

Investigation and Identification of Variables of Cost and Time Affecting International Freight Transportation in the International North-South Transit Corridor (INSTC)

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Abstract

The International North-South Transit Corridor (INSTC) is of prime importance because the economic desirability of international cargo transportation through this corridor can be theoretically much higher than rival routes. Many studies have focused on estimating the cost of transit via the INSTC. Although most of them have sought to collect field information from the status quo of the transportation of the transited cargo, the findings cannot be broken down to each of the rings of the logistics chain. Determining the share of each part of the chain in the total transit cost can help us identify, compare, and remove extra charges and optimize the cost in the entire chain. This paper aimed to analyze the cost breakdown for transported goods from India (Kandla Port) to Kazakhstan (Aktau Port) as a case study route based on the detailed tariffs and rates associated with each logistics activity in each ring of the chain. The findings revealed the high portion of the cost of the maritime sector (49 percent), followed by the land transportation sector (29 percent). Cutting costs in the mentioned sectors is a priority of trade facilitation strategies compared with other parts such as the port sector (22 percent) and custom sector. The results of this research applied to depict a holistic and integrated cost breakdown picture in the INSTC. This study demonstrates how the cost breakdown structure can help managers identify the practical solutions to reduce the transit cost and time.

Keywords: International transit, International North-South Transit Corridor, International trade, Transportation cost, Transportation time

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1. Introduction

Transportation is one of the primary needs of the community of human beings, which has been highly expanded with socio-economic development. Many economists believe that there is a direct relationship between economic development and expansion of the transportation infrastructure [e.g., Litman, 2017, Palei, 2015, Rodrigue, 2020, Tsiotas and Polyzos, 2018]. Economically speaking, transportation is so important that certain groups consider it as the body of economic development while other groups take it as the backbone. Moreover, the efficient transportation infrastructure serves as a major part of the logistics chain while standing as an influential factor in increasing the competitiveness level of countries in the competitive market of the international trade, trade facilitation, and ease of doing business [Palei, 2015].

The developed and efficient hardware and software infrastructure, with the specification of imposing lower cost and time on the procedure of goods exchanges, will raise the desirability of international freight transportation routes, consequently decreasing the final consumer price of commercial goods. In other words, the generalized cost of transportation from the trade origins to destinations is one of the most important components that determines the desirability of international transport corridors. These costs are generally related to maritime transport charges, inland transport charges, port charges (as the link point of maritime and land transportation), warehousing charges, custom declaration charges, the value-added tax (VAT), and the commercial profit (of the imported goods) and other charges. Based on the United Nations Conference on Trade and Development's 2016 estimates, the international transportation and insurance costs, on average, constitute 15% of the cost insurance freight (CIF) value of imported goods. This value is about 19 and 21% for landlocked and less developed countries,

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respectively [Hoffmann and Sirimanne, 2017]. Therefore, international transportation costs are an important factor in determining the final consumer price and influencing cargo owners' decision-making in selecting the corridor and routes.

On the other hand, Iran has a highly geostrategic position, is located between several international transit corridors, and has a high potential to earn incomes from the international freight transit sector. The mentioned corridors include International North-South Transit Corridor (INSTC), the Persian Gulf-Black Sea corridor (PBTC), the Transport Corridor Europe-Caucasus-Asia (TRACECA), the Central Asia Regional Economic Cooperation corridor (CAREC), the Asian Highway (AH), and the Kyrgyzstan-Tajikistan-Afghanistan-Iran (KTAI) corridor. In addition, the Uzbekistan-Turkmenistan-Iran-Oman (Ashgabat agreement) corridor, the India-Iran-Afghanistan (Chabahar agreement) corridor, and the New Silk Road (One belt -One road) corridor are other international transit corridors. Thus, determining the share and role of each of the parts of the international transportation chain of goods passing through Iran in the total cost and time of international transit usefully help in identifying and removing extra charges and optimizing the transit time (as two main parameters in the cross-border trade indices). The present article reviews the existing potentials for international cargo transit through the INSTC. Further, it focuses on analyzing the cost breakdown for transported goods in the whole chain of international transit from India (Kandla Port), which is an important country in the origin of the north-south corridor to Kazakhstan (Aktau Port), as one of the main gateways to the northern European states and the Commonwealth of Independent States (CIS).

