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# The Impact of the Belt and Road Initiative on the Air Transport Network in Central Asia: A Case Study of Kazakhstan and Uzbekistan

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## Abstract

This paper explores the impact of the Belt and Road Initiative on the air transport network in Central Asia, with a focus on Kazakhstan and Uzbekistan. The study uses a mixed-method approach to collect and analyze data from primary and secondary sources, including surveys, interviews, and statistical data. The results of the study suggest that the Belt and Road Initiative has had a significant impact on the air transport network in Central Asia, particularly in terms of increased connectivity, improved infrastructure, and greater economic integration. The study also identifies some challenges and limitations associated with the Belt and Road Initiative in the region.

## Keywords

Air Transport Network (ATN), Belt and Road Initiative (BRI), Kazakhstan, Uzbekistan

## 1. Introduction

The development of BRI in recent years has led to a growing appreciation of the importance of the Air Transportation Network (ATN) (Jaimurzina, 2014). China has negotiated intergovernmental agreements with 136 nations as of the end of July 2019, going far beyond the typical "Belt" and "Road" agreements (Czerewacz-Filipowicz, 2019). The Belt and Road Initiative (BRI), initiated by China in 2013, stands as a pivotal global economic and infrastructure development endeavor, aimed at fostering connectivity across Asia, Europe, and Africa through bolstered trade, investment, and overall connectivity (Dellios & Ferguson, 2017). This multifaceted initiative encompasses the construction of railways, highways, ports, and various other critical infrastructure projects, alongside the development of energy and telecommunication networks. In the context of Central Asia, the BRI assumes particular significance, as it endeavors to enhance regional connectivity, stimulate trade and investment, and drive economic advancement (Khan et al., 2018). This paper offers a comprehensive analysis of the intricate interplay between the Belt and Road Initiative and the air transport networks of Central Asia, with Kazakhstan and Uzbekistan as focal points (Farra et al., 2015). By examining the evolving landscape, infrastructure developments, economic implications, and strategic significance, it seeks to provide valuable insights into the transformation impact of the BRI on this critical region. The study employs a mixed-method approach, using both primary and secondary data sources, including surveys, interviews, and statistical data (Goswami et al., 2020). Although the significance of air travel in the BRI transportation network has been acknowledged, little is known about the network structure of the air transportation system and how it integrates with other modes of transportation (Lakshmanan, 2011). This paper uses combat data to build the structure of the ATN in the BRI region in order to close the gap.

Environmental sustainability and economic viability are highly interdependent in Central Asian nations (Dorian et al., 1999). For instance, Kazakhstan's efforts to transition from a resource-based economy to a more diversified service-based economy significantly affect sustainable development in the nation (Ascensão et al., 2018). There is a great deal of optimism that transport infrastructure will serve as the primary driver for this shift to sustainable economic growth. The Chinese government has been encouraging Chinese enterprises to invest in foreign countries. An improved infrastructure in BRI countries will greatly boost trade development in the region.

## 2. Literature Review

An overview of recent papers on the transport system covered by the BRI is provided in this section. Authors have utilized a variety of methodologies, to analyse the infrastructure network that exists in the region. Yang et al. (2018) discusses the BRI and rail shipping service by implementing the Bi-level mixed integer programming model.

There are numerous studies that analyse multi-modal transport networks using ATNs. An indicator-based assessment framework has been created by Chhetri et al. (2018) to analyse the position of the major global logistics cities. The capacity of the four major transport pillars of these chosen cities—road, rail, port, and air transport—is measured using 20 country-level variables, including road density, rail network length, and connection of the port and airport. Only the most significant cities, including Shanghai, cities in Kazakhstan and Uzbekistan, are included in this analysis. In order to visualize the transportation accessibility of the BRI region using grid cells (Lobyrev et al., 2018). Shi et al. (2019) suggested a global accessibility index. The density of the roads, railroads, and waterways is calculated and then combined to produce the impact.

