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Research Article

Impact of Transport Cost and Travel Time on Trade under China-Pakistan Economic Corridor (CPEC)

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China is the second biggest economy in the world and almost 40% of its trade in 2016 is transported through the South China Sea. China needs a small, secure, and low-cost path to trade with Europe and the Middle East and China-Pakistan Economic Corridor (CPEC) is a feasible solution to this requirement. This research analyzes the effect of CPEC on trade in terms of transport cost and travel time. In addition, the study compares the existing routes and the new CPEC route. The research methodology consists of qualitative and descriptive statistical methods. The variables (transport cost and travel time) are calculated and compared for both the existing route and new CPEC route. The results show that transport cost for 40-foot container between Kashgar and destination ports in the Middle East is decreased by about $1450 dollars and for destination ports in Europe is decreased by $1350 dollars. Additionally, travel time is decreased by 21 to 24 days for destination ports in the Middle East and 21 days for destination ports in Europe. The distance from Kashgar to destination ports in the Middle East and Europe is decreased by 11,000 to 13,000 km.

1. Introduction

Transportation is the shifting of goods by truck, rail, road, and sea and is reasoned as an important indicator for economic development [1]. Transport has two main parts. The first part represents vehicles that are either van, truck, rails, airplanes, or ships and second part represents the transport infrastructure such as roads, highways, seaways, airways, and railway tracks on which transport runs smoothly. In the recent days, both parts of transportation are considered as an important factor of trade and help in reducing transportation cost and travel time. The selection of transport mode for delivery of goods within less time and minimum cost is important to maximize the profit. Every state tries its best to discover short trade routes that can reduce trade cost and transfer time. To enhance their trade, countries invest in transport infrastructures like roads and rails and adequate transport infrastructure can potentially reduce transport cost and travel time. Transport cost and travel time are considered as the most important among all factors [2].

Shipping industry plays an significant part in the development of trade and about 80% of world trade is transported by the international shipping industry [3, 4]. The import and export of goods on large scale are not possible without shipping [5]. China is the second biggest economy and energy user in the world and safety of the oil supply chain stay the essential idea of China's strategies [6]. China is importing about 83% of oil supplies by sea, out of which 77% are functioning through the Strait of Malacca, a possible bottleneck for China [7]. There are some factors like China's regional disputes, pirate incidences, and geopolitics that make the Strait of Malacca as an attentive weakness for China and may stop economic development in case of any unanticipated events [8, 9]. About 60% of world pirate occurrences take place in the Strait of Malacca and presence of the Indian and US armadas in the seaway rises serious security concerns and in case of any unforeseen actions can affect trade and economic supplies of China [10–12]. To overcome these challenges, China wants to get access to deep water through Pakistan. The China-Pakistan Economic Corridor will link the city of Kashgar in Western China and the Gwadar Port in Pakistan by developing a transport infrastructure network comprising road and rail. Kashgar has great economic opportunities for the shortest land access to the local markets of Pakistan, Afghanistan, Iran, India, Uzbekistan, Kyrgyzstan, and Kazakhstan [13].

The geographic location of Pakistan is very important and has attracted many world powers for economic, political, and energy interests [2]. Pakistan has a border with China in the Northwest, Afghanistan in the West, India in the East, Iran in the Southwest, and the Arabian Sea in the South. It is the gateway of Central Asia and the Middle East and plays a vital role in transport economy. Pakistan also serves as a transit route to noncoastal courtiers, Central Asian states, and Afghanistan to trade by providing smooth access to the worldwide market by the Arabian Sea [15].

Gwadar is a deep-sea port situated at the mouth of the Persian Gulf, close to the Strait of Hormuz that is the third engaged route, running 35% of world sea trade. Gwadar port is very attractive for China to tackle sea trade challenges and connect Western China to the world by regional and economic connectivity [16]. Pakistan is also a main part of China's New Silk Road Initiative "Belt and Road Initiative (BRI)". Pakistan could be an important partner of this initiative that comprises land and sea routes [17].

The main aim of this study is to analyze how transport cost and travel time can affect trade. China needs an alternative trading route to the Middle East and Europe that is short, cost-effective, and safe, and CPEC can offer the shortest connection from China to Middle East and Europe. CPEC has the capacities to make a significant impact on world trade. This study compares the transport cost and travel time of the 40-foot container when transported by the existing route and the new CPEC route. We believe that this is the first study to analyze the impact of CPEC in terms of transport cost and transfer time. This research study is expected to provide useful information to all stakeholders including policy makers, trade organizations, and independent researchers to conduct further studies.

The next section presents the detailed introduction about China-Pakistan Economic Corridor. Section 3 represents the recent literature used to measure the relation between transport cost, travel time, and trade. Section 4 represents the methodology to estimate the transport cost and travel time. Section 5 represents the results and conclusion followed by section six.

2. China-Pakistan Economic Corridor

Chinese Premier Li Keqiang first proposed China-Pakistan Economic Corridor during his visit to Pakistan in May 2013. The planned project of linking Kashgar in Western China with Gwadar Port on Arabian Sea seashore in Balochistan was approved on July 5, 2013, during the visit of the Prime Minister of Pakistan to Beijing [18]. In 2015, the Chinese President visited Pakistan during which the final agreements worth $46 billion were signed for the construction of CPEC.

As concern to physical infrastructure, CPEC is a system of railways, roads, and pipelines. The government of Pakistan has decided three substitute highway routes: western route passing through Balochistan and Khyber Pakhtunkhwa; eastern route passing through Punjab and Sindh; the central route passing the entire country [19]. Figure 1 represents the highways networks under CPEC.

The additional transportation projects contain the construction of different railway tracks, although the upgrading of existing tracks has already been started. Figure 2 represents the railway network under CPEC.

2.1. Future Prospects of CPEC. The investment in infrastructure under CPEC will affect Pakistan's economic growth through numerous channels. First, it will decrease the trade cost of China and Pakistan and bring about a change in the modes of transportation. Secondly, it will enhance the economic cooperation with the world's biggest trading country, China. Finally, it will give a lift to trade within Pakistan [20]. The CPEC project will offer a system of railways and roads to connect isolated manufacturing areas in Karachi and Gwadar seaports. The better connectivity will decrease the transportation cost and shorten travel time. Additionally, it will not only improve the competitiveness of current firms but also increase exports [21–23].

