected like tyre erosion, Engines maintenance etc. The results of both routes are below:

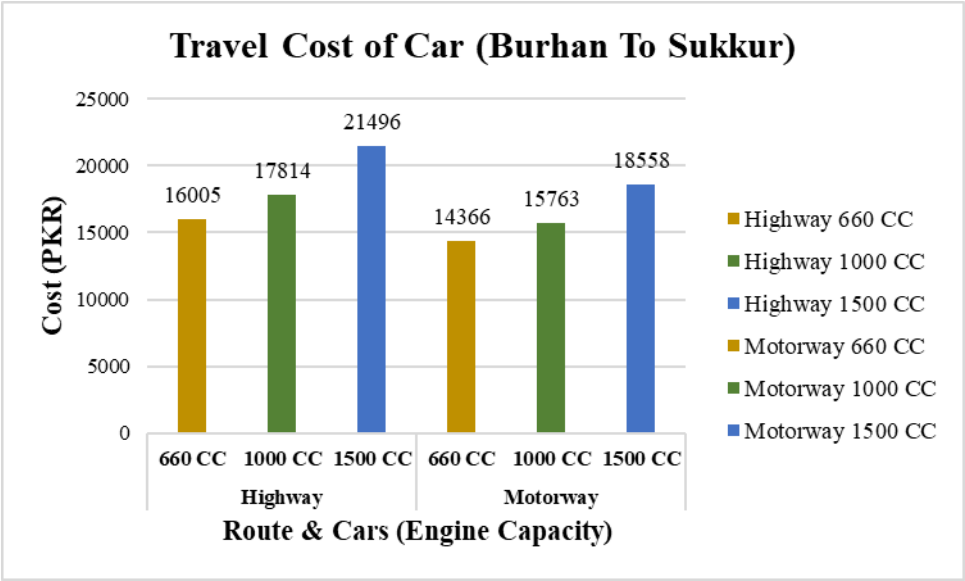


Figure 6: Results of Travel Cost of Car

For a calculation of road transport cost for a Jeep/4WD having Engine Capacity 2700CC. It is calculated, by taken an average milage achieved by a Vehicle for a route. According to NHA Interactive Map National Highway 05 (N-5) Torkham (Peshawar) to Karachi, but this study just uses the patch of Burhan to Sukkur (Rohri) having approximately route distance is 1115 KM's and alignment for Eastern Alignment of Motorway/CPEC Khunjerab to Gwadar but this study only done in between Burhan (Hassan Abdal) and Sukkur having an approximately distance of 960 KM's. As per OGRA Jun,2023 fuel price for a Petrol is 262/Litre. By calculation, the approximately Average Fuel cost per kilometer for a Jeep/4WD is 26.2 PKR for National Highway (N-5) and for CPEC / Motorway alignment its 24 PKR.

As per CPEC/Motorway a vehicle achieved good milage against a One Litre fuel. As per tolls, the route of National Highway having very less tolls as compared to Motorways. The other factors of travelling expenses are neglected like tyre erosion, Engines maintenance etc. The results of both routes are below:

Table 4: Calculations of Travel Cost of Jeep/4WD

Route	**National Highways**	**CPEC / Motorways**
Mode of Travel	Jeep/4WD	Jeep/4WD
Engine Capacity (CC)	2700	2700
Distance (KM's)	1115	960
Average per KM Fuel Cost (PKR)	26	24
Total Fuel Cost	29213	22865
Toll Cost	1050	2710
Total Travel Cost	30263	25575

As per CPEC/Motorway a vehicle achieved good milage against a One Litre fuel. As per tolls, the route of National Highway having very less tolls as compared to Motorways. The other

factors of travelling expenses are neglected like tyre erosion, Engines maintenance etc. The results of both routes are below:

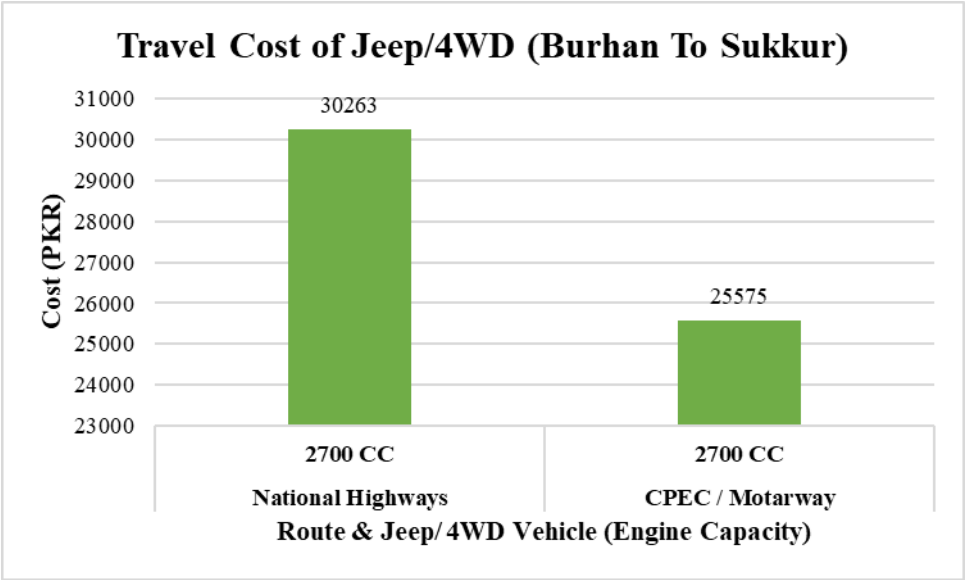


Figure 7: Results of Travel Cost of Jeep/4WD

For a calculation of road transport cost for a Bus having Engine Capacity 11000 CC. It is calculated, by taken an average milage achieved by a Vehicle for a route. According to NHA Interactive Map National Highway 05 (N-5) Torkham (Peshawar) to Karachi, but this study just uses the patch of Burhan to Sukkur (Rohri) having approximately route distance is 1115 KM's and alignment for Eastern Alignment of Motorway/CPEC Khunjerab to Gwadar but this study only done in between Burhan (Hassan Abdal) and Sukkur having an approximately distance of 960 KM's. As per OGRA Jun,2023 fuel price for a Petrol is 262/Litre. By calculation, the approximately Average Fuel cost per kilometer for a Bus is 72.3 PKR for National Highway 5 and for CPEC / Motorway alignment its 63.25 PKR.

Table 5: Calculations of Travel Cost of Bus

Route	National Highways	CPEC / Motorways
Mode of Travel	BUS	BUS
Engine Capacity (CC)	11000	11000
Distance (KM's)	1115	960
Average per KM Fuel Cost (PKR)	72	63
Total Fuel Cost	80599	60720
Toll Cost	2100	5700
Total Travel Cost	82699	66420

As per CPEC/Motorway a vehicle achieved good milage against a One Litre fuel. As per tolls, the route of National Highway having very less tolls as compared to Motorways. The other factors of travelling expenses are neglected like tyre erosion, Engines maintenance etc. The results of both routes are below:

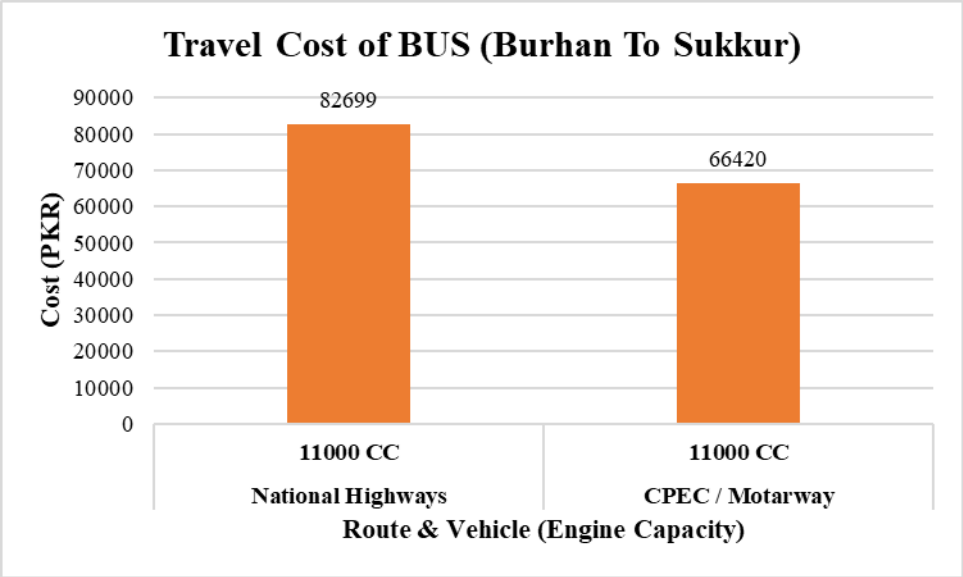


Figure 8: Results of Travel Cost of Bus

4.3 TRAVEL TIME

In this study travel time for journey is obtained by dividing the total distance by average speed of a vehicle. It also includes the toll stay time of respective route. Both of these route distances are taken from Highway Department which is exact in chainage (KM's). The start points for calculating the distance is Burhan (Hasan Abdal) which is junction point of E35 and M1. The major play of this point is because it is the point where both routes is joining parallel. If we talk about Motorway/ CPEC route it includes Burhan (Hasan Abdal), Taxila, Fateh Jang, Islamabad M1 Entry/Exit, M2 Islamabad Entry/Exit, Chakri, KallarKhar, Sargodha, Hafizabad, Pindi Bhattian, Faisalabad, Toba Tek Singh, Shorkot, Abdul Hakim, Khanewal, Multan, Bahawalpur, Rahim Yar Khan, Ghotki, and Rohri/Sukkur which is End point of this study.

Likewise, if we say about National Highway of this region which is commonly known as GT Road / N-5. It includes Burhan, Taxila, Sang Jani, Rawalpindi, Rawat, Gujar Khan, Sohawa, Jhelum, Gujrat, Gujranwala, Lahore, Sahiwal, Khanewal, Multan, Dunyapur, Lodhran, Ahmedpur East, Zahir peer, Sadiqabad, and finally Sukkur. Only travel time and stoppage at Toll plaza's is kept in calculations. This study shows travel time by Car, Jeep/4WD and Bus only.