The average of the transportation convenience and density indices is known as the global accessibility index (Liu, 2018). Grid-based or area-based assessment approaches have been utilized by both Chhetri et al. (2018) and Shi et al. (2019), but little has been known about the connectivity linkages in transportation networks. Derudder et al.'s (2018) study of the six BRI routes' cities' centrality. Rail, road, aviation, and information technology networks are combined to create a multi-modal transportation network. To rank the cities from diverse perspectives, three centrality metrics are used: degree centrality, betweenness centrality, and closeness centrality. The size of the two nodes and their distance from one another in Euclidean space determine the degree of connection between them in each layer (Lu et al., 2018). In short, the actual connectivity relationship between the nodes in the transport network is ignored.

Governments in Central Asia are constantly working to reconstruct the Silk Road's transport network, either by creating new routes like the Western Europe-Western China (WE-WC) project or by collaborating with Chinese BRI-related projects. The activities of the Central Asian governments, however, are being taken in the absence of data regarding the actual influence of the attracted investment in the development of transport infrastructure on regional growth in the Central Asian setting (Öberg et al., 2017).

The purpose of this article is to bridge this gap and evaluate the effects of the WE-WC project, which is supported by outside sources, on the growth of Kazakhstan's connecting regions and cities. The study's findings demonstrated that agricultural districts adjacent to major cities in neighbouring China and Kyrgyzstan benefited more from the WE-WC corridor than mining regions in neighbouring Russia and Uzbekistan (Ma et al., 2019).

The poor quality of the road and the dearth of regional assistance, however, raise concerns about the economic viability of the WE-WC linking regions. The investment in road construction or rehabilitation should be complemented by additional funding on a regional level to ensure a high standard of road maintenance (Teo et al., 2019) and adequate development of the road safety equipment if Central Asian governments want to reap long-term benefits from Silk Road projects. In order for them to gain from the utilization of the WE-WC corridor, it is critical to include regional governments and important economic participants in the conversation (White, 2013).

## 3. Method and Methodology

Because they enable inter-regional human and products movement, well-developed transport corridors are acknowledged as one of the essential criteria for the sustainable development of trade and economic diversification. It should come as no surprise that throughout time, transport corridors evolved into a tool for policymakers to promote regional development, particularly in so-called developing nations and those in transition. The idea that transportation corridors might spur regional development by luring foreign investment and facilitating the better transportation of goods from producing districts to local and global markets is extensively promoted by international development banks and humanitarian organizations (Keser, 2015).

Investors like China support the development of transport infrastructure in Central Asian nations like Kazakhstan, motivated not only by a desire to reach Europe but also by the possibility of utilizing these nations' abundant energy supplies to support their expanding economies. The countries receiving funding for the development of transport infrastructure, however, may only reap economic rewards provided the conditions are favourable for the development of the transport corridor, as demonstrated by real-world examples. More specifically, the transport corridor ought to transform from a physical infrastructure into an economic one with multi-modal transport connections and logistical services.

When creating impact pathways and associated assumptions, there are four primary stages of corridor development to take into account. The influence can only be evaluated in relation to the "transport infrastructure" at the first stage of corridor construction (see **Figure 1**).

The goals of the ATN are for the western route of the corridor to raise the standard of transport links, boost traffic safety, and save maintenance costs. As a result, the study begins by analyzing how the transport link has changed while putting a special emphasis on the quality and safety of the roads. Improved mobility along the WE-WC transport corridor was thought to boost the amount of cargo moved through the nation and have a favourable impact on the export potential of the regions that connect it. The analysis of the shift in cargo turnover and export sustainability structure thus follows the evaluation of many conditions such as airport connectivity. Last but not least, the evaluation of the region's capacity to generate non-commodity goods with high export value adds to the examination of trade structure.

### 3.1. Data Collection and Analysis

The State Committee on Statistics of the Ministry of National Economy, regional statistics obtained from the State Revenue Committee of the Ministry of Finance of the Republic of Kazakhstan and trade data obtained from the World Bank are among the data sources.