Additionally, the project will also help to increase the export of products. For example, fruits and vegetables are produced in northern areas of Pakistan and most of this product cannot be exported due to a lack of good connectivity. The CPEC will connect the northern parts to Rawalpindi, Peshawar, and Lahore. This will help to increase the exports of agricultural commodities, as most of these goods are transported by air due to their unpreserved nature. The CPEC would bring a change in the modes of transportation. A large portion of trade with China will be shifted to the land route following the completion of the project. While sea transport is comparatively cheap, road transport is the cheapest [20].

The infrastructure expansion projects would improve the development in Pakistan. The planned industrial parks and economic zones established in cities along the CPEC route would lift Pakistan's labor market, and with the speedy infrastructure development, Pakistan's real estate and construction sector would improve, afterward contributing towards the development of remote areas of Balochistan, Khyber Pakhtunkhwa, and Gilgit-Baltistan.

2.2. Benefits to China. CPEC will connect China with Europe through Central Asia and the Maritime Silk Road will safeguard a safe passage for sea trade through the Indian Ocean and the South China Sea. CPEC will link China with nearly half of the population of the world. Development of Gwadar seaport will allow China's marine warships and trade ships to avoid Malacca Strait and allowing Beijing to keep an eye on American and Indian marine activities in the Indian Ocean. China wants prompt modernization of Xinjiang and other underdeveloped provinces to bring them at par with eastern provinces. For the achievement of these objectives, China needs access to deep waters in the Arabian Sea through Gwadar since this path to world markets is the shortest and the inexpensive [24].

The most important benefit for China under CPEC would be the decrease of China's trade way from existing sea route

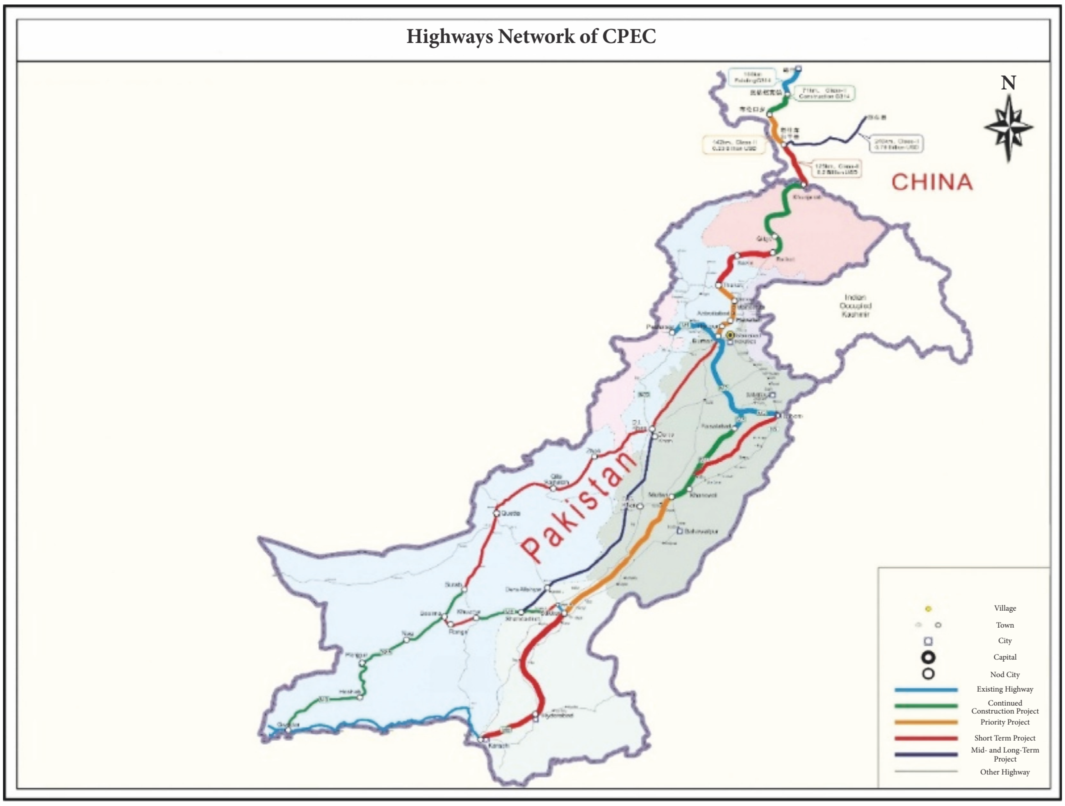

Figure 1: National highways network of CPEC [58].

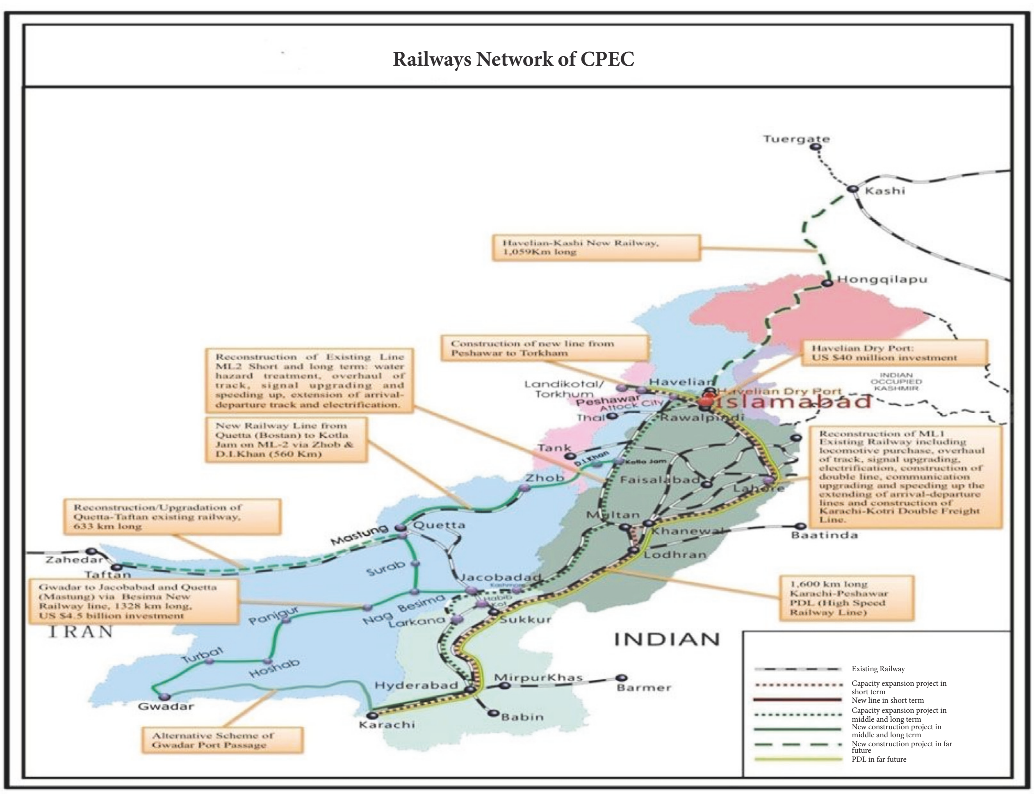

Figure 2: Railways network of CPEC [58].