2. The Importance of the INSTC

Ministers of transportation from the Islamic Republic of Iran, Russia, and India signed an

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intergovernmental agreement (the INSTC agreement) in Saint Petersburg on September 12, 2000. For the time being, 13 countries are the state members of the INSTC, including Iran, Russia, India, Armenia, Oman, Belorussia, Kazakhstan, Azerbaijan, Russia, Tajikistan, Ukraine, Turkey, and Kyrgyzstan. The INSTC was established to expand transportation relations and harmonize the transportation policies of the committed states, guarantee travel security and the safety of consignments, and increase access to the global markets to Within the list of ports operating in the corridor, Shahid Rajaei and Chabahar Ports in the south and Amirabad and Anzali Ports in the north of Iran enjoy a high potential for linking the Indian subcontinent to Central Asia, Russia, and Europe. In addition, they provide a favorable opportunity for easy and cost-effective access of the member states to foreign markets. Approximately two million tons of goods are annually transited between the border origins and destinations in the INSTC. Nearly 40 and 60% of the portion are transported through the railway and on the road, respectively. Furthermore, as many as 200,000 tons/year goods are transited between the southern and northern ports, and about 10% of the total volume of transit belongs to the INSTC routes. According to [Karavayev and Thishehyar, 2019], the long-term capacity of the INSTC is estimated to be 15-20 million tons per year.

Regarding the importance of India as the origin or destination of international freight transit from the INSTC, this paper first delves into investigating the volume and value of trade between the Indian sub-continent and other countries, especially countries in the influence area of the INSTC, and the potential of

decrease the dependency to trade and transit from the South Asian states to the Suez Canal. Additionally, it aims to increase the volume of cargo exchanges among the South Asian states and the Indian subcontinent, Central Asia and Europe with India, Russia, and Iran on the axis. The INSTC has a considerable potential for helping India boost its economic interest by connecting this subcontinent to Russia, North Europe, and Central Asia through Iran [Ghiasi, 2019].

international freight transit via the corridor. As one of the newly emerging global powers, India reserves a considerable share in international trades so that the value of India's international trade equaled \$602 billion in 2016. Imports (\$345 billion) and exports (\$257 billion) constituted 57 and 43% of the trade value. The trade's highest value of India (over 69 billion dollars) was related to China. The overall value of India's trade with Central Asia was around 700 million dollars [Simoes, 2016]. With respect to the high potential markets and forecasted fast economic growth rate of CIS countries in the future, especially after they successfully overcame three economic crises in 2008, the oil crisis in 2016, and Ruble crisis in 1998, part of the future trade can be drawn to the INSTC. On the other hand, regarding the high volume of trade between the Indian sub-continent and Europe, which is over 80 billion dollars a year [Rossow, 2021], the INSTC needs to prioritize attention and focus on the absorption of the transited goods between these two regions. Figures 1 and 2 and Table 1 show the value of trade and the absorption potential of transit goods from/to India to/from countries located in the influence area of the INSTC.