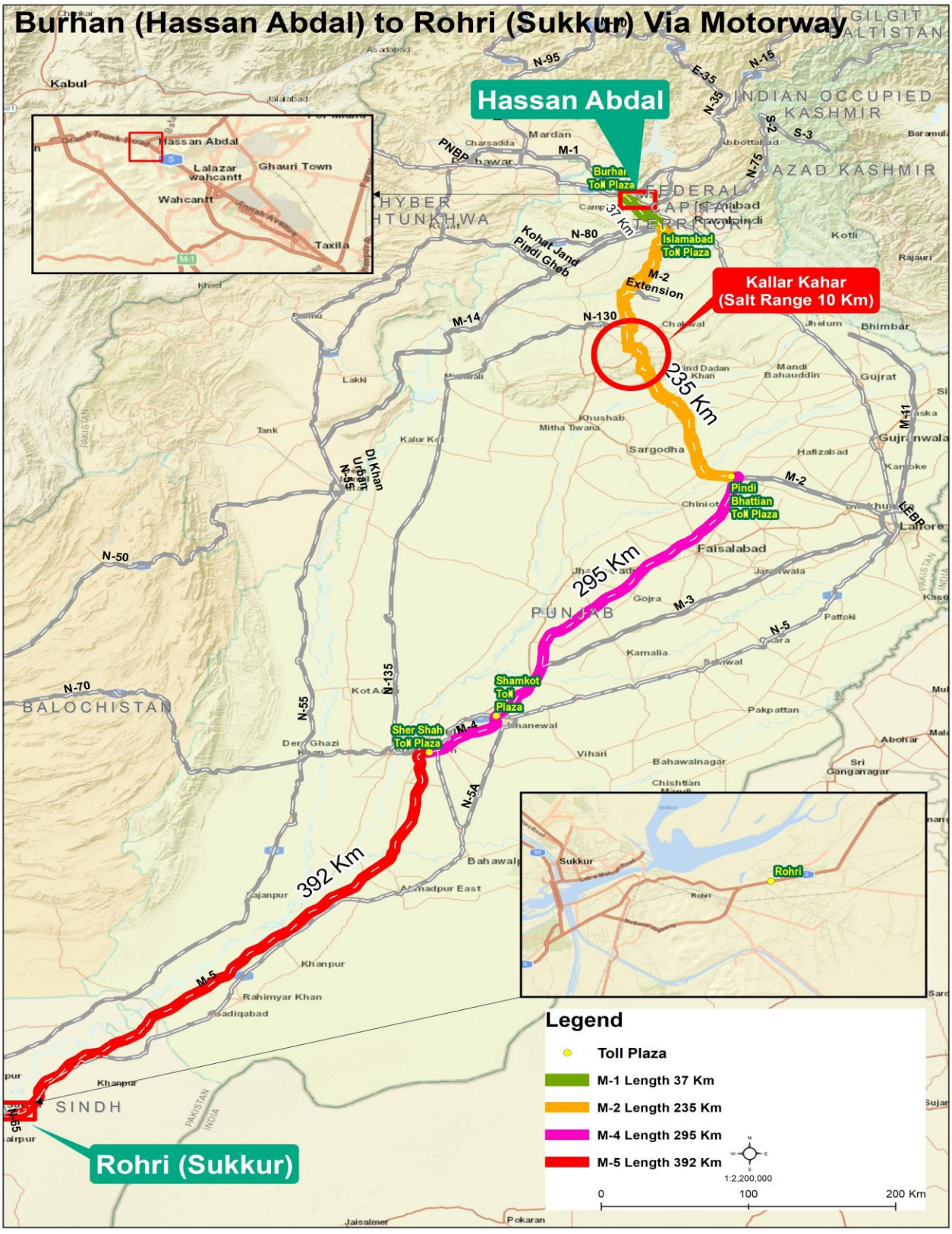


Figure 9: Map of Burhan to Sukkur via Motorways / CPEC Route

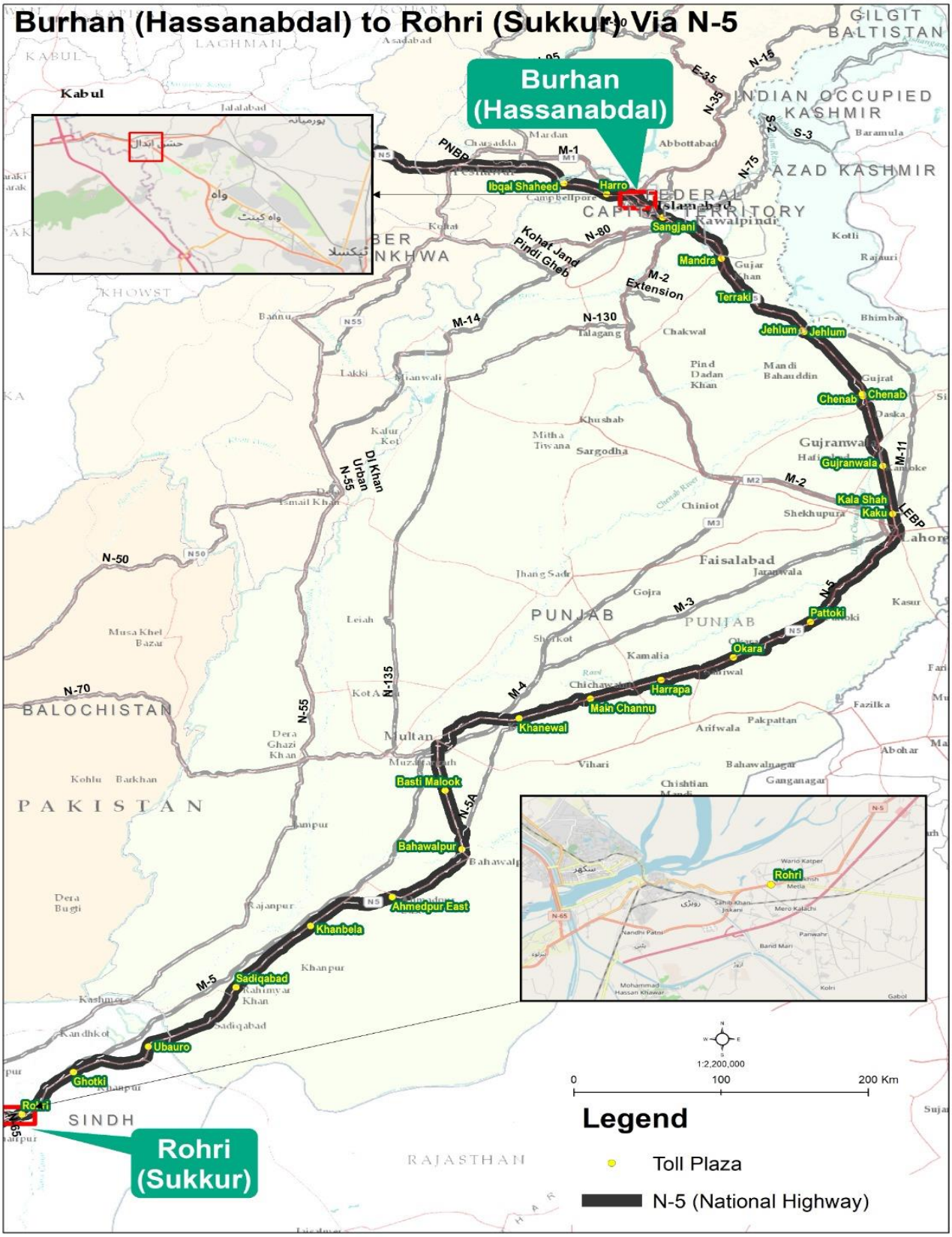


Figure 10: Map of Burhan to Sukkur via National Highway 5

Table 6: Details Speed Limits of National Highway 5

National Highway Speed Limits (N-5) (Rohri, Sukkur - Burhan, Hassan Abdal)							
S. No.	**Route**	**Location**	**Chainage Start (KM)**	**Chainage End (KM)**	**Length (KM)**	**LTV Speed**	**HTV Speed**
1	National Highway 5 (N-5) Grand Trunck Road	Rohri (Sukkur) - Pano Aqil	483	512	29	100	90
2		Pano Aqil	512	516	4	50	50
3		Pano Aqil – Ghotki	516	537	21	100	90
4		Ghotki	537	544	7	50	50
5		Ghotki – Sarhad	544	550	6	100	90
6		Sarhad	550	553	3	50	50
7		Sarhad – Sadiqabad	553	633	80	100	90
8		Sadiqabad	633	642	9	50	50
9		Sadiqabad - Ahmedpur Shirqia	642	790	148	100	90
10		Ahmedpur Shirqia	790	798	8	50	50
11		Ahmedpur Shirqia – Gharibabad	798	849	51	100	90
12		Gharibabad	849	853	4	50	50
13		Gharibabad - Lodhran – Multan	853	930	77	100	90
14		Multan City	930	943	13	50	50
15		Multan City – Lahore	943	1245	302	100	90
16		Lahore City	1245	1268	23	50	50
17		Lahore City – Gujranwala	1268	1320	52	100	90
18		Gujranwala	1320	1340	20	50	50
19		Gujranwala - Sarae Alamgir	1340	1430	90	100	90
20		Sarae Alamgir – Jhelum	1430	1443	13	50	50
21		Jhelum - Gujar Khan	1443	1496	53	100	90
22		Gujar Khan	1496	1499	3	50	50
23		Gujar Khan - Rawat	1499	1523	24	100	90
25		Rawat – Tarnol	1523	1560	37	50	50
26		Tarnol – Taxila	1560	1574	14	100	90
27		Taxila - Wah Cantt Gate 03	1574	1587	13	50	50
28		Wah Cantt Gate 03 – Burhan	1587	1598	11	100	90
Total Length (Km)					**1115**		

There are some additional elements like Rest time of drivers, weather conditions, traffic jams, and strikes or any other unforeseen that might increase for travel time. The law-and-order situations in Pakistan; therefore, special consideration to this factor as well on scheduling the time of your trip.

Firstly, we talk about the National Highway (N-5) the general Maximum speed fixed by concerned departments is 100 Kph for LTV and for HTV is 90 Kph. But on this alignment several Urban/populated areas are observed where speed limit is 50 Kph for all types of vehicles. There is total 21 Toll plazas are faced by traveler for whole journey. It is observed by the travelers that approximately five mins is consumed at each toll plaza on National Highway. After calculations it is observed that the average speed for whole journey is 93 Kph for Car / Jeep / 4WD and 84 Kph for Bus. The calculations for travel time of LTV are shown in below table:

Table 7: Calculations for Travel Time of LTV at N-5

Travel Vehicle (LTV)									
Route	**Start Point**	**End Point**	**Populated Area Speed (KM/Hr)**	**Populated Area Distance (KM's)**	**Un Populated Area Speed (KM/Hr)**	**Un Populated Area Distance (KM's)**	**Toll Time (Mins)**	**Travel Time (Mins)**	**Travel Time**
N-5	Burhan (Hassan Abdal)	Rohri, Sukkur	50	958	100	157	105	868	**14 Hr 28 Mins**

Likewise, the calculations for travel time of HTV are shown in below table:

Table 8: Calculations for Travel Time of HTV at N-5

Travel Vehicle (HTV)									
Route	**Start Point**	**End Point**	**Populated Area Speed (KM/Hr)**	**Populated Area Distance (KM's)**	**Un Populated Area Speed (KM/Hr)**	**Un Populated Area Distance (KM's)**	**Toll Time (Mins)**	**Travel Time (Mins)**	**Travel Time**
N-5	Burhan (Hassan Abdal)	Rohri, Sukkur	50	958	90	157	105	932	**15 Hr 32 Mins**

Secondly, Motorway/CPEC route 120 Kph is for Car / Jeep / 4WD and for Bus its 110 Kph. But the portion of M4 Pindi Bhattian to Multan the speed limit for Car / Jeep is 100 Kph and for bus is 80 Kph. The car and Jeep/ 4WD come in Light Transport Vehicle (LTV) and Bus comes in Heavy Transport Vehicle (HTV). For LTV speed limit is 120Kph from Burhan to Pindi Bhatian except the portion of Kalar Kahar (Salt Range) which have 40 Kph for 10 KM's. For Pindi Bhatian to Multan the speed limit is 100 Kph for LTV. For Multan Sukkur portion the limit is 120 Kph. The detail of calculations is below:

Table 9: Travel Time of LTV at Motorways/CPEC Route

Travel Vehicle (LTV) Motorway Route					
Motorway	**Start Point**	**Destination Point**	**Speed (KM/Hr)**	**Distance (KM's)**	**Road Travel Time (Mins)**
M1	Burhan (Hassan Abdal)	Islamabad	120	38	19
M2	Islamabad	Kalar Kahar Range Start	120	120	56
	Kalar Kahar Range Start	Kalar Kahar Range End	40	10	15
	Kalar Kahar Range End	Pindi Bhatian	120	105	57
M4	Pindi Bhatian	Multan	100	295	177
M5	Multan	Sukkur	120	392	196

For HTV speed limit is 100Kph from Burhan to Pindi Bhatian except the portion of Kalar Kahar (Salt Range) which have 30 Kph for 10 KM's. For Pindi Bhatian to Multan the speed limit is 80 Kph for HTV. For Multan Sukkur portion the limit is 100 Kph. The detail of calculations is below:

Table 10: Calculations for Travel Time of HTV at Motorways/ CPEC Route

Travel Vehicle (HTV) Motorway Route					
Motorway	**Start Point**	**Destination Point**	**Speed (KM/Hr)**	**Distance (KM's)**	**Road Travel Time (Mins)**
M1	Burhan (Hassan Abdal)	Islamabad	100	38	23
M2	Islamabad	Kalar Kahar Range Start	100	120	67
	Kalar Kahar Range Start	Kalar Kahar Range End	30	10	20
	Kalar Kahar Range End	Pindi Bhatian	100	105	68
M4	Pindi Bhatian	Multan	80	295	221
M5	Multan	Sukkur	100	392	235

After taking average of portion wise speed LTV gets 113Kph for whole journey Burhan to Sukkur. After calculations road travel time is 520 Mins (08 Hours & 40 Mins) with addition of average time of each toll is 05 mins. This route has 02 tolls so time consumed at Toll plazas is 10 Mins. With this total travel time is 530 mins (08 hours & 50 mins).

The detail of calculations is below:

Table 11: Calculations for Travel Time of LTV at Motorways/CPEC Route

Travel Vehicle (LTV)							
Route	**Start Point**	**Destination Point**	**Avg. Speed (KM/Hr)**	**Distance (KM's)**	**Road Travel Time (Mins)**	**Toll Time (Mins)**	**Travel Time**
Motorway/CPEC	Burhan (Hassan Abdal)	Sukkur	113	960	520	10	**08 Hr 50 Mins**

For HTV average speed of each portion is 93Kph for whole journey Burhan to Sukkur. After calculations road travel time is 634 Mins (10 Hours & 34 Mins) with addition of average time of each toll is 05 mins. This route has 02 tolls so time consumed at Toll plazas is 10 Mins. With this total travel time is 644 mins (10 hours & 44 mins). The detail of calculations is below:

Table 12: Calculations for Travel Time of HTV at Motorways/CPEC Route

Travel Vehicle (HTV)							
Route	**Start Point**	**Destination Point**	**Avg. Speed (KM/Hr)**	**Distance (KM's)**	**Road Travel Time (Mins)**	**Toll Time (Mins)**	**Travel Time**
Motorway/CPEC	Burhan (Hassan Abdal)	Sukkur	93	960	634	10	**10 Hr 44 Mins**

It was observed that on National Highway if a vehicle travelled at its maximum speed at each chainage takes more time to complete its journey with compares to Motorway/CPEC route in between the selected two points.

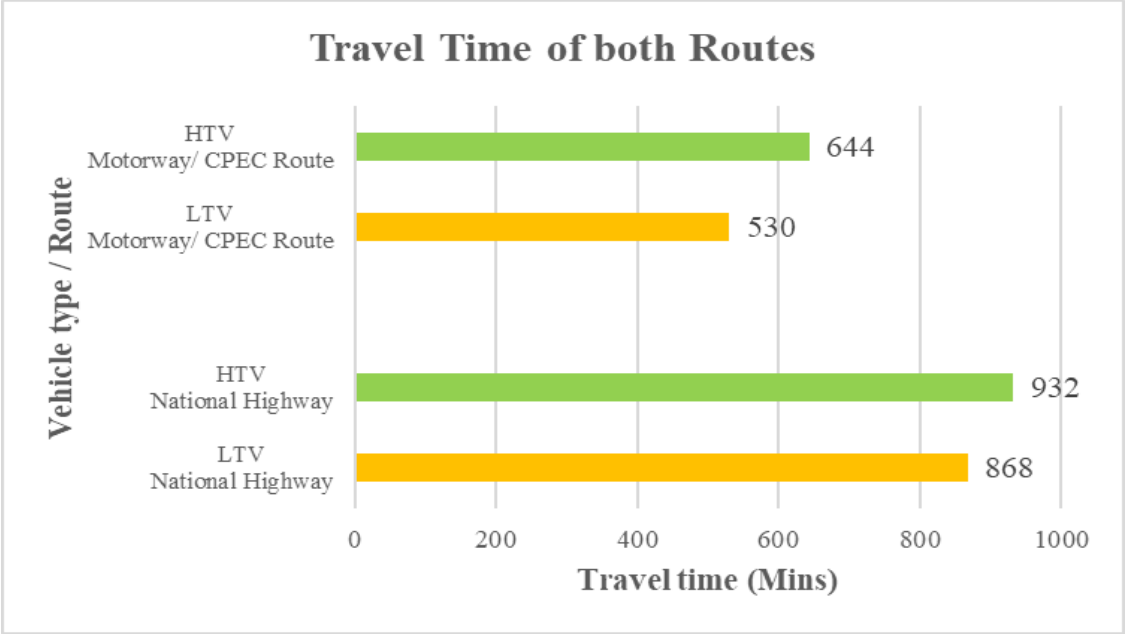
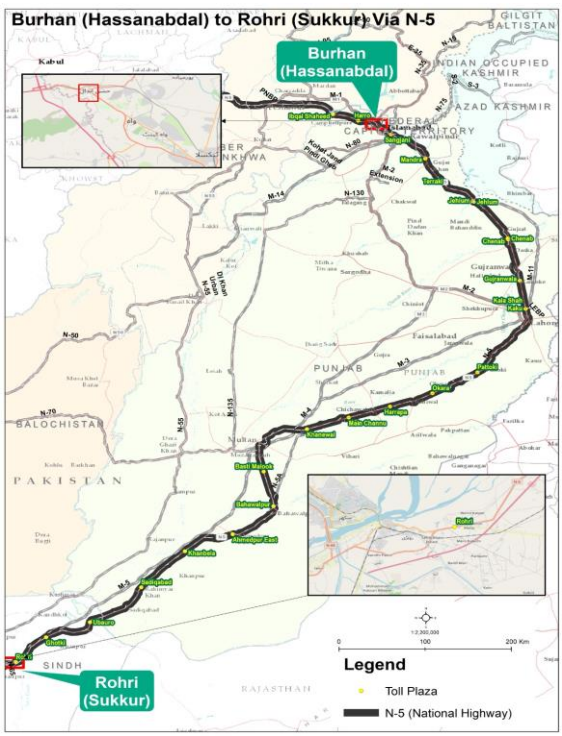
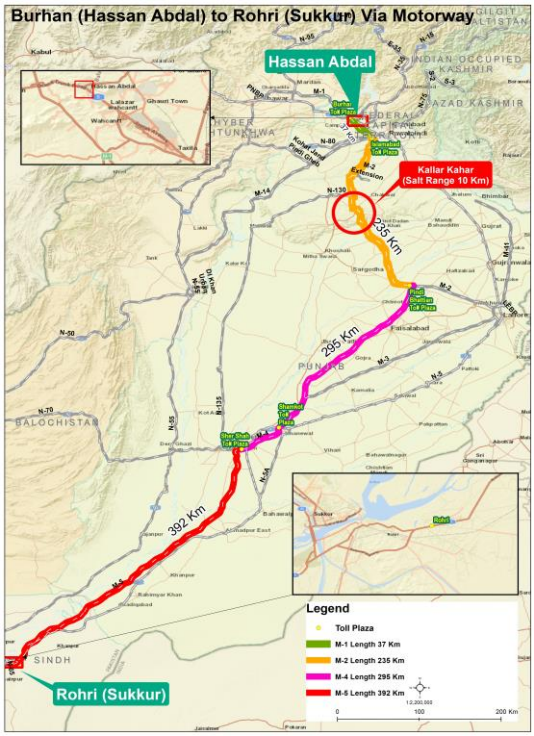


Figure 11: Results of Travel time of both Routes

4.4 REGIONAL CONNECTIVITY

For this we take the Industrial area located in nearby divisions of this route in Pakistan. We compared the distances from such points to getting any road from both routes.





By using Geographic Information System (GIS) and Satellite imaginary it is observed that maximum Industrial areas are connected with Motorway route easily. Motorway route have Hattar Industrial area, Bhalwal Industrial Estate, Faisalabad Industrial area, Multan Industrial Estate and SITE as well.