The research team encountered numerous challenges when gathering data on the various areas of Kazakhstan. Finding regional transport statistics that could be compared from several historical eras that were statistically created using the same methods proved difficult. The authors were unable to employ the initially planned variables and could not find all possible planned empirical correlations due to a lack of trustworthy data. Because of this, authors only used a few indications.

Only historically stable indicators (developed using the same methods) that allowed for tracking progress or comparing changes between the WE-WC project's and Kazakhstan and Uzbekistan. The results of a field study by the Transport and Communications Research Institute (NIITK), data on traffic safety from the Centre for Strategic and International Studies (CSIS), and information on the economic

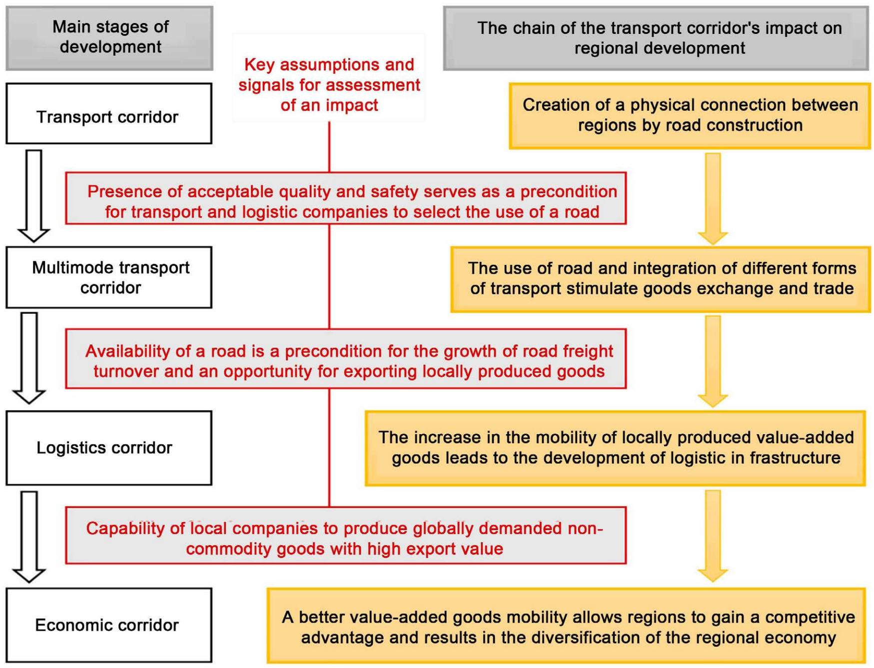


**Figure 1.** Transport corridor development and impact.

complexity of regions in Kazakhstan from a study by White shield Partners were also used by the authors in addition to the regional statistics that are gathered annually.

The data set was gathered from the OAG database, which offers details on all international flights (https://analytics.oag.com/analyser-client/home). The flights in the entire week of May 21-May 27, 2023 are used to construct the BRI network. There were 209,811 flights that week that were run by the airlines on 7380 connections between 1193 airports in the nations of concern. There are about 14.28 flights per week on these links.

## 3.2. Air Transport Hub

Let $A=\{A_1, A_2, A_3, \cdots, A_i, \cdots, A_n\}$ denote the set of airports. The centrality of an airport $A_i$ denoted by $C_{Ai}$ is the contribution to the connectivity of its network. The Hub of the airport is estimated by two ways: global center and local center. The local hub (Airport) is the quantification of the degree of the node. It represents direct flights, i.e. connections to the airport. It is equal to the number of airports directly connected to this airport. An airport with a larger node degree has more airports directly connected to it by flights and therefore contributes more to the local connectivity of the overall network. The global centrality (GC) of an airport is given by its betweenness, given as:

$$C_{G_{Ai}} = \sum_{A_i \neq A_j \neq A_k \in A} \frac{\sigma_{A_j A_k}^{A_i}}{\sigma_{A_j A_k}}$$

where: $A_j$ and $A_k$ are set of airports (air transport Network). $\sigma_{A_j A_k}$ is the shortest path. $\sigma_{A_j A_k}^{A_i}$ is the path of traversing to the airport. The airports having a larger degree of betweenness act as a bridge for more airports hence contributing towards the global connectivity of the network.