Figure 3: CPEC and One Belt One Road [59].

of 12,000 kilometers to 2,000 kilometers. The oil consignments from Gulf nations would be transported to China via Pakistan, while nonoil imports could be transported to the world by Gwadar as a transport route. CPEC will also help to resuscitate the early trade route called Silk Route, that was one of the historically and oldest trade routes preexisting the Han Dynasty of China, connecting China through the Indian subcontinent, Asia Minot, Africa, Greece, Rome, and Britain. Apart from moneymaking goods, the highest worth of the Silk Route lies in swap of culture, technology, science, and architecture. Keeping in view narrowness and nationalism in modern societies, such advantages may act as a sign of raise of peace and acceptance to unite people.

Being a neighboring country, Pakistan and China will strengthen their trade relations. Due to construction and improvement of land route, physical distance and travel time between Pakistan and China will fall significantly and the GDP of both economics will increase sharply. The advantages for China in trade will happen not only from the decrease in travel time and distance but through the linkage with the larger market. In addition, the development in worldwide trade flows; a considerable shift is expected in the within trade between various regions of Pakistan and China.

2.3. CPEC under Belt and Road Initiative. There are almost 65 developing countries under Belt and Road Initiative. Figure 3 represents Silk Route Economic Belt, Maritime Silk Road, and China-Pakistan Economic Corridor. The main aim of Belt and Road Initiative is to enhance the economic prosperity of the B&R Initiative countries through improving the transport infrastructure. The One Belt One Road countries can learn from the experiences of China-Pakistan Economic Corridor to maximize the benefit of investment among different transport infrastructure. The construction of CPEC is one of the mega projects under BRI and Pakistan is an important companion country in the execution of the Belt and Road Initiatives [25]. It connects Pakistani port of Gwadar with Xinjiang Uyghur Autonomous Region, North Western China, through a link of roads and offers Pakistan with a much-needed economic infrastructure [26]. The CPEC is anticipated to not only bring new openings of trade and economic collaboration between Pakistan and China but also own a great demonstration value for mounting cooperation under the B&R Initiative [27].

Pakistan has a distinctive geostrategic site. Although Pakistan and China started border trade in the 1990s, the trade and economic levels between two countries are still quite low because of a weak transport infrastructure [28]. Its economy drops down to 6% of GDP because of poor infrastructure [29, 30]. Construction and improvements in railways, roads, and oil and gas pipelines in the CPEC will enhance the economic activity and will improve the relations in both countries.

CPEC will connect the country to the One Belt One Road project and offer shortest access to the markets of Central Asia and Europe as well. CPEC is not a bilateral project but has local dimensions and it will give an incredible enhancement to Pakistan's trade with China and other countries [31].

3. Literature Review

In past two decades, many researches are attracted by intermodal freight transport and comprehensive classification and explanations are given by Bontekoning et al. [32] and

Macharis and Bontekoning [33]. In many previous studies, land bridges are discussed as a central part of intermodal cargo transport. According to destinations and origins, Rodrigue et al. [34] divided land bridges into three categories: land bridge, minibridge, and microbridge. Some studies also examined the importance and future prospects of land bridges for intermodal transportation [35–38]. China and Pakistan jointly initiated the road and rail projects under CPEC to construct intermodal transport system and Pakistan is used as land bridge for shipping Chinese goods to Middle East and Europe. Wiseman and Giat [39] highlighted the importance of land bridges for bypassing freight routes. This study further addressed that intermodal transport service is essential to optimize transport cost, time, and distance for freight. The different alternatives of intermodal freight transport are kept under consideration when time is grave and takes priority over other factors.

The US is used as land bridge for bypassing Panama Canal [40]. This study suggests that larger ships would bypass the land bridge and complete their journey through Panama Canal to minimize time. The smaller ships will unload their container at west coast ports and trucks, and rail transportation would then compete their journey across the country. Saudi Arabia is constructing a double track railroad of 590-mile linking Jeddah to Dammam (Red Sea to Gulf coast). Presently, transport time requires about three days between these ports. The rail connection will decrease port-to-port time to nearly 10 hours [41]. The Thailand government is building a rail land bridge from Andaman Sea to Gulf of Thailand similar to Eastern Seaboard project known as "Thailand land bridge project" which includes excellent port and a dry port linked by railway and highways. The Thailand land bridge will decrease the freight transport time and will bypass the Strait of Malacca [42]. The Great Equatorial land bridge is the longest forthcoming land bridge running from Douala in Cameroon to Lamu in Kenya via Central African Republic and South Sudan. This prospective rail land bridge is about 2625 miles linking the South Atlantic Ocean with Indian Ocean. The cargo trains will travel at average speed of 75 mph [43] with capacity of 20 million TUEs per year [44].

Qi and Wang [45] compared the time and cost incurred on a maritime route and Eurasian land bridge to transport goods from China to Europe. The study concluded that land bridge takes 10 days lesser than maritime route in transfer of goods. Talley [46] examined the effects on freight transportation when goods are transported by trains instead of using Panama Canal to cross US. A normal speed of ship is less than 20 to 25 knots in usual conditions, which normally travels less than 20 mph. Speed of train is much faster than ship, so transport time is reduced by five to six days. Hilletofth et al. [47] distinguished the hindrances that hamper the proper utilization of Eurasian land bridge, such as imperfect of function of railways and ports on the land bridge. Banomyong [48] estimated the transport costs of one TEU (twenty-foot equivalent unit) for four different intermodal routes, and study found that high logistic cost and poor physical infrastructure are not altered to modern intermodal business practices.

Giat [49] developed a multiperiod dynamic model to improve the reliability of project for optimal allocation of investment. This model will help managers to decide how much to invest improving process reliability. The optimal allocation of investment decision will minimize the firms failure cost and preventive cost. The study suggest that investment will be made periodically for large output growth, investment will be made for some periods for intermediate output growth, and investment will be made upfront for small output growth.