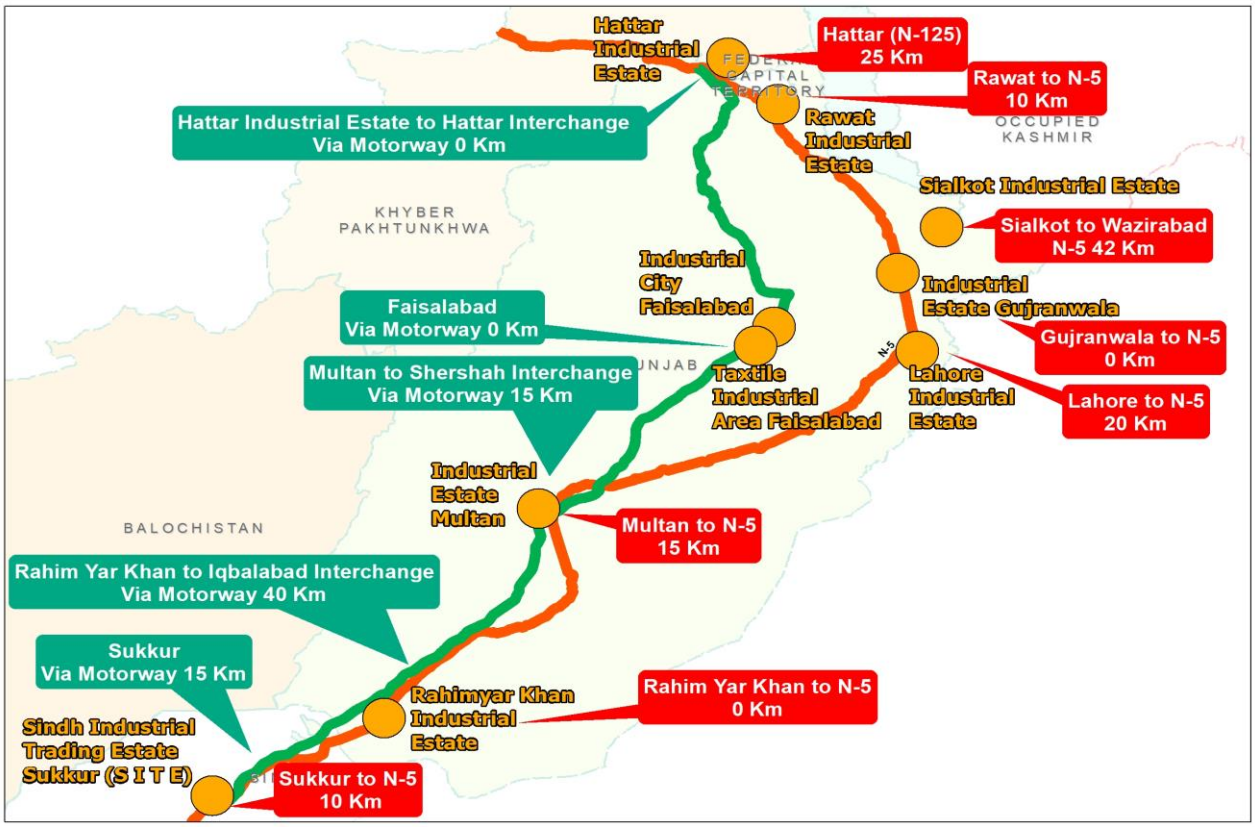


Figure 12: Industrial areas along both routes

4.5 QUALITY OF TRAVELLING

According to the responses by the travelers of National highways and Motorways, it is found that Motorway is the route where user experienced more comfortability and convenience while entering and exiting it. The findings of one sample t test indicated that the participants who traveled the National highways and Motorways for entry (N=300, M=1.98, SD=0.128) and for their exit (N=300, M=1.95, SD=0.211) exhibited Motorways with significantly favorable results than National highways, t(299) = 0.000. Moreover, users who have given opinions about the

efficiency of drainage system at Motorways and National Highways (N=300, M=1.99, SD=0.115) declared that drainage of liquid (i.e., Rain water or any other fluid) at Motorways is more efficient as compared with National Highways with scores t(299) = 0.000. Which depicts that they experienced no stagnant water at Motorways after rain stops.

The travelers who traveled the both National highways and Motorways for lane width (N=300, M=1.91, SD=0.287) and for guard rails/ barriers (N=300, M=1.97, SD=0.171), their opinions depicted that Motorways are significantly far better in scores t(299) = 0.000 as with the comparison of National highways. Approx 80% users feel good for desirable space to Park their vehicle at shoulder lanes for any minor emergency stop. With this lane width and guard rails, the users feels/observed that motorways having safe and secure arrangements along complete alignment against National highways. On the comparison it is exhibited by the maximum traveler's that Motorways have no better access for U-turns or even have no U-turns, therefore, they are not satisfied with it.

Table 13: Percentage of Route Responses

S. No	Item	Route Responses (%)		P Value
		National Highways	Motorways	
1	Good in Entry	1.7	98.3	0
2	Good in Exit	4.7	95.3	0
3	Drainage is more efficient	1.3	98.7	0
4	Parking Area/ Shoulder Lane	17.7	82.3	0
5	Lane Width satisfaction	9	91	0
6	Guard Rails/ Barriers	3	97	0
7	Easy U Turns Access	61.7	38.3	0

Some of users denoted that if a person enters mistakenly to other side, he/she would definitely make himself in trouble and hurries for taking U- turn of his journey. Which would cause her/him late to reach his/her destination. So the findings of the participants who

experienced the accessibility of U-turns (N=300, M=1.38, SD=0.487) established signified scores at National highways as compared to Motorways, t(299) = 0.000.

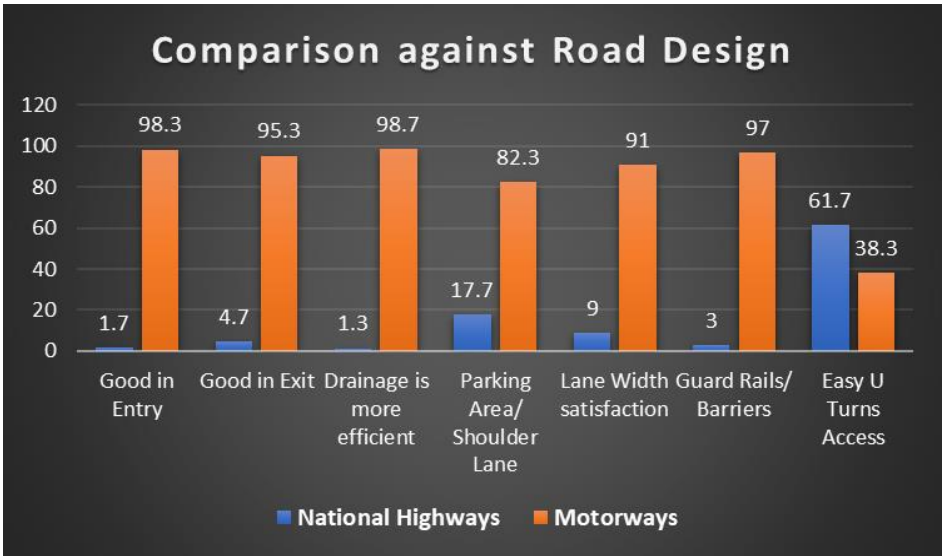


Figure 13: Results of comparison against Road Design

Furthermore according to the responses of other questions it has been seen that people on the safe arrangement of the U-turns (N=300, M=1.56, SD= .497) given more positive responses toward Motorways rather than National highways t(299) = 0.000. The participants who found more welcoming toll plaza designs (N=300, M=1.93, SD=0.250) and more friendly road design (N=300, M=1.85, SD=0.358) remarked Motorway with better scores as compared to National Highway t(299) = 0.000. Which exposed Motorways with high comfortability level for their users.

On the contrast the travelers of both ways (N=300, M=1.31, SD=0.463) revealed that National Highways have landslides greater in number t (299) = 0.000. Which results that Motorway is favorable to fend off landslides while long and regular journey. Travelers on the opinion of experiencing alternate interchange at both Motorways and National highways (N=300, M=1.43, SD=0.496) established significant responses for Motorways t(299) = 0.000,

which indicates they got facility of frequent alternate interchange at Motorways while traveling which would be indeed a considerable feasibility for them.

The details are given in the following table:

Table 14: Percentage of Route Responses

S. No	Item	Route Responses (%)		P Value
		National Highways	Motorways/ CPEC Route	
1	Safe arrangements for U Turns	44	56	0
2	Welcoming Toll Plaza	6.7	93.3	0
3	More land slides	69	31	0
4	Design of road is friendly	15	85	0
5	Alternative Interchanges	56.7	43.3	0
6	Saves your time	17.3	82.7	0

Moreover Motorways are found to be more time savers for their riders rather than National highways t(299) = 0.000. Through which it has been gotten that the riders of both roads (N=300, M=1.83, SD=0.379) save their precious time via Motorways whether it is travel for business, job, family or study purposes.

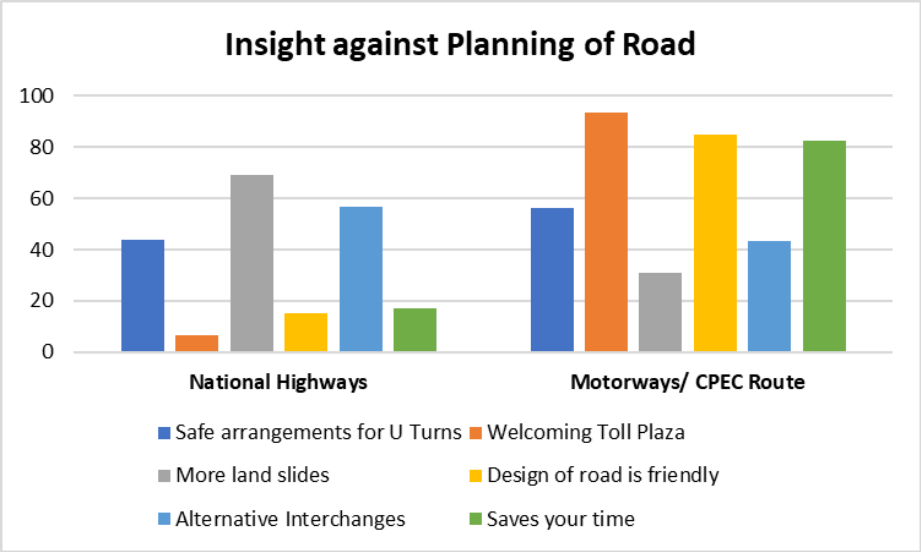


Figure 14: Results of insight against Planning of Road

If we talk about the concern of congestion free travel (N=300, M=2.00, SD=0.000) and uniform flow of traffic (N=300, M=2.00, SD=0.000), the individualists responses mentioned Motorway as a best way for the experiencing congestion free and uniform flow of traffic while

driving t(299) = 0.000. They never felt any storm of traffic in a haphazard way while moving on their way. The results of analysis showed that the participants who traveled the National highway and Motorways at midnight (N=300, M=1.72, SD=0.451) signified Motorways with greater scores t(299) = 0.000. Likewise responses regarding proper cat eyes at National Highway and Motorway (N=300, M=1.90, SD=0.296), demonstrated positive significant results in the favor of Motorways t(299) = 0.000.Which means Motorways have adequate arrangements of cat eyes on the way. Another result of single sample t test indicated that the individuals who used both National highways and Motorways and responded them as a safe from accidents (N=300, M=1.82, SD=0.385) and having CCTV Cameras (N=300, M=1.94, SD=0.232), exposed that Motorways are more safe from accidents and likewise more CCTV cameras facilities while travelling as compared to National Highways t(299) = 0.000. According to their experiences they found more accidents at National Highways rather than Motorways. There was another question about frequent bumpy alignments (N=300, M=1.44, SD=0.497), according to sample responses National highways have more frequent bumpy alignments t(299) = 0.000, which shows that people face less unpleasant experiences while travelling at Motorways.