## 4. Results

### 4.1. Logistic Performance Index (LPI)

A global survey of international freight forwarders and express carriers was used to create the LPI, which is a composite index based on proxy measures for supply chain management (SCM), information and transport infrastructure, and trade facilitation skills. The LPI is based on six fundamental aspects of logistics performance: 1) effectiveness of customs and other border agencies in clearing shipments; 2) quality of transportation and IT infrastructure for logistics; 3) ease and affordability of setting up international shipments; 4) competence and quality of logistics services; 5) capability to track and trace international shipments; 6) timeliness of shipments in reaching a destination.

LPI values, which range from 1 (worst) to 5 (best), demonstrate the importance of fostering relationships between businesses, suppliers and consumers in an environment where predictability and dependability are increasingly valued alongside costs when making sourcing selections. A rating below 3.0 typically indicates a number of issues with a country's goods distribution system, leading to unwarranted delays and extra expenses. For example, a one-point differential in the LPI is associated with two to four extra days of port hinterland access and a 25% higher physical inspection rate at customs. See **Figure 2** below.

Better transport iBetter transport is required because of the country's extensive domestic geographical distance. Due to its lack of access to seaports and land borders, the effectiveness of its internal transportation system as well as that of its neighbors is necessary for efficient cross-border transportation. Prior to the BRI, the cross-border corridor programs CAREC and SPECA, assisted in boosting and coordinating countries' investments in the region along respective corridors. There are large gaps in the region's cross-border transport infrastructure's quality and coverage due to the high cost of transport investments and the resource shortages in many of the neighbouring nations. Compared to the majority of CAC nations, Kazakhstan has a better transport infrastructure.

Logistic Performance

Logistic performance Index (LPI), however, falls short of the region's average for nations in Europe and Central Asia. Additionally, outside of metropolitan areas, road connectivity is comparable to that of other Central Asian nations. This is important since Central Asia has very poor rural accessibility, which limits the capacity of the hinterlands to reach markets. **Figure 3** and **Figure 4** show the LPI of different nations in the region.

### 4.2. Average Trade Time

The completion of BRI transport projects is estimated to lower Kazakhstan's average shipment time by between 4.4 and 8.3 percent.