Edwards & Odendaal [50] investigated the impact of quality of infrastructure in exports. The results reveal that improving the quality of infrastructure in exports has a positive effect on exports by lowering the transport cost faced by the exporter. The results also suggest that it is the minimum quality of infrastructure between two trading countries that matter most for transport cost and trade. Bougheas et al. [51] examined the role of infrastructure in a bilateral trade model with transport costs and found that transport costs are assumed to depend inversely on the level of infrastructure. Djankov et al. [52] determined how time delays affect international trade. The results reveal that, on average, each additional day that product is delayed prior to being shipped reduces trade by at least 1 percent or each day is equivalent to country distancing itself from its trade partners by 70 km on average. Nordås & Piermartini [53] examined the role of quality of infrastructure on country's trade performance. The results showed that bilateral tariffs have a negative impact on trade and quality of infrastructure is an important determinant of trade performance and port efficiency has the largest impact on trade. Hummels [54] found that shipping transport experienced a technological revolution in the form of container shipping, but dramatic price declines are not in evidence. The results reveal that increasing the share of trade that is containerized lowers shipping costs from three to thirteen percent.

4. Methodology

This research estimates and compares the transport cost and travel time for both the existing route and new CPEC route. Both these routes are based on roadways and seaways. This research paper selects three countries from both Europe and the Middle East based on highest imports or exports from/to China. Each port from every country is selected based on the highest number of berths (Table 1).

Figure 4 represents the different ports from Europe, the Middle East, China, and Pakistan. The red mark shows the port of Hamburg, Rotterdam, and Le Havre in Europe, black mark represents the Shuwaikh port, Jeddah Islamic seaport, and Salah port in the Middle Eastern region, blue mark represents the Gwadar seaport in Pakistan, and green mark represents the Shanghai seaport in China.

4.1. Imports of China from Target Countries. In 2016, China was the third major importer of goods in the world with a share of 12% of world imports. The total volume of China's imports in 2016 was 3.41 trillion dollars [14]. Saudi Arabia

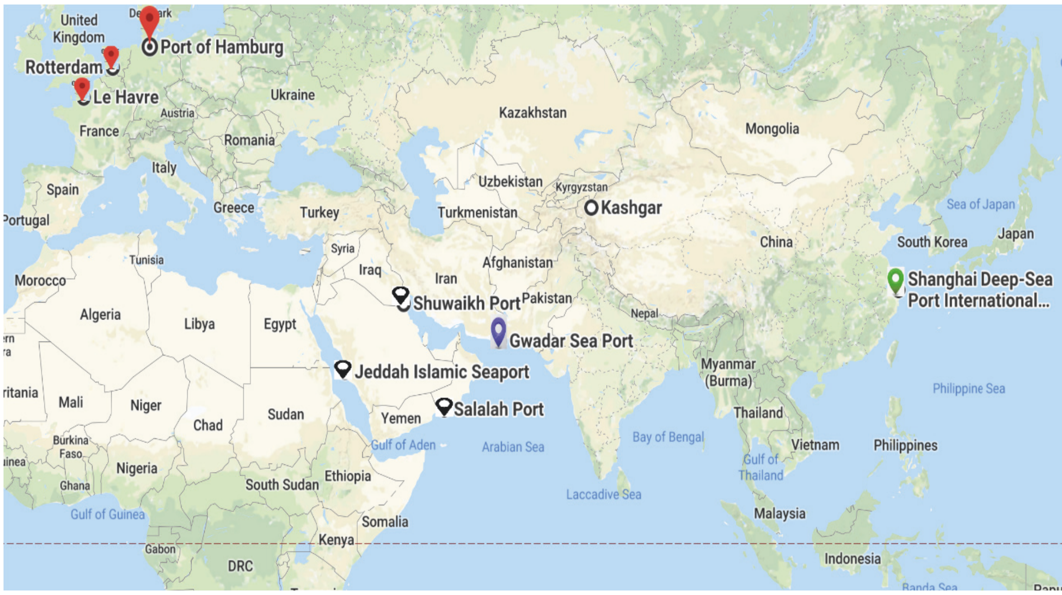

Figure 4: Seaports.

Table 1: Selected ports from Europe and the Middle East.

Port	Country	Region
Port of Salalah	Oman	Middle East
Jeddah	Saudi Arabia	
Shuwaikh Port	Kuwait	
Rotterdam	Netherlands	Europe
Hamburg	Germany	
Le Havre	France	

Table 2: Import from target countries.

Countries	Imports in Billion	Imports of China
Saudi Arabia	23.7	1.39%
Kuwait	6.19	0.36%
Oman	11.2	0.65%
Germany	98.8	5.81%
France	24.3	1.42%
Netherlands	12.9	0.75%

Source: Atlas media OEC, 2016 [14].

Table 3: Export from target countries.

Destination Countries	Exports in Billion	Exports of China
Saudi Arabia	26.4	1%
Kuwait	4.99	0.18%
Oman	2.52	0.09%
Germany	104	3.93%
France	49.3	1.86%
Netherlands	60.6	2.29%

Source: Atlas media OEC, 2016.

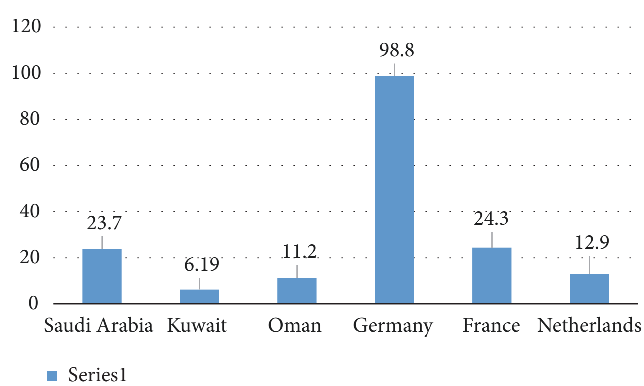

Figure 5: Imports of China from target countries [14].

and Germany are large import partners of China from Middle East and Europe countries, respectively. China mainly imports cars and vehicle parts from Germany and crude petroleum from Saudi Arabia. Table 2 represents the imports of China from selected countries from Middle East and Europe.

Figure 5 shows that China imports about $23.7 billion from Saudi Arabia, $6.19 billion from Kuwait, $11.2 billion from Oman, $98.8 billion from Germany, $24.3 billion from France, and $12.9 billion from the Netherlands.

4.2. Exports of China from Target Countries. In 2016, China stood first in exports with a share of 17% of world exports. The total volume of China's exports in 2016 was 5.291 trillion dollars [14]. In terms of exports, Germany is the large export partner of China from Europe and Saudi Arabia from Middle East countries. China mainly exports computer and broadcasting equipment to Germany and Saudi Arabia. Table 3 represents the exports of China from selected countries from Middle East and Europe.