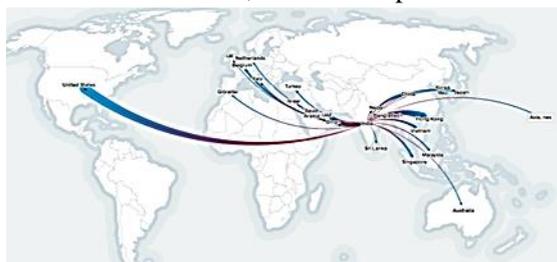


Figure 1. Main Destinations of India's Exports in Trade Value (Left) and Volume (Right) (2016)



Figure 2. Main Origins of India's Imports in Trade Value (Left) and Volume (Right) (2016)

Table 1. Trade Value and Potential of Absorbing International Transits from/to India to/from Countries Located in the Influence Area of the INSTC

Country	Value (in Million \$)	Country	Value (in Million \$)
Exports		Imports	
Switzerland	19430	The UK	9,787
Iraq	18519	The Netherlands	7992
Germany	12772	Germany	7504
Belgium	10753	Italy	5268
Iran	10332	France	5119
The UK	6046	Iran	4921
Italy	4159	Turkey	4432
Russia	3899	Spain	2884
France	3564	Russia	2147
The Netherlands	3140	Switzerland	1818
Spain	1844	Poland	992
Ukraine	1830	Iraq	917
Sweden	1680	Denmark	762
Azerbaijan	1137	Sweden	732
Finland	1056	Portugal	627
Australia	829	Ukraine	481
Turkey	761	Afghanistan	474
Norway	747	Finland	415
Kazakhstan	656	Ireland	414
Poland	624	The Czech Republic	388
Ireland	603	Hungry	345
The Czech Republic	519	Australia	342
Denmark	445	Greece	335
Pakistan	427	Lebanon	293
Romania	376	Romania	286
Portugal	340	Kazakhstan	258
Hungary	220	Syria	235
Afghanistan	209	Norway	229
Belorussia	158	Slovenia	212
Slovenia	118		
Estonia	115		
Greece	109		
	107418		60,613

Source. FFFAI: The Federation of Freight Forwarders' Association of India [2014].

3. Literature Review

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So far, a large body of research has attempted to estimate the cost and time of international transit as two factors of the desirability of international transit corridors [e.g., Abutalebpur, 2002, Achmadi et al., 2017, COMCEC, 2017, FFFAI, 2014, Kazani, 2015, Mohsenpour, 2004, Rogers, 2015]. Some studies have focused on estimating the mentioned factors in the existing routes in the INSTC. Nonetheless, they are mainly based on collecting the field information from the status quo of the transportation of the transited cargo through the INSTC. Accordingly, the obtained results cannot be compared and contrasted due to various reasons including different applied methods, the calculation details, different assumptions on the origin and destination of the corridor, the transit route, the mode and procedure of transportation, the type, number, packaging, and dimensions of the transited cargoes. However, reviewing previous findings facilitates evaluating the role of each of the rings of the transportation chain in the INSTC. According to [Rogers, 2015], the INSTC has been estimated to save \$2,500 per 15 tons of goods compared to the conventional corridor. In a study by the [Federation of Freight Forwarders Association, 2014] in India, implementing a pilot transit of two 20-foot containers in two selected routes in the INSTC, a comparison was made between the mentioned routes and the traditional sea corridor in terms of the transit cost and time. It is worth mentioning that the mentioned studies take charge of maritime container transportation through two tentative routes from India's Nhava Sheva Port to Bandar Abbas Port of Iran, standing at \$1588 and \$1800, respectively, which was extremely higher than the maritime transportation charge from Nhava Sheva to Hamburg Port. This might be because of the absence of any regular shipping liners between Indian ports and southern Iranian ports when implementing the pilot study. The mentioned study has been completed by the Committee for the Economic and Commercial Cooperation of the Organization of the Islamic Cooperation