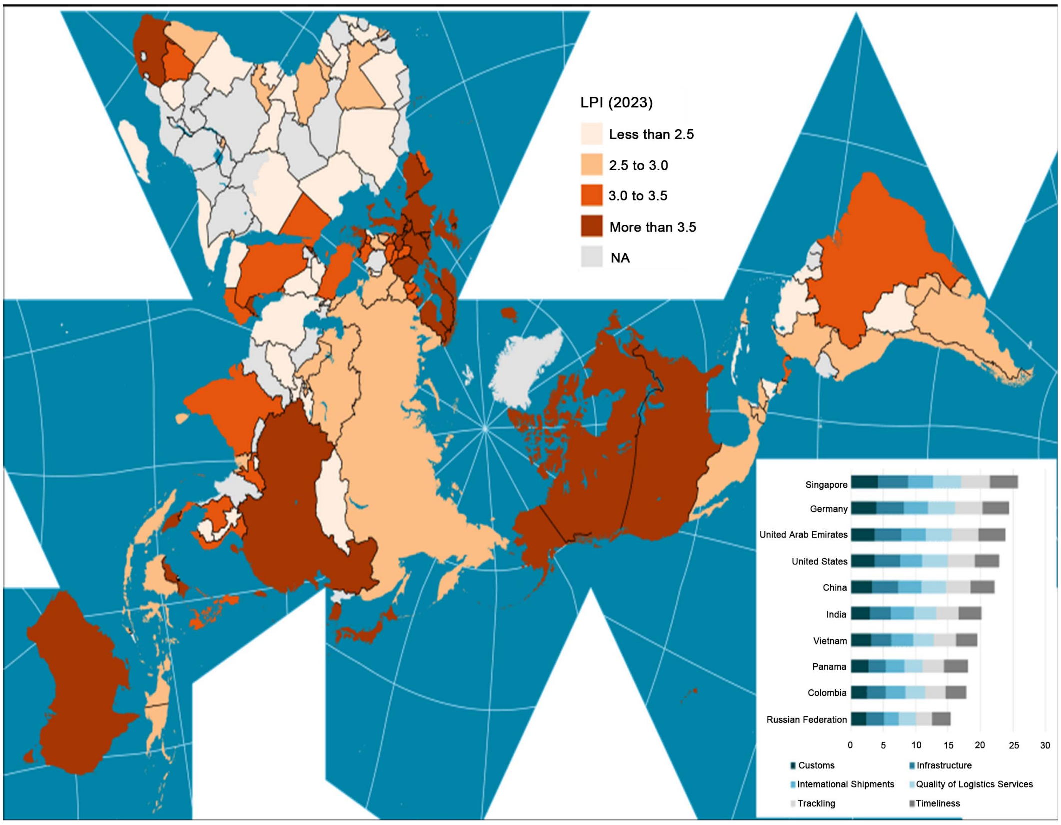


**Figure 2.** LPI of different world economies (Source: World bank).

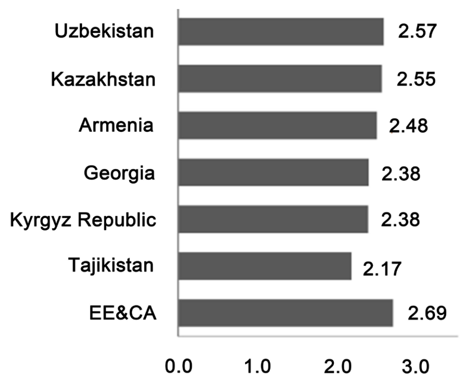


**Figure 3.** LPI of Europe and Central Asia nations (Source: World Bank).

Currently, trade between Kazakhstan and BRI partners takes an average of 15.4 days (12 days in the case of trade with China). Shipping time for trades with BRI partners would be more than a day quicker under the upper bound scenario (Table 1).

This is one of the largest percentage-wise decrease in shipment time among BRI countries especially through ATN mainly due to the projects and strategic position of these countries in the cross-border network of the CAC region. Kyrgyzstan and Uzbekistan are predicted to have had a greater drop in average shipment time. More significantly, if trade facilitation and logistics reforms that

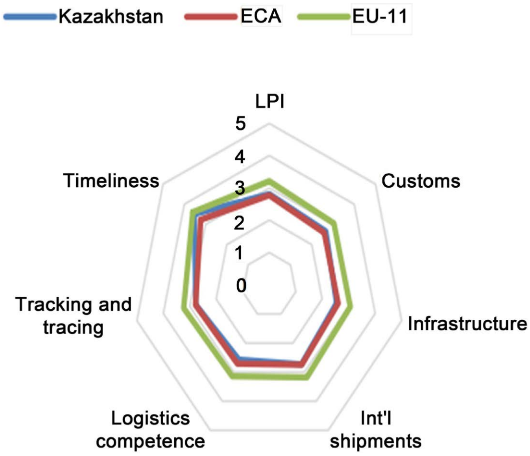


**Figure 4.** LPI comparison between Kazakhstan, ECA and EU-11 (Source: World Bank).

**Table 1.** Effect on average trade time.

| | AVERAGE TIME TO TRADE TO | | | REDUCTION IN TIME TO TRADE TO | |
|---|---|---|---|---|---|
| | BRI | BRI + RAIL | BRI + ATN | LOWER BOUND | UPPER BOUND |
| KAZ | 15.4 | 13.2 | 8.0 | 4.1 | 8.1 |
| KGZ | 18.0 | 13.0 | 9.2 | 7.9 | 12.3 |
| UZB | 18.7 | 12.2 | 7.6 | 2.9 | 3.5 |