Table 4: Cost of domestic road transportation.

Road Transport charges	Distance in Kilometres	*	Average per/km cost
Domestic Transport charges	5150	* $2317	$0.45

Table 5: Sea transport cost.

Origin port	Destination Port	Country	Region	Transport Cost
Shanghai China	Port of Salalah	Oman	Middle East	$1100
	Jeddah	Saudi Arabia		$1200
	Shuwaikh Port	Kuwait		$1200
	Rotterdam	Netherlands	Europe	$1800
	Hamburg	Germany		$1880
	Le Havre	France		$1800

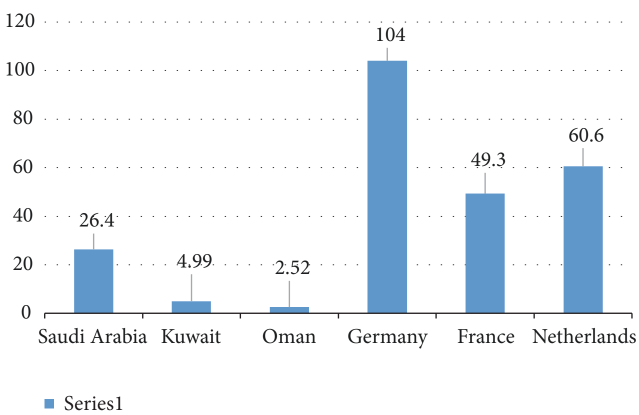

Figure 6: Exports of China from destination countries [14].

Figure 6 shows that China exports about $26.4 billion to Saudi Arabia, $4.99 billion to Kuwait, $2.52 billion to Oman, $104 billion to Germany, $49.3 billion to France, and $60.6 billion to the Netherlands.

4.3. Existing Route Transport Cost and Travel Time. The existing route from Kashgar (Western China) to selected destination ports in Europe and the Middle East comprises a seaway and a roadway. The existing route is divided into two parts, the distance between Kashgar to Shanghai seaport is called a roadway, and distance from Shanghai seaport to target seaports in Europe and the Middle East is called a seaway. In this section, the research paper calculates the transport cost and travel time for a 40-foot container that is transported from Kashgar (western China) to selected ports of destination countries. The container comes from Kashgar (Western China) to Shanghai seaport by road, which goes to the destination seaport by sea. Figure 7 represents the existing route, which China is using to trade from Kashgar (Western China) to Europe and the Middle East.

4.3.1. Existing Route Road Cost. For calculation of road transport cost, the total distance is multiplied with an average per kilometer truck cost. According to Google Maps, average total distance is 5150 kilometers from the dry port of Kashgar to seaport of Shanghai. Domestic transport cost of different transporters differs, so average cost is used to determine the truck cost. The average per kilometer cost is taken from different local transporters, which is $0.45 per kilometer. Calculations for estimation of domestic transport charges are shown in Table 4.

Table 4 depicts that total road transport for 40-foot container that will reach to port of Shanghai from dry port of Kashgar in $2317.

4.3.2. Existing Route Transport Cost. Table 5 represents the cost of sea for selected countries from Middle East and Europe. Shanghai port is used as origin seaport in all cases. Cost of sea freight is taken by MSC and CMA lines, FREIGHTOS, Hapag Lloyd, and China shipping. These prices are effective for only one month and are taken in the month of June 2018.

4.3.3. Total Transport Cost for the Existing Route. Table 6 represents the total transport cost from Kashgar to selected ports in Middle East and Europe. For estimation of total transport cost for existing route, the transport cost of both road and sea is added. Transport cost of road for a 40-foot container is taken from Table 4 and transport cost for sea is taken from Table 5.

$$\textit{Total transport cost} = \textit{Road cost} + \textit{Sea cost} \quad (1)$$

4.4. Existing Route Road Travel Time. Travel time for road transport is obtained by dividing total distance of road transport by average speed of a truck. The speed of the truck is high up to 80 km/h on the smooth way and dropped to 30 km/h or below in mountain areas; therefore an average speed of 40kph is taken to fulfill the requirements. Total distance is retrieved from Google Maps.

Table 7 represents that a container will take 129 hours or 5 days to reach from Kashgar to Shanghai seaport.

4.4.1. Delay in Travel Time. There are additional elements like rest of drivers, weather, traffic jam, and strikes that might

Table 6: Total cost of the 40-foot container.

Origin port	Destination port	Cost of Road (Kashgar to Shanghai)	Cost of the sea (Shanghai to destination ports)	Total cost
Kasghar China	Port of Salalah	$2317	$1100	$3417
	Jeddah	$2317	$1200	$3517
	Shuwaikh Port	$2317	$1200	$3517
	Rotterdam	$2317	$1800	$4117
	Hamburg	$2317	$1880	$4117
	Le Havre	$2317	$1800	$4117

Table 7: Road transport travel time.

Road travel time	Distance (km)	/	Average speed of truck
Road travel time	5150	/	40km/h
		129 hours or 5.33 days	

Table 8: Delay in travel time.

Delay in travel time	Number of days	*	08 hours delay per day
Delay in travel time	5.33	*	08
		42.6 hours or 1.7 days	

Table 9: Total travel time for road transportation.

Total travel time	Existing travel time	+	Delays in travel
Total travel time	129 hours or 5.33 days	+	42.6 hours or 1.7 days
		171.6 hours or 7.1 days	

increase the road travel time. In order to get precise results, 08 hours per day of delays in travel time is added to each journey.

Table 8 represents that a 40-foot container will take about 43 extra hours or 1.7 days as delay in travel time due to other factors.

4.4.2. Total Travel Time for Road Transportation. Total travel time for road transport is obtained by adding travel time and delays in travel time.

$$\textit{Total Travel Time} = \textit{Travel time} + \textit{Delays in travel} \quad (2)$$

Table 9 shows that one 40-foot container will take 171.6 hours or 7 days to reach Shanghai seaport from Kashgar (western China).

4.4.3. Travel Time for Sea Transport. For estimation of travel time, we use an online software ports.com [55]. The average speed of 12 knots is used to determine the travel time for cargo ship. A combination of the recession and growing awareness about climate change emissions in the shipping industry encouraged many shipping owners to adopt super-slow steaming at the speed of 12 knots [56]. The marine travel time is calculated from Shanghai port in China to destination ports. Table 10 represents the travel time in days with speed of 12 knots from the port of Shanghai to destination ports.