The details are given in the following table

Table 15: Percentage of Route Responses

S. No	Item	Route Responses (%)		P Value
		National Highways	Motorways/ CPEC Route	
1	Congestion free	0	100	0
2	Uniform flow of traffic	0	100	0
3	Secure at day	13.7	86.3	0
4	Secure at Midnight	28.3	71.7	0
5	Proper cat eyes	9.7	90.3	0
6	Safe from Accidents	18	82	0
7	Road having CCTV	5.7	94.3	0

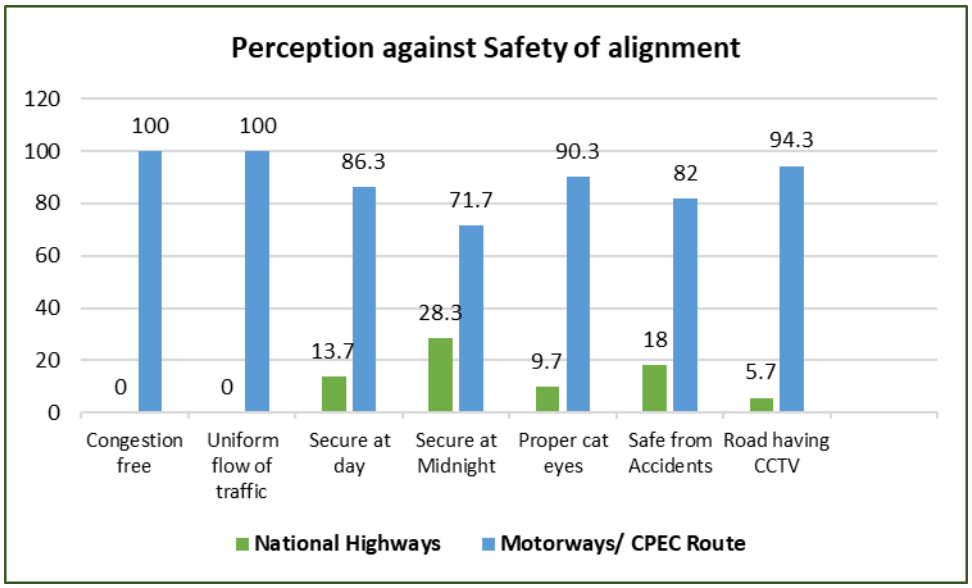


Figure 15: Results against Safety of Alignment

On the other hand, people who traveled National highways and Motorways their response regarding E-tag system on toll plaza (N=300, M=1.96, SD=0.196) explained that Motor is better in comparison for having E- tag system on toll plaza t (299) = 0.000. Moreover, participant's response about having emergency climbing lanes (N=300, M=1.90, SD=0.301), speed reduction methods (N=300, M=1.58, SD=0.495), and proper lane marking (N=300, M=1.95, SD=0.218) demonstrated Motorways are remarkable in the matter of scores rather than National highways. People shared their pleasant experiences while travelling at Motorways due to these feasibilities. The participants who found road properly visible at night (N=300, M=1.94, SD=0.238) and having appropriate antiglare arrangements (N=300, M=1.79, SD=0.406) remarked Motorway with better scores as compared to National Highway t(299) = 0.000. That's why they prefer Motorways whenever they need to move at night. There was another question about the road which would be preferable for travelling at uniform speed (N=300, M=1.93, SD=0.261), according to sample responses Motorways are more suitable for travelling at uniform speed t(299) = 0.000. Which means riding at Motorway is less tiresome for riders that revealed from their responses.

The details are given in the following table

Table 16: Percentage of Route Responses

S. No	Item	Route Responses (%)		P Value
		National Highways	Motorways/ CPEC Route	
1	E-Tag systems	4	96	0
2	Emergency Climbing lanes	10	90	0
3	Speed reduction methods	42.3	57.7	0
4	Proper lane markings	5	95	0
5	Visibility at Night	6	94	0
6	Anti-glare arrangements	20.7	79.3	0
7	Uniform travelling	7.3	92.7	0
8	More violations	44.3	55.7	0
9	More concentration	81	19	0

On the comparison users respond at the question of violation of traffic during traveling (N=300, M=1.96, SD=0.498) more negatively for National Highway as comparison with Motorway t(299) = 0.000 . They found less recklessness of traffic rules while driving at Motorways. Similarly at the opinion of requiring more concentration while driving (N=300, M=1.96, SD=0.498), people respond with greater score for National highways as compared to Motorways t(299) = 0.000. Which shows getting journey at National Highway is not as convenient as it is at Motorways.

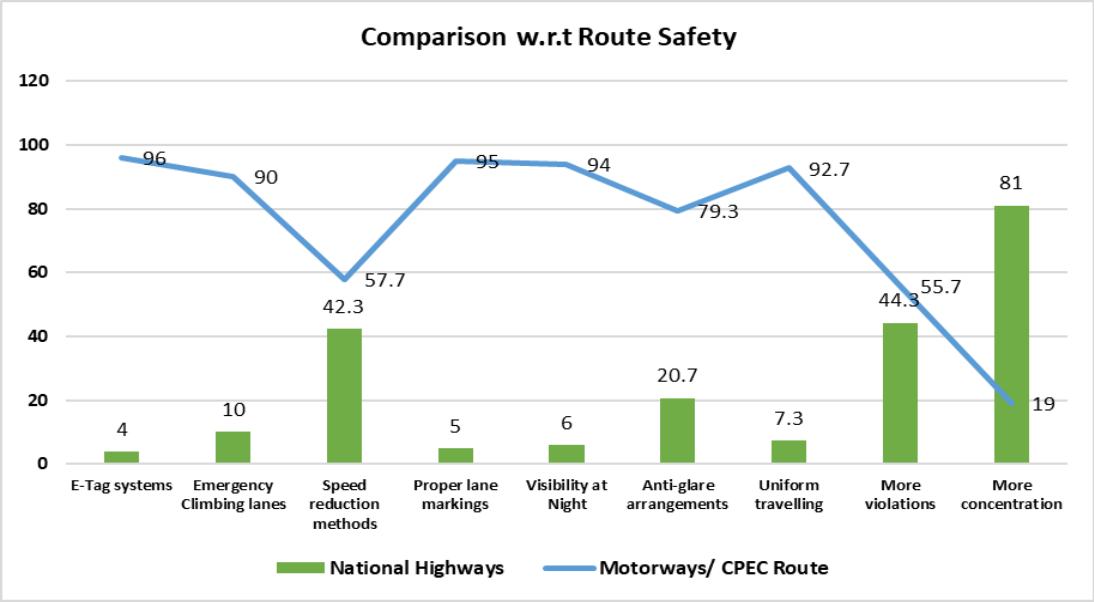


Figure 16: Results of comparison w.r.t Route safety

Moreover if we concern about the feedback relating cleanliness (N=300, M=1.99, SD=0.163) and beautiful sceneries at both roads (N=300, M=1.89, SD=0.309), it has been found that Motorway is significantly remarkable at scores than National highways t(299) = 0.000. It also has been seen that participant who participated in this research project and respond on the question of economical rates at both type of roads (N=300, M=1.23, SD=0.419) found Motorways consume less charges on the toll plazas as compared to National highways t(299) = 0.000. Similarly, people remarked at the question of which road they prefer to travel for their job (N=300, M=1.70, SD=0.460) and local citizen got which road better for their living (N=300, M=1.49, SD=0.501) so, likewise mostly results Motorway got significant findings for the preference of travel for jobs than other road t(299) = 0.000, but on the contrast National highway got higher scores for the safely living of local citizens at it t(299) = 0.000. On the other hand the remarks on the good connectivity between big cities through both roads (N=300, M=1.80, SD=0.401) and for choosing a road for better accessibility of industries (N=300, M=1.32, SD=0.467), So the Motorways exposed better results for the reason of good connectivity between big cities of Pakistan t(299) = 0.000 and on the comparison National Highway revealed better results for the higher accessibility of industrial areas t(299) = 0.000.

The details are given in the following table:

Table 17: Percentage of Route Responses

S. No	Item	Route Responses (%)		P Value
		National Highways	Motorways/ CPEC Route	
1	Better Cleanliness	1.3	98.7	0
2	Greenery and beautiful scenery	10.7	89.3	0
3	Economical toll rates	77.3	22.7	0
4	prefer for jobs travelling	30.3	69.7	0
5	Easy for locals living	51	49	0
6	Good connectivity	20	80	0
7	Access to industrial areas	68	32	0

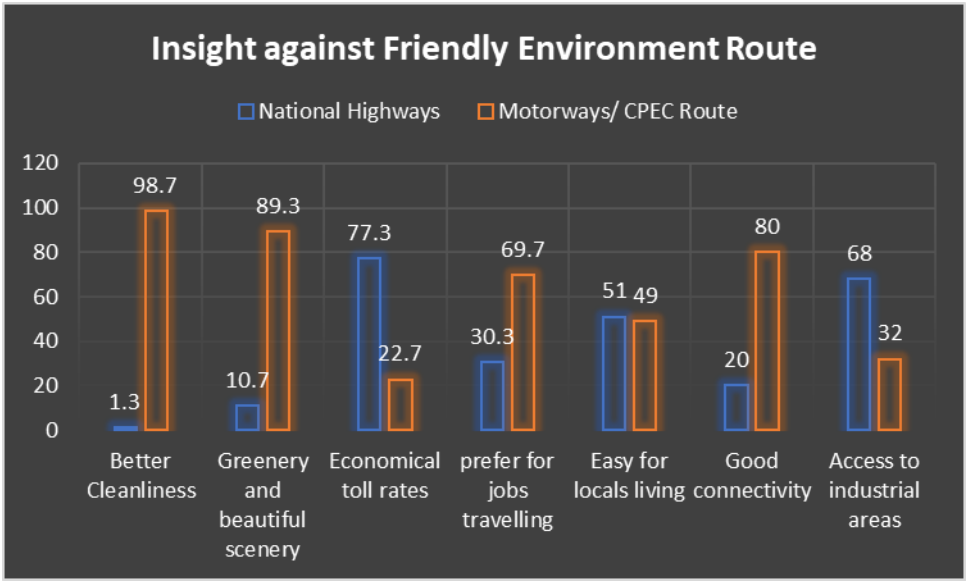


Figure 17: Results against friendly environment route

Here was the question about availability of local market areas (N=300, M=1.11, SD=0.318) and the results have gone to the favor of National highways t(299) = 0.000. Which indicated that on the way of National highways there are excessive and exceptional opportunities of local market to visit and to fulfill our needs. If we concerned regarding the question of individuals experiences about the rescue services (N=300, M=1.77, SD=0.424), emergency services (N=300, M=1.73, SD=0.443) and quick positive response from police at both roads (N=300, M=1.92, SD=0.267), it is surprisingly found that Motorways are the routes which got to be much better in each type of previous services t(299) = 0.000. Indeed, there were great percentage difference on participants responses for both roads services. Likewise people found services at one point whether they were services of pumps, food or prayer areas services (N=300, M=1.88, SD=0.329), most of them signified Motorways for that services as compared to National highway t(299) = 0.000. Another question was about the individuals preference of choosing alignment for travelling from upper region to lower region of Pakistan and vice versa (N=300, M=1.89, SD=0.309) most of them indicated their reply in the favor of Motorways,

whenever they get choice to travel through both road they prefer Motorway on National Highway t(299) = 0.000. On the comparison when it was asked that which road is pedestrian free (N=300, M=1.31, SD=0.463), their responses revealed that National Highway is more pedestrian free as comparison with Motorway t(299) = 0.000. They feel more convenient to move on National Highway as a pedestrian.