reduce border crossing delays are implemented simultaneously with the completion of BRI transport projects, the percentage reduction in Kazakh air transport time could be more than 2.5 times the upper-bound estimate shown.

As a result, decreasing shipping times through either increased transportation infrastructure or improved border crossing efficiency also reduces trade costs. However, because some commodities are more time-sensitive than others and because the composition of trade in relation to such goods may differ significantly across the two countries, the same decrease in shipment time in two countries can result in varying magnitudes of loss in trade costs. Kazakhstan's export-weighted trade cost is projected to decrease by 2.5 percent as a result of a decrease in shipment time of 8.3 percent (upper bound scenario above) brought on by BRI transport projects (Roberts et al., 2018). The airports having a larger degree of betweenness act as a bridge for more airports hence contributing towards the global connectivity of the network.

## 5. Conclusion

This study covers a knowledge gap on the influence of the Silk Road transport corridors on local development in Kazakhstan and Uzbekistan. Some of the main research points covered include: the evolving air transport landscape, infrastructure development, economic implications and strategic significance. In order to evaluate the impact of the transport corridor, the authors suggested a novel analytical framework that took into account the corridor's transformation from one for transportation to one for commercial. The integrated approach served as the foundation for the suggested methodological framework. Additionally, by offering development suggestions that are highly advantageous to both carriers and governments (Wang, 2018), this paper also contributes to the practical utilization of the BRI's proposed new trading hubs (such as cities along the China-Europe rail route) and the concurrent development of the Air Silk Road.

To assess the influence of investment on the sustainability of mobility and sustainable regional development, the authors suggest taking into account the current interdependence between commerce, economic development, and the environment. In order to gain conceptual clarity, the authors see sustainable mobility as a catalyst for a sustainable economy. The sustainable transport corridor aims to increase the effectiveness of trade flow and serves as a significant stimulus for the development of new logistical networks. Sustainable transport results in sustainable trade, which motivates local companies to look into global markets and increases the degree of competitiveness of locally produced goods.

Based on the results of the study, we were able to divide the WE-WC transport corridor into two major sections: 1) the road section connecting China and Kyrgyzstan via Kazakhstan, passing through Almaty city, the Almaty region, and the Jambyl region (the China-Kyrgyzstan section); and 2) the road section connecting Russia and Uzbekistan via Kazakhstan. The WE-WC Russia-Uzbekistan portion continues to function as a transportation infrastructure component and primarily as a transit route. The multi-model transport corridor to the logistics corridor transition has begun in the WE-WC China-Kyrgyzstan Sustainability segment through air transport network. Hence, the air transportation reduces the trade time with the countries specially linking with BRI regions. Based on the results of the study, we were able to divide the WE-WC transport corridor into two major sections: 1) the road section connecting China and Kyrgyzstan via Kazakhstan, passing through Almaty city, the Almaty region, and the Jambyl region (the China-Kyrgyzstan section); and 2) the road section connecting Russia and Uzbekistan via Kazakhstan. The WE-WC Russia-Uzbekistan portion continues to function as a transportation infrastructure component and primarily as a transit route. The multi-model transport corridor to the logistics corridor transition has begun in the WE-WC China-Kyrgyzstan Sustainability segment through air transport network. Hence, the air transportation reduces the trade time with the countries specially linking with BRI regions. A few challenges faced in this paper are related to data collection. There is very little data and literature about the Belt and Road Initiative especially when it comes to air transport network. Further research will ensure more data in years to come.

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## Conflicts of Interest

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

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