(COMCEC), estimating the cost and time of the international transit of a 20-foot container via the routes cross the INSTC via the origin point of Nhava Sheva in India to the destination point of Moscow in Russia and the traditional sea corridor via Hamburg Port [Achmadi et al., 2017]. The findings of this study revealed that the routes passing through Iran in the INSTC could compete with the traditional sea route in terms of cost, especially the transit time. Similarly, [Abutalebpur, 2002] provided methods for increasing the productivity of the international transit of goods in the INSTC and the desirability of the transit in different parts of the India (Mumbai Port) –Bandar Abbas – Bandar Amirabad/Anzali –Russia (Astrakhan Port)- Finland (Helsinki Port) route. In the mentioned study, it was attempted to estimate the cost of transporting each 20-foot container, putting it at \$2464 while estimating the international transit time to stand at about 14 days. Meanwhile, the study determined the cost and time of the international transit of goods through the traditional maritime corridor via the Suez Canal at \$3,000 and 30 days, respectively. Furthermore, [Mohsenpour, 2004] compared three routes, which connect Singapore, Hamburg, and Helsinki via the INSTC, and the sea corridor (The Suez Canal). The scholar estimated direct and indirect costs, including the time cost and the risk cost for the transportation of a 20-foot container. In this study, the time of international transit from the INSTC was estimated many times less compared to the traditional maritime route. This is especially true when comparing the travel cost from Singapore to Hamburg port via the corridor, which is about half the expected figure. However, Measurement of the transit cost indicates a considerable increase in the passage of the transit cargo in the route compared to that via the sea route. In a report to the INSTC conference held in India in 2015, [Kazani, 2015] reported the cost and time for a 20-foot container transit from Mumbai Port to Moscow through Bandar Abbas Port-Amirabad Port-Astrakhan Port at 1250 dollars for 19 days.

The estimation of multimodal transportation from Mumbai Port to Amirabad Port stands at 500 dollars. The combined cost of transportation from Amirabad Port to Moscow was also estimated to be 600 dollars. Furthermore, 150 dollars was set to be the cost for transporting cargo within India.

In 2017, Iran Road Maintenance and Transportation Organization [RMTO, 2017] compared the cost and time of international transit by a 40-foot container from Mumbai to Vorskino, a city near Moscow, on three routes crossing Iran in the INSTC to the Mumbai-Moscow sea route.

Table 2. Summary of the Results of Reviewed Studies

Route	Distance (KM)	Time (Day)	Expense (\$)
Federation of Freight Forwarders Association			
India (Nhava Sheva Port)-Bandar Abbas Port-Astara-Azerbaijan (Baku)	3458	28	3123
India (Nhava Sheva Port)-Bandar Abbas Port-Amirabad Port-Russia (Astrakhan)	3765	41	5242
India (Nhava Sheva Port)-Germany (Hamburg Port)-Russia (Saint Petersburg)	8675	30	955 to 1400
COMCEC			
India (Nhava Sheva Port)-Bandar Abbas Port-Astara-Azerbaijan (Baku)-Russia (Moscow)	-	32	3882
India (Nhava Sheva Port)-Bandar Abbas Port-Amirabad Port-Russia (Astrakhanskiy Port)-Russia (Moscow)	-	44	5765
India (Nhava Sheva Port)-Bandar Abbas Port-Russia (Moscow) through Railway	-	26	3550
India (Nhava Sheva Port)-Germany (Hamburg Port)-Russia (Moscow)	-	32	3133
Abutalebpur			
India (Mumbai Port)-Bandar Abbas Port-Amirabad Port/Anzali Port-Russia (Astrakhanskiy Port)-Finland (Helsinki)	7372	14	2464
India (Mumbai Port)-Suez Canal-Finland (Helsinki)	-	30	3000
Mohsenpour			
Singapore-Bandar Abbas Port-Amirabad Port-Russia (Astrakhanskiy Port)-Germany (Hamburg)	7889	15.7	5697
Singapore-Bandar Abbas Port-Jolfa-Germany (Hamburg)	12469	15.8	4127
Singapore-Suez Canal-Germany (Hamburg)	13600	29.2	2194
Singapore-Bandar Abbas Port-Amirabad Port-Russia (Astrakhanskiy Port)-Finland (Helsinki)	12237	26.5	5413
Singapore-Bandar Abbas Port-Jolfa-Finland (Helsinki)	12469	26.5	4818
Singapore-Suez Canal-Finland (Helsinki)	13600	27	2087
Kazani			
India (Mumbai Port)-Bandar Abbas Port-Amirabad Port-Russia (Astrakhanskiy Port)-Russia (Moscow)	6740	19	1250
RMTO			
Singapore-Bandar Abbas Port-Amirabad Port-Russia (Astrakhanskiy Port)-Germany (Hamburg)	7889	15.7	5697
Singapore-Bandar Abbas Port-Jolfa-Germany (Hamburg)	12469	15.8	4127
Singapore-Suez Canal-Germany (Hamburg)	13600	29.2	2194
Singapore-Bandar Abbas Port-Amirabad Port-Russia (Astrakhanskiy Port)-Finland (Helsinki)	12237	26.5	5413
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Route	Distance (KM)	Time (Day)	Expense (\$)
Note. RMTO: Iran Road Maintenance and Transportation Organization; COMCEC: Committee for Economic and Commercial Cooperation of the Organization of the Islamic Cooperation			