The details are given in the following table:

Table 18: Percentage of Route Responses

S. No	Item	Route Responses (%)		P Value
		National Highways	Motorways/ CPEC Route	
1	Access to local markets	88.7	11.3	0
2	Good Rescue Services	23.3	76.7	0
3	Good emergency services	26.7	73.3	0
4	Positive response from police	7.7	92.3	0
5	Services at one point	12.3	87.7	0
6	Prefer for travelling	10.7	89.3	0
7	Pedestrians friendly	69	31	0

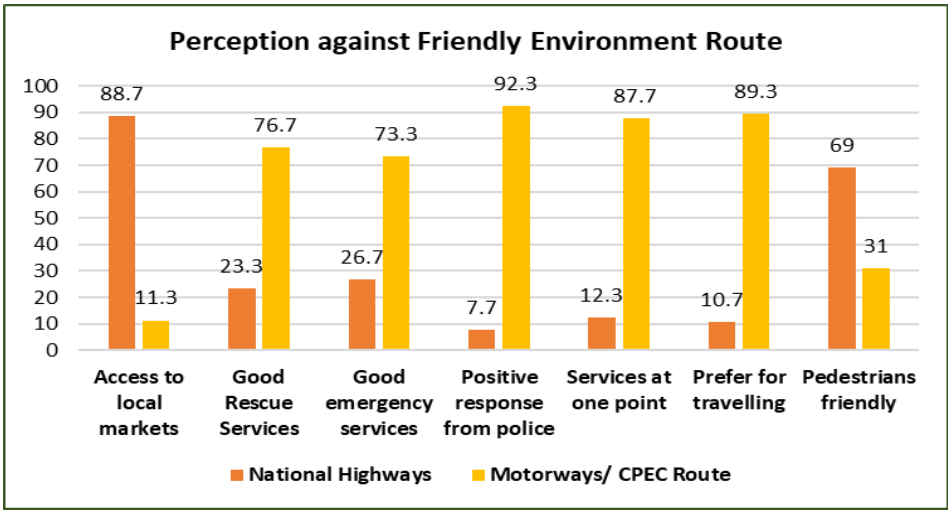


Figure 18: Results against Friendly environment route

Furthermore the most of the feedback of travelers of both Motorways and National Highway (N=300, M=1.98, SD=0.151) exposed in their response of which road is properly fenced from living things, Motorways are at significant scores rather than National Highway

t(299) = 0.000. Which meant that they never experience any hazards of living things like animals while travelling at Motor way. Users of both road elaborated their opinions on the question that which road is properly planned (N=300, M=1.92, SD=0.267), and which road require less time while overtaking other vehicles (N=300, M=1.93, SD=0.256), for both questions they gave significant scores for Motorways t(299) = 0.000. On the other hand, at National highway local goods are available (N=300, M=1.27, SD=0.443) even at economical rates (N=300, M=1.22, SD=0.413) as compared to Motorways. It has been noticed that like previous question of accessibility of local markets it was found that at National highway there are more convenience of local markets and likewise local goods are also frequently available at National highways at economical rates t(299) = 0.000. At the question that which road is pollution free (N=300, M=1.97, SD=0.171), the Motorways scored better than National highway t(299) = 0.000.

The details are given in the following table:

Table 19: Percentage of Route Responses

S. No	Item	Route Responses (%)		P Value
		National Highways	Motorways/ CPEC Route	
1	Properly fenced	2.2	97.7	0
2	Properly planned	7.7	92.3	0
3	Less time for overtaking	7	93	0
4	Availability of local Goods	73.3	26.7	0
5	Prices are economical	78.3	21.7	0
6	Pollution free	3	97	0
7	Prefer for future travelling	2.3	97.7	0

That shows that the motorway itself and including its surroundings are mostly pollution free which gave pleasant experiences for its travelers. Moreover, at the opinion of that road which they would prefer to travel in the future (N=300, M=1.98, SD=0.151) and which road is secure for travelling at daytime (N=300, M=1.86, SD=0.344), at both questions majority notified

Motorways with significant results t(299) = 0.000. Which depicts that Motorways are more secured and safer for travelling at daytime and even at night time for travelers as in the previous results it was already shown.

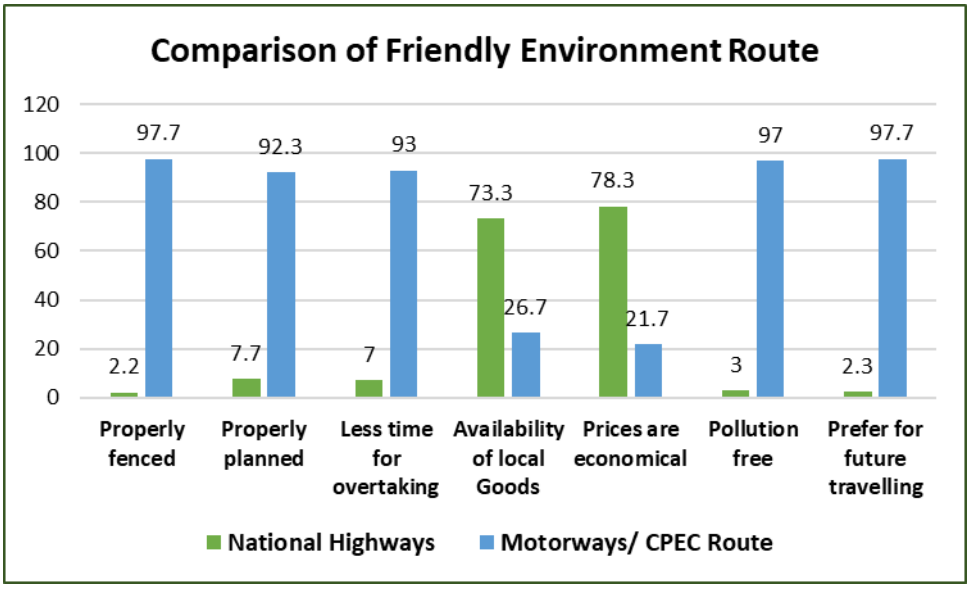


Figure 19: Results of comparison of friendly Environment route

4.6 STATISTICAL ANALYSIS

The categorized questionnaire data was processed in IBM SPSS Statistics 21 software. First of all, the reliability of the data was checked by using the Cronbach's Alpha Method in SPSS. Cronbach's Alpha is used to measure the internal consistency among the available factors and tells us whether our data is reliable or not. The values of the reliability coefficient range from 0 to 1. The reliability test showed a result of 0.707, which means that our data was 70.7% reliable. According to (Darko, Chan et al. 2017), as 0.707 is greater than the threshold value of 0.7, then it means that our data of survey was reliable at a significance level of 5 %. In SPSS, 70.7% reliability of data stands among the maximum possible reliability for any data set.

4.6.1 FACTOR ANALYSIS

Factor analysis was performed for better interpretation and easy understanding of the barriers. It categorizes a large number of variables, which are connected or similar to some extent, into small categories and makes it easy for us to interpret and then explain all the variables quickly and smartly. Many other tests were also performed to check the suitability of factor analysis to our study requirements. Bartlett's test of sphericity and KMO measure test was also conducted. Using IBM SPSS, factor analysis was performed on all the factors to convert them into suitable and well-integrated categories. The KMO value was found to be 0.457, and the chi-square value in Bartlett's test was recorded to be 6683.283, which is very large and the associated significance to lowest possible at 0.000. These values showed that our data was suitable for the Factor Analysis.

Table 20: KMO and Bartlett's Test Values

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.457
Bartlett's Test of Sphericity	Approx. Chi-Square	6683.283
	df	861
	Sig.	.000

For Factor Analysis, the Principal component analysis method and varimax rotation were applied to the data in SPSS to make categories. The number of factors was not specified, and a free hand was given to SPSS to make the desired categories. For factor retention, the default option of retaining all factors having eigenvalues that are greater than 2.0 was selected. This means that the factors having eigenvalues greater than 2.0 will be included for factor extraction. The results showed that the factors having Eigenvalues greater than one were accumulating 70.7% of the total variance.

Table 21: Calculations of Principal Component Analysis

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.756	11.325	11.325	4.756	11.325	11.325
2	4.035	9.608	20.933	4.035	9.608	20.933
3	2.927	6.969	27.902	2.927	6.969	27.902
4	2.653	6.316	34.218	2.653	6.316	34.218
5	2.318	5.518	39.736	2.318	5.518	39.736
6	2.099	4.997	44.733	2.099	4.997	44.733
7	1.903	4.530	49.263			
8	1.778	4.234	53.496			
9	1.574	3.748	57.244			
10	1.484	3.534	60.779			
11	1.408	3.353	64.131			
12	1.288	3.067	67.198			
13	1.173	2.793	69.992			
14	1.087	2.589	72.580			
15	.995	2.369	74.949			
16	.907	2.160	77.109			
17	.850	2.024	79.134			
18	.750	1.786	80.920			
19	.694	1.653	82.573			
20	.653	1.554	84.127			
21	.631	1.502	85.629			
22	.598	1.424	87.053			
23	.582	1.385	88.438			
24	.550	1.310	89.748			
25	.504	1.200	90.948			
26	.426	1.013	91.961			
27	.402	.956	92.918			
28	.374	.891	93.809			
29	.358	.852	94.661			
30	.325	.774	95.435			
31	.292	.695	96.130			
32	.271	.644	96.774			
33	.231	.551	97.325			
34	.207	.493	97.817			

35	.196	.466	98.284			
36	.167	.397	98.681			
37	.158	.377	99.057			
38	.118	.282	99.339			
39	.095	.225	99.564			
40	.084	.199	99.763			
41	.068	.162	99.925			
42	.031	.075	100.000			

The results of the variance table showed that factor one explained 11.325% of the total variance of all the variables in the correlation matrix. The second factor explained 9.608% of the total variance of all the variables. The third factor explained 6.969% of the total variance of all the variables. The fourth factor explained 6.316% of the total variance of all the variables. The fifth factor explained 5.518% of the total variance of all the variables. The sixth factor explained 4.997% of the total variance of all the variables.

4.7 BARRIER CATEGORIZATION

The Factor analysis converted all the barriers into 6 categories. The Factor Loading value (the suppress small coefficient absolute value below) was taken as 0.40, which removed all the coefficient values smaller than 0.40. The factors having values greater than 0.40 remained in the Rotated Component Matrix. The Rotated Component Matrix is given as follows;

Table 22: Results of Rotated Component Matrix

Rotated Component Matrix							
Barrier	**Statements**	**Component**					
		1	**2**	**3**	**4**	**5**	**6**
BR 01	Road having more land slides	.798					
BR 02	Road required more concentration during traveling / driving	.739					
BR 03	Road having alternative interchange / access to desired destination	.681					
BR 04	Route has economical traveling rates (Toll charge)	.661					
BR 05	Alignment having good emergency services	.542		-.496			
BR 06	Route having prices of things is economical	.465					
BR 07	Road has proper and easily accessible U Turns	.441					
BR 08	Road has easy access to local market areas	.432				-.406	
BR 09	Road having safe and secure in day time while traveling		.750				
BR 10	Road marked safe and secure at Midnight while traveling		.704				
BR 11	Properly planned route		.602				
BR 12	Road has greenery and beautiful scenery		.574				
BR 13	Route prefers to travel for your jobs		.479				
BR 14	Road is safe from accidents		.471				
BR 15	Route having parking area / Shoulder Lane		.434				
BR 16	Route that local citizen feels safe and easy to live		.433				
BR 17	Road has safe arrangements for U Turn			.643			
BR 18	Road having speed reduction methods like: (Speed humps etc.)			.580			
BR 19	Road having more violations of traffic			.546			
BR 20	Road having bumpy alignment and un-pleasant for driving			.485			
BR 21	Road saves your more time			-.414			
BR 22	Route has more efficient drainage				.678		
BR 23	Traffic at uniform speed				.565		
BR 24	Route having good Rescue services				.559		