4.4.4. Total Travel Time for the Existing Route. Table 11 represents total travel time for selected countries from Middle East and Europe. The existing travel time for container is estimated by adding travel time of road and sea. Travel time for road is taken from Table 9 and travel time for sea is taken from Table 10.

$$\textit{Total travel time} = \textit{Road travel time} + \textit{Sea travel time} \quad (3)$$

4.5. New CPEC Route Transport Cost and Travel Time. The new CPEC route from Kashgar (Western China) to selected destination ports from Europe and the Middle East comprise a seaway and a roadway. New CPEC route is divided into two sections, the distance from Kashgar to Gwadar is called a roadway, and distance from Gwadar seaport to different seaports in Europe and the Middle East is called a seaway. In this section, the research paper calculates the transport cost and travel time for a 40-foot container that is transported by new CPEC route from Kashgar (Western China) to selected ports of destination countries. The container comes from Kashgar (Western China) to the Gwadar seaport (Pakistan) by road and goes to destination seaports by sea. Figure 8 represents the new CPEC route, which China will use as an alternative route to trade from Kashgar (Western China) to Europe and the Middle East.

4.5.1. New CPEC Route Road Cost. Domestic transport charges for the road are estimated by multiplying the total

FIGURE 7: Existing route roadway and seaway.

TABLE 10: Travel time from Shanghai to selected ports.

Origin port	Destination Port	Country	speed	Days in sea	Distance in nautical miles
Shanghai port	Port of Salalah	Oman	12 knots	22 days	6027nm
	Jeddah	Saudi Arabia	12 knots	26 days	7341nm
	Shuwaikh Port	Kuwait	12 knots	25 days	7094nm
	Rotterdam	Netherlands	12 knots	42 days	11999nm
	Hamburg	Germany	12 knots	43 days	12277nm
	Le Havre	France	12 knots	41 days	11744nm

TABLE 11: Total travel time from Kashgar to different ports.

Origin port	Destination port	Road travel time (Kashgar to Shanghai)	Sea travel time (Shanghai to different ports)	Total travel time
Kashgar China	Port of Salalah	7 days	22 days	27 days
	Jeddah	7 days	26 days	33 days
	Shuwaikh Port	7 days	25 days	32 days
	Rotterdam	7 days	42 days	49 days
	Hamburg	7 days	43 days	50 days
	Le Havre	7 days	41 days	48 days

TABLE 12: Road cost of the container from Kashgar to Gwadar.

Road Transport charges	Distance in Kilometres	*	Average per/km cost
Domestic Transport charges	2800	*	$0.45
		$1260	

distance with an average per kilometer cost for truck. According to Google Maps, the total distance is about 2800kms from Kashgar (Western China) to Gwadar seaport. In order to get good comparison results, the same average per kilometer cost of $0.45 is used for both existing and CPEC route.

Table 12 represents that the 40-foot container will reach from Kashgar to Gwadar seaport at the cost of $1260.

4.5.2. New CPEC Route Transport Cost. Table 13 represents the sea cost from Gwadar to selected ports in Middle East and Europe. Gwadar seaport is used as origin in all cases. Cost of sea freight is taken by MSC and CMA lines, FREIGHTOS, Hapag Lloyd, and China shipping. These charges are valid for only one month and taken in the month of June 2018.

Figure 8: New CPEC route roadway and seaway.

Table 13: Sea cost from Gwadar to destination ports.

Origin port	Destination Port	Country	Region	Cost of shipment
Gwadar Pakistan	Port of Salalah	Oman	Middle east	$300
	Jeddah	Saudi Arabia		$800
	Shuwaikh Port	Kuwait		$800
	Rotterdam	Netherlands	Europe	$1500
	Hamburg	Germany		$1500
	Le Havre	France		$1500

4.5.3. Total Transport Cost for New CPEC Route. Table 14 represents the total cost of road and sea from Kashgar to selected ports in Middle East and Europe. For estimation of total transport cost for new CPEC route, the shipping cost of both road and sea is added. Transport cost of the road for a 40-foot container is taken from Table 12 and transport cost for sea is taken from Table 13.

$$\textit{Total transport cost} = \textit{Road cost} + \textit{Sea cost} \quad (4)$$

4.6. New CPEC Route Road Travel Time. Travel time for road transport is obtained by dividing the total distance of road transport by average speed of trucks. The speed of a truck is high up to 80 km/h on the smooth way and drops to 30 km/h or below in mountain areas; therefore an average speed of 40kph is taken to fulfill the requirements. Total distance is retrieved from Google Maps.

Table 15 represents that a container will take 70 hours or 2.91 days of travel time from Kashgar to Gwadar seaport.

4.6.1. Delay in Travel Time. There are additional elements like rest of drivers, weather, traffic jam, and strikes that might increase the road travel time. The law and order situation in Pakistan is not good as compared to China; therefore, special consideration should be given to this route. Average 10 hours per day of delay in travel time is added in each journey, as compared to 08 hours of per day delay in China route due to above-mentioned elements.

Table 16 represents that a 40-foot container will take about 29.1 hours or 1.21 days extra as delay in travel time due to other factors.

4.6.2. Total Travel Time for Road Transportation. Total travel time for road transport is obtained by adding travel time and delays in travel time.

$$\textit{Total Travel Time} = \textit{Travel time} + \textit{Delays in travel} \quad (5)$$

Table 17 represents that a container will take 99.1 hours or 4.12 days of travel time from Kashgar to Gwadar seaport.

4.6.3. Travel Time for Sea Transport. For estimation of travel time, we use an online software ports.com [55], which is based on the average speed of 12 knots of the cargo ship. A combination of the recession and growing awareness about climate change emissions in the shipping industry encouraged many shipping owners to adopt super-slow steaming at speed of 12 knots [56]. The marine travel time is calculated from Gwadar port in Pakistan to destination ports. Table 18 represents the travel time in days with speed of 12 knots from the port of Shanghai to destination ports.

4.6.4. Total Travel Time for CPEC Route. Table 19 represents total travel time of road and sea for new CPEC route from Kashgar to selected ports in Middle East and Europe. Total travel time for one 40-foot container from Kashgar to

Table 14: Total cost from Kashgar to destination ports.

Origin port	Destination port	Cost of Road (Kashgar to Gwadar)	Cost of the Sea (Gwadar to destination ports)	Total cost
Kasghar China	Port of Salalah	$1260	$300	$1560
	Jeddah	$1260	$800	$2060
	Shuwaikh Port	$1260	$800	$2060
	Rotterdam	$1260	$1500	$2760
	Hamburg	$1260	$1500	$2760
	Le Havre	$1260	$1500	$2760

Table 15: Travel time from Kashgar to Gwadar port.