As mentioned earlier, these studies have mainly focused on collecting field information from the status quo of the transportation of the transited cargo. Accordingly, the obtained data cannot be broken down to each of the parts of the transportation and logistics chain, which can be highly useful in identifying, comparing, and removing extra charges and optimizing the cost and time of transportation in the whole logistics chain. As a new innovative approach, this paper analyzes the cost breakdown for transported goods in the whole chain of international transit from India to Kazakhstan as a case study route based on detailed tariffs associated with each activity in each ring of logistics and transportation chain using various sources (e.g., port and marine service tariffs notebooks, and the like). Data related to the cost breakdown structure are presented in Annex 1.

4. Analysis of the Charges of International Freight Transit via India-Iran-Kazakhstan Route

This part of the research investigates the charges of international freight transit in the whole chain of multimodal transportation from India to Kazakhstan through Shahid Rajaei and Amirabad Ports. For this purpose, the detailed charges of transporting container goods from the origin of the Indian port of Kandla to Aktau, Kazakhstan were carefully examined, followed by presenting the method of calculation. In this report, the charges of the multimodal transport of goods from origin to destination are divided into maritime transportation, land (road) transportation, port charges (The midpoint of the maritime and land transportation), and the customs sector. The proportionate charges of each section are provided in Figure 4.

4.1. Maritime Service Sector

The prepared invoice by a shipping line for the sake of the sea transportation of cargo initially

depends on the type of contract that the shipping line signs with the rental company or the cargo owner. The contract can even consist of part of the port charges in the origin and the destination. In general, the sea transportation contracts are of four types as follows:

- **Liner In/Free Out Contract:** The responsibility for loading is with the shipping line, but the good owner is responsible for the unloading.
- **Liner In/Liner Out Contract:** The shipping company endures the loading and unloading charges.
- **Free In/Liner Out Contract:** The renter or cargo owner assumes the responsibility for paying the charges for loading while the shipping line is in charge of unloading.
- **Free In and Out (FIO) Contract:** The renter or cargo owner is responsible for both the loading and unloading charges.

This section estimates the marine service charges concerning the fourth type of contract (FIO), which recognizes that the renter or cargo owner is responsible for paying for loading and unloading charges. It also considers the charges for loading in the origin and unloading in the destination in the port sector charges.

4.1.1. Freight Rate

These charges comprise the fare of maritime transportation and marine services offered on the sea by the shipping line company. They depend on various factors such as the distance of transportation, volume and type of cargo, type of packaging (less than container load and full container load), the path of transportation, type of the shipping contract, presence and/or absence of regular shipping liners, and the like. The freight rate typically consists of two sections: the basic ocean freight and adjusting factors such as surcharge, the most important of which are adjustment of the bunker adjustment factor and currency adjustment factor.

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It is noteworthy that in the case of using a domestic fleet, the owner of the Iranian goods will be exempted from paying 10% duties on the freight rate of the goods shipped by a foreign fleet. On the other hand, the owner of Iranian goods will be asked to pay the duties in case he uses the foreign fleet.