BR 25	Alignment having all services (Pump, Food, prayer areas etc.) at one point				.533		
BR 26	Road having Emergency climbing lanes				.524		
BR 27	Route having better cleanliness					.662	
BR 28	Road has good and welcoming toll plaza design					.650	
BR 29	Road having E-Tag systems on toll plazas					.588	
BR 30	Road having good in Exit / diverging lane					.494	.459
BR 31	Properly visible alignment at night						.646
BR 32	Road having proper cat eyes / studs in between lanes and carriageway end point						.595
BR 33	Road having Anti-glare (front vehicle head light) arrangements						.584
BR 34	Route in good connectivity between big cities of Pakistan						-.477
BR 35	Road having good in Entry / merging lane						.452
BR 36	Road properly fenced to avoid any disturbance by animals/other living things						.407

When the Rotated Component Matrix was evaluated, All the coefficient values were present in the first 6 categories. That meant that there were 6 possible categories of all the barriers that had connections or similarities among them. The Factor analysis converted all 42 statements into 6 Factors. The Factor Loading value was taken as 0.40 which removed all the coefficient values smaller than 0.40. The statements having values greater than 0.40 remained in the Rotated Component Matrix and their number decreased to 36. Therefore, 6 categories were selected for all 36 barriers from Factor Analysis. The frequency table was already made with the help of IBM SPSS. Then, the frequencies and percentages of the categories were calculated for each category with Microsoft Excel. Those six factors are further categorized with such divisions/ names:

- Economical Effect and Focus
- Impact of Landscape and Citizen facilities
- Safety measures
- Basic Services and Profile of Road
- Pleasant Alignment
- Visibility of Road

4.7.1 ECONOMICAL EFFECT AND FOCUS

People preferred National Highway (N-5) w.r.t prices of things and toll rates are economical and affordable. As tolls at National Highway (N-5) are much lesser than Motorway tolls. But they preferred Motorways due to other circumstances.

4.7.2 IMPACT OF LANDSCAPE AND CITIZEN FACILITIES

Respondents preferred Motorways route and feel secure while traveling. It is also properly planned. Travelers appreciate that all facilities are at one point, which definitely a good for travelers / drivers' behaviour.

4.7.3 SAFETY MEASURES

Motorway have safer U-turns having better speed reduction methods. As per safety concerns Motorways journey is safer than National Highway 5. Mostly safety features / requirements are designed on Motorways rather than N-5.

4.7.4 BASIC SERVICES AND PROFILE OF ROAD

All services (Like: Fuel stations, restaurants, Prayer breaks etc.) are at same point which also saves the time and this route have good response while emergency situations. Due to this traveler and driver feel secure while traveling at Motorway alignment.

4.7.5 PLEASANT ALIGNMENT

Motorway have pleasant alignment due to better cleanliness and environment. As this alignment have good environment due to having maximum greenery areas on both sides. With this very less pollution is on this network. So, it gives pleasant atmosphere to travelers / commuters.

4.7.6 VISIBILITY OF ROAD

Motorway route have more visibility to drivers. As it is properly fenced, so no outer disturbance came suddenly. With this, it has no trees in Middle of both sides of road so gives clear alignment. It has also a proper lane markings and cat eyes showing a visible alignment at day and night as well.

4.8 DISCUSSION

In this study travel cost includes Fuel cost consumption by a vehicle. It also includes the toll rates of respective route. Both of these costs sum the total travel cost of a vehicle. This study was done on National Highway Peshawar to Karachi and CPEC/ Motorway alignment Khunjerab to Gwadar. As per this study, the start points for calculating the cost is Burhan (Hasan Abdal) which is junction point of E-35 and M1. The major play of this point is because it is the point where both routes is joining parallel. If we talk about Motorway/ CPEC route it includes Taxila, Fateh Jang, Islamabad M1 Entry/Exit, M2 Islamabad Entry/Exit, Chakri, KallarKhar, Sargodha, Hafizabad, Pindi Bhattian, Faisalabad, Toba Tek Singh, Shorkot, Abdul Hakim, Khanewal, Multan, Bahawalpur, Rahim Yar Khan, Ghotki, and Rohri/Sukkur which is End point of this study.

Likewise, if we say about National Highway of this region which is commonly known as GT Road / N-5. It includes Burhan, Taxila, Sang Jani, Rawalpindi, Rawat, Gujar Khan, Sohawa, Jhelum, Gujrat, Gujranwala, Lahore, Sahiwal, Khanewal, Multan, Dunyapur, Lodhran, Ahmedpur East, Zahir peer, Sadiqabad, and Sukkur. In these calculations only Car, Jeep/4WD and Bus included. In which Car is further divided into three types like 660 CC, 1000 CC and 1500CC. Furthermore, includes Jeep/4WD like Toyota Fortuner / Revo/ Vigo having 2700 CC engine capacity and Bus is included having Approx. 11000 CC.

For a calculation of road transport cost for a Car having Engine Capacity 660 CC, 1000CC, and 1500CC. It is calculated, by taken an average milage achieved by a Vehicle for a route. According to NHA Interactive Map National Highway 05 (N-5) Torkham (Peshawar) to Karachi, but this study just uses the patch of Burhan to Sukkur (Rohri) having approximately route distance is 1115 KM’s and alignment for Eastern Alignment of Motorway/CPEC

Khunjerab to Gwadar but this study only done in between Burhan (Hassan Abdal) and Sukkur having an approximately distance of 960 KM's. As per OGRA Jun,2023 fuel price for a Petrol is 262/Litre. By calculation, the approximately Average Fuel cost per kilometer for car 660 CC, 1000CC and 1500CC for traveling on National Highway (N-5) is 13.78 PKR, 15.4 PKR and 18.7 PKR respectively.

As per CPEC/Motorway a vehicle achieved good milage against a One Litre fuel. After calculating, a user of car 660CC, 1000CC and 1500CC beard cost (PKR) per Kilometer is 13.1 PKR, 14.55 PKR and 17.46 PKR respectively.

For a calculation of road transport cost for a Jeep/4WD having Engine Capacity 2700CC. It is calculated, by taken an average milage achieved by a Vehicle for a route. According to NHA Interactive Map National Highway 05 (N-5) Torkham (Peshawar) to Karachi, but this study just uses the patch of Burhan to Sukkur (Rohri) having approximately route distance is 1115 KM's and alignment for Eastern Alignment of Motorway/CPEC Khunjerab to Gwadar but this study only done in between Burhan (Hassan Abdal) and Sukkur having an approximately distance of 960 KM's. As per OGRA Jun,2023 fuel price for a Petrol is 262/Litre. By calculation, the approximately Average Fuel cost per kilometer for a Jeep/4WD is 26.2 PKR for National Highway (N-5) and for CPEC / Motorway alignment its 24 PKR.

For a calculation of road transport cost for a Bus having Engine Capacity 11000 CC. It is calculated, by taken an average milage achieved by a Vehicle for a route. According to NHA Interactive Map National Highway 05 (N-5) Torkham (Peshawar) to Karachi, but this study just uses the patch of Burhan to Sukkur (Rohri) having approximately route distance is 1115 KM's and alignment for Eastern Alignment of Motorway/CPEC Khunjerab to Gwadar but this study only done in between Burhan (Hassan Abdal) and Sukkur having an approximately distance of

960 KM's. As per OGRA Jun,2023 fuel price for a Petrol is 262/Litre. By calculation, the approximately Average Fuel cost per kilometer for a Bus is 72.3 PKR for National Highway 5 and for CPEC / Motorway alignment its 63.25 PKR.

As per CPEC/Motorway a vehicle achieved good milage against a One Litre fuel. As per tolls, the route of National Highway having very less tolls as compared to Motorways. The other factors of travelling expenses are neglected like tyre erosion, Engines maintenance etc. For travel time, there are some additional elements like Rest time of drivers, weather conditions, traffic jams, and strikes or any other unforeseen that might increase for travel time. The law-and-order situations in Pakistan; therefore, special consideration to this factor as well on scheduling the time of your trip.

Firstly, we talk about the National Highway (N-5) the general Maximum speed fixed by concerned departments is 100 Kph for LTV and for HTV is 90 Kph. But on this alignment several Urban/populated areas are observed where speed limit is 50 Kph for all types of vehicles. There is total 21 Toll plazas are faced by traveler for whole journey. It is observed by the travelers that approximately five mins is consumed at each toll plaza on National Highway. After calculations it is observed that the average speed for whole journey is 93 Kph for Car / Jeep / 4WD and 84 Kph for Bus.

Secondly, Motorway/CPEC route 120 Kph is for Car / Jeep / 4WD and for Bus its 110 Kph. But the portion of M4 Pindi Bhattian to Multan the speed limit for Car / Jeep is 100 Kph and for bus is 80 Kph. The car and Jeep/ 4WD come in Light Transport Vehicle (LTV) and Bus comes in Heavy Transport Vehicle (HTV). For LTV speed limit is 120Kph from Burhan to Pindi Bhatian except the portion of Kalar Kahar (Salt Range) which have 40 Kph for 10 KM's. For Pindi Bhatian to Multan the speed limit is 100 Kph for LTV. For Multan Sukkur portion the limit

is 120 Kph. For HTV speed limit is 100Kph from Burhan to Pindi Bhatian except the portion of Kalar Kahar (Salt Range) which have 30 Kph for 10 KM's. For Pindi Bhatian to Multan the speed limit is 80 Kph for HTV. For Multan Sukkur portion the limit is 100 Kph.

After taking average of portion wise speed LTV gets 113Kph for whole journey Burhan to Sukkur. After calculations road travel time is 520 Mins (08 Hours & 40 Mins) with addition of average time of each toll is 05 mins. This route has 02 tolls so time consumed at Toll plazas is 10 Mins. With this total travel time is 530 mins (08 hours & 50 mins). For HTV average speed of each portion is 93Kph for whole journey Burhan to Sukkur. After calculations road travel time is 634 Mins (10 Hours & 34 Mins) with addition of average time of each toll is 05 mins. This route has 02 tolls so time consumed at Toll plazas is 10 Mins. With this total travel time is 644 mins (10 hours & 44 mins). It was observed that on National Highway if a vehicle travelled at its maximum speed at each chainage takes more time to complete its journey with compares to Motorway/CPEC route in between the selected two points.

For Regional connectivity we take the Industrial area located in nearby divisions of this route in Pakistan. We compared the distances from such points to getting any road from both routes. By using Geographic Information System (GIS) and Satellite imaginary it is observed that maximum Industrial areas are connected with Motorway route easily. Motorway route have Hattar Industrial area, Bhalwal Industrial Estate, Faisalabad Industrial area, Multan Industrial Estate and SITE as well.