Road travel time	Distance (km)	/	Average speed of truck
Road travel time	2800	/	40km/h
		70 hours or 2.91 days	

Table 16: Delays in travel time.

Delay in travel time	Number of days	*	10 hours delay per day
Delay in travel time	2.91	*	10
		29.1 hours or 1.21 days	

Table 17: Total travel time from Kashgar to Gwadar.

Total travel time	travel time	+	Delays in travel
Total travel time	70 hours or 2.91 days	+	29.1 hours or 1.21 days
		99.1 hours or 4.12 days	

Table 18: Travel time for sea transport.

Origin port	Destination Port	Country	speed	Days in sea	Distance in nautical miles
Gwadar Seaport Pakistan	Port of Salalah	Oman	12 knots	3 days	755 nm
	Jeddah	Saudi Arabia	12 knots	8 days	2127 nm
	Shuwaikh Port	Kuwait	12 knots	4 days	942 nm
	Rotterdam	Netherlands	12 knots	24 days	6785 nm
	Hamburg	Germany	12 knots	25 days	7063 nm
	Le Havre	France	12 knots	23 days	6530 nm

Table 19: Total travel time from Kashgar to different ports by new CPEC route.

Origin port	Destination port	Road travel time (Kashgar to Gwadar)	Sea travel time (Gwadar to different ports)	Total travel time
Kashgar China	Port of Salalah	4 days	3 days	07 days
	Jeddah	4 days	8 days	12 days
	Shuwaikh Port	4 days	4 days	08 days
	Rotterdam	4 days	24 days	28 days
	Hamburg	4 days	25 days	29 days
	Le Havre	4 days	23 days	27 days

destination ports by new CPEC route is estimated by adding travel time by road and sea. Travel time for the road is taken from Table 17 and travel time for sea is taken from Table 18.

$$\textit{Total travel time} = \textit{Road travel time} + \textit{Sea travel time} \quad (6)$$

5. Results

The main purpose of this research is to compare the transport cost and travel time between the existing route and new CPEC route.

Table 20: Comparison of transport cost between the existing route and new CPEC route.

Origin port	Destination ports	Existing route transport cost	CPEC route transport cost	Difference	Percentage
Kasghar China	Port of Salalah	$3417	$1560	$1857	54.35%
	Jeddah	$3517	$2060	$1457	41.43%
	Shuwaikh Port	$3517	$2060	$1457	41.43%
	Rotterdam	$4117	$2760	$1357	32.96%
	Hamburg	$4117	$2760	$1357	32.96%
	Le Havre	$4117	$2760	$1357	32.96%

Table 21: Comparison of travel time between the existing route and new CPEC route.

Origin port	Different ports	Existing route travel time	CPEC route travel time	Difference	Percentage
Kashgar China	Port of Salalah	27 days	07 days	20 days	74.07 %
	Jeddah	33 days	12 days	21 days	63.64%
	Shuwaikh Port	32 days	08 days	24 days	75.00%
	Rotterdam	49 days	28 days	21 days	42.86%
	Hamburg	50 days	29 days	21 days	42.00%
	Le Havre	48 days	27 days	21 days	43.75%

Table 22: Existing route distance from Kashgar to different ports.

Origin port	Destination port	Road distance (Kasghar to Shanghai)	Sea Distance (Shanghai to destination ports)	Total distance
Kasghar China	Port of Salalah	5,150 km	6027nm x 1.852 = 11,162km	16,312km
	Jeddah	5,150 km	7341nm x 1.852 = 13,596km	18,746 km
	Shuwaikh Port	5,150 km	7094nm x 1.852 = 13,138km	18,288 km
	Rotterdam	5,150 km	11999nm x 1.852 = 22,222km	27,372 km
	Hamburg	5,150 km	12277nm x 1.852 = 22,737km	27,887 km
	Le Havre	5,150 km	11744nm x 1.852 = 21,749km	26,889 km

5.1. Comparison of Transport Cost. The existing route transport cost of a container between Kashgar (Origin Port) and six different ports are compared with new CPEC route. To measure the difference impact, the transport cost of an existing route is subtracted from CPEC route transport cost.

The difference column in Table 20 represents a reduction in transport cost and has positive effect. Results show that China is able to save about $1350 (32.9%) from trade made to all over Europe. Conversely, China is able to save about more than $1450 (41.4%) of transport cost on all exports and imports made to all over the Middle East.

5.2. Comparison of Travel Time. To compare the travel time for a 40-foot container between six different ports and Kashgar (China), travel time for the existing route is subtracted from travel time for CPEC route.

The difference column in Table 21 represents the reduction in travel time and has positive impact. Results show that China can save about 21 days of travel time from trade that were made all over Europe. Conversely, China can save about 20 to 24 days of travel time from trade that were made all over the Middle East.

5.3. Distance Comparison. The distance of the existing route and new CPEC route from Kashgar (origin port) is compared with different ports of destination. The sea distance for both routes is taken from online software (Ports.com) and road distance is taken from Google Maps for both existing and new CPEC route.

5.3.1. Existing Route Distance. Table 22 represents total distance for existing route from Kashgar to selected ports in Middle East and Europe. The existing route distance is measured by adding both road and sea distance. The sea distance in nautical miles is transformed into kilometers by multiplying sea distance with 1.852.

$$\begin{aligned} &\textit{Total existing route distance} \\ &\quad = \textit{Road distance} + \textit{Sea distance} \end{aligned} \tag{7}$$

5.3.2. New CPEC Route Distance. Table 23 represents total distance for new CPEC route from Kashgar to selected ports in Middle East and Europe. The new CPEC route distance is measured by adding both road and sea distances. Sea distance

Table 23: New CPEC route distance from Kashgar to different ports.

Origin port	Destination port	Road distance (Kashgar to Gwadar)	Sea Distance (Gwadar to different ports)	Total distance
Gwadar Pakistan	Port of Salalah	2800km	1,027nm x 1.852 = 1398km	4,198km
	Jeddah	2800km	2,399 nm x 1.852 = 3939km	6739 km
	Shuwaikh Port	2800km	1,213 nm x 1.852 = 1745km	4545 km
	Rotterdam	2800km	7,057 nm x 1.852 = 12566km	15,366 km
	Hamburg	2800km	7,335 nm x 1.852 = 13081km	15881 km
	Le Havre	2800km	5,106 nm x 1.852 = 13083km	15883 km

Table 24: Distance comparison of existing and new CPEC route.