If we talk about Quality of travelling, When the Rotated Component Matrix was evaluated, All the coefficient values were present in the first 6 categories. That meant that there were 6 possible categories of all the barriers that had connections or similarities among them. The Factor analysis converted all 42 statements into 6 Factors. The Factor Loading value was

taken as 0.40 which removed all the coefficient values smaller than 0.40. The statements having values greater than 0.40 remained in the Rotated Component Matrix and their number decreased to 36. Therefore, 6 categories were selected for all 36 barriers from Factor Analysis. The frequency table was already made with the help of IBM SPSS. Then, the frequencies and percentages of the categories were calculated for each category with Microsoft Excel. Those six factors are further categorized with such divisions/ names:

Economical Effect and Focus, People preferred National Highway (N-5) w.r.t prices of things and toll rates are economical and affordable. As tolls at National Highway (N-5) are much lesser than Motorway tolls. But they preferred Motorways due to other circumstances.

Impact of Landscape and Citizen facilities, Respondents preferred Motorways route and feel secure while traveling. It is also properly planned. Travelers appreciate that all facilities are at one point, which definitely a good for travelers / drivers' behaviour.

Safety measures, Motorway have safer U-turns having better speed reduction methods. As per safety concerns Motorways journey is safer than National Highway 5. Mostly safety features / requirements are designed on Motorways rather than N-5.

Basic Services and Profile of Road, all services (Like: Fuel stations, restaurants, Prayer breaks etc.) are at same point which also saves the time and this route have good response while emergency situations. Due to this traveler and driver feel secure while traveling at Motorway alignment.

Pleasant Alignment, Motorway have pleasant alignment due to better cleanliness and environment. As this alignment have good environment due to having maximum greenery areas on both sides. With this very less pollution is on this network. So, it gives pleasant atmosphere to travelers / commuters.

Visibility of Road, Motorway route have more visibility to drivers. As it is properly fenced, so no outer disturbance came suddenly. With this, it has no trees in Middle of both sides of road so gives clear alignment. It has also a proper lane markings and cat eyes showing a visible alignment at day and night as well.

Through this all It is observed that Motorway route is best and economical regardance with cost and time as well. And this route is good for quality traveling and having more connectivity w.r.t National Highway 5.

CHAPTER 5: CONCLUSION

This research mainly focused on measuring the impact of 02 big Road infrastructure in Pakistan. Which is mainly known as National Highway 5 (N-5) Grand Trunck Road and Eastern CPEC alignment. National Highway 05 (N-5) Torkham (Peshawar) to Karachi, but this study just uses the patch of Burhan to Sukkur (Rohri) having approximately route distance is 1210 KM's and alignment for Eastern Alignment of Motorway/CPEC Khunjerab to Gwadar but this study only done in between Burhan (Hassan Abdal) and Sukkur having an approximately distance of 960 KM's. First of all, existing measuring frameworks were identified with the help of a literature review. These frameworks were then used to choose and shortlist the indicators to measure the selection of route for traveling. The literature review revealed that no study done on these alignments after New Motorway/ CPEC route being a functional/open for traveling.

First of all, we say about the Travel cost, we take three different Modes of travelling Car, Jeep/4WD, and Bus. While selection of a car we take as most commonly 03 Engine capacity was taken like 660 CC, 1000 CC, and 1500 CC. And for Jeep/ 4WD concern we take 2700 CC and commonly used Bus in Pakistan having Engine capacity approximately 11000 CC. After achieving this objective, the results concluded that the CPEC/ Motorway route have uniform flow which means that vehicle have smooth running with very less breaks and change of gears. Good millage is achieved by all three modes as compared to travel on National Highway. While maintaining a Moderate speed 100 Kph for LTV and 90 Kph for HTV was taken and recommended by travelers that this speed has given good millage.

In this study, CAR and Jeep/ 4WD is taken under LTV and Bus is taken under HTV. As per the data given by respondents and Government departments it was concluded that CPEC/ Motorway route is overall more economical while taking to components like fuel cost and Tolls.

If we talk about Fuel cost of respective vehicle Motorway route is low-cost route as compared to National Highway (N-5). While taking Tolls concern it is concluded after a calculation that total Tolls of whole route Motorway/CPEC route are higher than National Highway (N-5). But if we talk about both components, the overall cost of traveling in between the points of Hassan Abdal and Sukkur Motorway/ CPEC route is more economical than National Highway (N-5). Other factors/ components were not concerned in this study as approximately all other components are about to same on both routes for a vehicle.

For Regional connectivity we take the Industrial area located in nearby divisions of this route in Pakistan. We compared the distances from such points to getting any road from both routes. By using Geographic Information System (GIS) and Satellite imaginary it is observed that maximum Industrial areas are connected with Motorway route easily. Motorway route have Hattar Industrial area, Bhalwal Industrial Estate, Faisalabad Industrial area, Multan Industrial Estate and SITE as well.

If we talk about Quality of travelling, When the Rotated Component Matrix was evaluated, All the coefficient values were present in the first 6 categories. That meant that there were 6 possible categories of all the barriers that had connections or similarities among them. The Factor analysis converted all 42 statements into 6 Factors. The Factor Loading value was taken as 0.40 which removed all the coefficient values smaller than 0.40. The statements having values greater than 0.40 remained in the Rotated Component Matrix and their number decreased to 36. Therefore, 6 categories were selected for all 36 barriers from Factor Analysis. The frequency table was already made with the help of IBM SPSS. Then, the frequencies and percentages of the categories were calculated for each category with Microsoft Excel. Those six factors are further categorized with such divisions/ names:

Economical Effect and Focus, People preferred National Highway (N-5) w.r.t prices of things and toll rates are economical and affordable. As tolls at National Highway (N-5) are much lesser than Motorway tolls. But they preferred Motorways due to other circumstances. Impact of Landscape and Citizen facilities, Respondents preferred Motorways route and feel secure while traveling. It is also properly planned. Travelers appreciate that all facilities are at one point, which definitely a good for travelers / drivers' behaviour.

Safety measures, Motorway have safer U-turns having better speed reduction methods. As per safety concerns Motorways journey is safer than National Highway 5. Mostly safety features / requirements are designed on Motorways rather than N-5. Basic Services and Profile of Road, all services (Like: Fuel stations, restaurants, Prayer breaks etc.) are at same point which also saves the time and this route have good response while emergency situations. Due to this traveler and driver feel secure while traveling at Motorway alignment.

Pleasant Alignment, Motorway have pleasant alignment due to better cleanliness and environment. As this alignment have good environment due to having maximum greenery areas on both sides. With this very less pollution is on this network. So, it gives pleasant atmosphere to travelers / commuters. Visibility of Road, Motorway route have more visibility to drivers. As it is properly fenced, so no outer disturbance came suddenly. With this, it has no trees in Middle of both sides of road so gives clear alignment. It has also a proper lane markings and cat eyes showing a visible alignment at day and night as well.

Through this all It is observed that Motorway route is best and economical regardance with cost and time as well. And this route is good for quality traveling and having more connectivity w.r.t National Highway 5.

CHAPTER 6: RECOMMENDATIONS

It is recommended that motorway route is more economical than the National Highway, so a detailed study must be done on Logistics movement via this route. And after completing the ongoing construction detailed research is recommended from Kashgar to Gwadar.

It is observed that Tolls are at higher side at Motorways. So, we recommend that the tolls at Motorway must be revised and make it economical so, everyone use/avail this alignment. As people / travelers have a very common perception that Tolls are higher side so, they move towards Old National Highway as it is not a friendly highway for the vehicle. It increases the Maintenance cost of vehicle.

Similarly for time Motorway/CPEC route reduces the time of traveling from higher regions towards lower of Pakistan and vice versa. It is observed that if a vehicle travel in Max. speed limits at Motorway approx. 1/3 time saving route.

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APPENDIX A

Impact of CPEC on Cost & Time of Transportation, and Regional Connectivity in Pakistan

This questionnaire is prepared for data collection that will be used to measure the **Quality of Traveling** on NationalHighways / Old Route and Motorways (MTWYs) / CPEC Route within Pakistan. Therefore, you are requested toparticipate in this survey. I would be very grateful for your valuable input and the time. Your information will be kept anonymous and used only for research purposes.

S. No.	Questions	Route		Level of Quality				
Design of Road / Alignment / Route								
1	On which road do you feel good in Entry / merging lane?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
2	On which road do you feel good in Exit / diverging lane?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
3	On which road you feel drainage is more efficient?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
4	On which road do you feel/experienced parking area / Shoulder Lane given for any emergency case throughout the route?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
5	On which road are you satisfied with lane width?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
6	On which road Guard rail / barriers are provided through its overall length?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
7	Which road has proper and easily accessible U Turns?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
8	Which road has safe arrangements for U Turn?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
9	Which road has good	National	MTWYs /	Very	Poor	Average	Good	Very

	and welcoming toll plaza design?	Highways	CPEC Route	Poor				Good
10	On which road do you feel/experienced more land slides?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
11	On which road do you feel that the design of overall road is friendly while driving?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
12	On which road do you feel/experienced alternative interchange / access to desired destination?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
13	Which road saves your more time?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
Traffic Safety / Intelligence Transport System								
14	Which road is more congestion free?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
15	Which road have you experienced uniform flow of traffic?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
16	On which road do you feel safe and secure in day time while traveling?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
17	On which road do you feel safe and secure at Midnight while traveling?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
18	On which road you experienced proper cat eyes / studs in between lanes and carriageway end point?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
19	Which road you feel is safe from accidents?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
20	Which route/Road has Safety/CCTV cameras?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
21	Which road do you experience bumpy alignment and un-pleasant for driving?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good

22	Which road do you experience E-Tag systems on toll plazas?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
23	On which road do you have Emergency climbing lanes?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
24	On which road do you experience speed reduction methods like: (Speed humps etc.)?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
25	On which road have you experience proper lane markings?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
26	Which road is properly visible at night?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
27	Which roads have you experienced Anti-glare (front vehicle head light) arrangements?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
28	On which road do you feel good while travelling at uniform speed?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
29	On which road have you experienced more violations of traffic?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
30	On which road you required more concentration during traveling / driving?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
Friendly Environment Route								
31	On which route did you experience better cleanliness?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
32	Which road has more greenery and beautiful scenery?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
33	Which route has economical traveling rates (Toll charge)?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
34	Which route do you prefer to travel for your jobs?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good

35	On which route do you experience that local citizen feel safe and easy to live?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
36	Which route do you feel good connectivity between big cities of Pakistan?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
37	Which road do you prefer to for access to industrial areas?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
38	Which road has easy access to local market areas?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
39	Which route have you experienced with good Rescue services?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
40	Which alignment have you experienced with good emergency services?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
41	Which route have you experienced having positive response from Police?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
42	Which alignment do you experience having all services (Pump, Food, prayer areas etc.) at one point?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
43	Which alignment do you prefer for travelling from upper region to lower region of Pakistan or vice versa?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
44	Which road is pedestrians friendly?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
45	Which roads are properly fenced to avoid any disturbance by animals/other living things?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
46	Which road do you feel is properly planned?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
47	Which roads require less time while	National Highways	MTWYs / CPEC	Very Poor	Poor	Average	Good	Very Good

	overtaking of other vehicles?		Route					
48	On which route do you experience that availability of local goods is easier?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
49	On which route do you experience prices of things is economical?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
50	Which road is Pollution free?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good
51	Which road do you prefer/wish to travel in future?	National Highways	MTWYs / CPEC Route	Very Poor	Poor	Average	Good	Very Good