Origin port	Destination ports	Existing route distance	CPEC route distance	Difference	Percentage
Kasghar China	Port of Salalah	16,312km	4,198km	12114km	74.26%
	Jeddah	18,746 km	6739 km	12007 km	64.05%
	Shuwaikh Port	18,288 km	4545 km	13743 km	75.15%
	Rotterdam	27,372 km	15,366 km	12006 km	43.86%
	Hamburg	27,887 km	15881 km	12006 km	43.05%
	Le Havre	26,889 km	15883 km	11006 km	40.93%

Table 25: Impact of CPEC in terms of import and exports.

Country	Imports (Billion)	Exports (Billion)	Total trading Volume (Billion)	15% save (Billion)
Saudi Arabia	$23.7	$26.4	$50.1	$7.51
Kuwait	$6.19	$4.99	$11.18	$1.67
Oman	$11.2	$2.52	$13.72	$2.05
Germany	$98.8	$104	$202.8	$30.42
France	$24.3	$49.3	$73.6	$11.04
Netherlands	$12.9	$60.6	$73.5	$11.02
Saudi Arabia	$23.7	$26.4	$50.1	$7.51
Total	$200.79	$274.21	$475	$71.25

is converted to kilometers by multiplying nautical miles with 1.852.

$$\begin{aligned} &\textit{New CPEC route distance} \\ &\quad = \textit{Road distance} + \textit{Sea distance} \end{aligned} \tag{8}$$

5.3.3. Decrease in Distance. The difference between existing and new CPEC route distance will tell how much the distance will decrease due to the new CPEC route.

The difference column in Table 24 represents the decrease in distance due to the new CPEC route. With the function of new CPEC route, China can save the distance of up to 12,000 to 13,000 km. It will not only cut the travel time and transport cost but also make China's trade more competitive in terms of low cost and fast delivery.

5.4. Impact on Trade in Terms of Transport Cost and Supply Time. In terms of transport cost and travel time, the impact of CPEC is twofold. Table 25 represents that the total trade volume from different destinations is about $475 billion dollars in 2016. China's total exports in 2016 to different destination countries are about $274 billion dollars and total imports are about $200 billion dollars.

The transport cost decreases by about $1350 and travel time reduces by 20 to 26 days for each 40-foot container that is traded to European destinations. China depends deeply on Middle Eastern countries for fulfilling its energy needs and the transport cost from Middle Eastern countries decreases by $1450 dollars and travel time from 21 to 23 days. China will enjoy the advantage of low cost and fast delivery of imports and exports because of low transport cost and reduced travel time. Transport cost for Europe decreases by $1357 dollars that are about 32% and $1457 dollars for Middle Eastern countries that is about 41% (Table 20). Regardless of that percentage, this research study undertakes that if China will save only 15% of transport cost for total trade from different countries than outcomes will as follows in Table 25 .

The results in Table 25 show that China can save $71 billion dollars on all the imports and exports that it made from different selected countries. The calculation of this research shows that China is able to save transport cost of about $71 billion dollars from only three Middle Eastern and three European countries. China can save billions of dollars annually by shifting its trade to new CPEC route. CPEC route will not only save the transport cost but also reduce the travel time due to a decrease in distance from about 11,000 to 14,000 km. China can also get a competitive advantage in the form of quick and fast delivery, which is an innumerable benefit.

6. Conclusion

The main objective of this study is to analyze the impact of transport cost and travel time on trade under China-Pakistan Economic Corridor. Transportation plays an important role in the movement of raw material for production and finished goods for consumption. Good transport infrastructure facilitates faster, safe, and low-cost transfer of goods and has a positive impact on trade. Shipping industry plays an important role in the development of trade and about 90% of world trade is carried by the international shipping industry. The import and export of goods on a large scale are not possible without shipping.

China is the world largest export economy and the 33rd most complex economy. In 2016, China exported 2.27 trillion dollars and stood first in the world ranking. Imports of China were 1.23 trillion dollars in 2016, making it the second largest importer in the world [14]. China is trading 39% by the South China Sea through the Strait of Malacca, a possible bottleneck for China [57]. China is importing large quantities of oil from the Middle East to fulfill its energy requirements. There are some factors like China's regional disputes, pirate incidences, and geopolitics that make the Strait of Malacca a strategic weakness for China and may stop economic development in case of any unpredicted events.

China needs an alternative, safe, short, and inexpensive route to trade with Europe and Middle East countries. In this manner, China will not only save travel time but can also save billions of dollars in transport cost. The China-Pakistan Economic Corridor is an alternative and short route that connects Kashgar (Western China) to the Gwadar seaport in Pakistan by developing a transport infrastructure network, consisting of road and rail. Gwadar is a deep-water port situated at the mouth of the Persian Gulf, near the Strait of Hormuz, which is the third busiest route, managing 35% of world sea trade. Seaport of Gwadar is highly attractive to China to handle sea trade challenges and connect Western China to the world through regional and economic connectivity. Pakistan is also a central part of China's New Silk Road Initiative "Belt and Road Initiative".

Findings in this paper represent the fact that China will save about $71 billion dollars from new CPEC route on its imports and exports in terms of shipping cost from selected destination countries from Europe and the Middle East. Table 20 represents that China would able to save about $1450 dollars on each container that is traded from the Middle East and $1350 dollars from Europe. The travel time will reduce by about 21 days from trade that is made to all over from Europe and travel time will reduce by 21 to 24 days from the Middle East. With the new CPEC route, total distance will also reduce by about 11,000 to 13,000 kilometers from Kashgar (Western China) to destination countries in the Middle East and Europe.

CPEC is considered a game changer for the entire region. It will not only benefit Pakistan and China but also the Middle East, Europe, and noncoastal Central Asian countries. Land-locked Central Asian countries like Tajikistan, Turkmenistan, Kazakhstan, Kyrgyzstan, and Afghanistan would get the advantage of shortest seaway to the Gwadar port.

7. Limitations of Study

CPEC project is not operational fully so it is hard to get the accurate data of cost and time associated with road transportation. The transport cost of a 40-foot container provided by shipping companies is normally effective for one month. The cost may change depending on different factors like oil prices, demand, and supply. The new CPEC route and existing route are comprised of roadway and seaway. It is comparatively easy to calculate the transport cost and travel time for seaway, though it is challenging for roadway because different local transporters charge differently. Local transporters in Pakistan and China charge differently and same average cost for road transportation is taken to get the reliable results for both routes.

Data Availability

The data that support the findings of this study are taken from different local transporters, Google Maps, and ports.com.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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