4.1.2. Marine Services

The charges are related to marine services offered to the cargo owner by the port and shipping company. The charges include those on the ship in the port, including the port duty (e.g., the port entrance duty, harbor entry duty,

and loading/unloading on quay duty), port duties (lighterage duties), port charges (e.g., towage charge, pilotage charge, dredging charge, wharfage charge, arrival clearance charge, and garbage clearance charge), and the quarantine charge. As mentioned earlier, the shipping companies levy the charges on the shipping invoice and have the cargo owner pay it. Tables 5 and 6 present charges on a container ship in the ports of Shahid Rajaei and Amirabad per mentioned tariff in the notebook of the port and marine service tariffs.

Table 5. The Charges of Marine Services for a Container Ship in Shahid Rajaei Port

The Receiving Institution	Unit	Amount (\$)	Charge	
Shahid Rajaei Port	Ship	4790	Pilotage charge	
Shahid Rajaei Port	Ship	4975	Dredging charges	
Shahid Rajaei Port	Ship	9585	Towage charge	
Shahid Rajaei Port	Ship	804	Wharfage charge	
Shahid Rajaei Port	Ship	1500	Arrival clearance charge	
Shahid Rajaei Port	Ship	480	Port entrance duty	Port dues
Shahid Rajaei Port	Ship	480	Harbor entry duty	
Shahid Rajaei Port	Ship	2552	Loading/unloading on quay duties	Marine service charges
Shahid Rajaei Port	Ship	1915	Lighthouse charge	
Shahid Rajaei Port	Ship	100	Garbage clearance charge	

Assumptions:

- The gross capacity of ships entering port is assumed to be 50001 tons.
- The tonnage of unloaded and loaded goods is 80,000 tons for each entrance and departure of the ship.
- The container ship stops next to the berth for 24 hours.
- The average ship capacity is assumed to be 12,000 TEU.
- Nationality of the vessel is taken to be Iranian.

Table 6. The Charges of Marine Services for a Container Ship in Amirabad Port

The Receiving Institution	Unit	Amount (\$)	Charges	
Amirabad Port	Ship	1500	Pilotage charge	
Amirabad Port	Ship	3000	Dredging charge	
Amirabad Port	Ship	670	Towage charge	
Amirabad Port	Ship	36	Wharfage charge	
Amirabad Port	Ship	9	Arrival clearance charge	
Amirabad Port	Ship	180	Port entrance duties	Port dues
Amirabad Port	Ship	300	Harbor entry duties	
Amirabad Port	Ship	750	Loading and unloading dues	Marine service charges
Amirabad Port	Ship	90	Lighthouse dues	
Amirabad Port	Ship	20	Garbage collection charge	
Iran Ministry of Health and Medical Education	Ship	41.8	Quarantine charge	

Assumptions:

- The gross capacity of ships entering is assumed to be 3001 tons.
- The tonnage of unloaded and loaded goods is 5,000 tons for each entrance and departure of the ship.
- The container ship stops next to the berth for 24 hours.
- The capacity of the ship is assumed to be 750 TE on average.
- Nationality of the vessel is taken to be Iranian.

4.1.3. Local Charges

Generally, these charges are for the issuance of related documents. They are mentioned in the invoice of the shipping company, and the shipping line asks the cargo owner to pay them prior to the issuance of the delivery order (D/O). The charges include D/O issuing charges, information uploading, temporary container entry license, issuance of the identity card of the container, and the container damage

insurance. The charges are mainly determined in Iranian ports per tariff announced by the Shipping Association of Iran (SAOI).

The charges of container damage insurance are received as a "guarantee of the obligations of container recipients to container owners". Further, the charges are received to stop the use of checks and cash as a guarantee in the relationship between container owners and container recipients.

Table 7. Local Charges for Issuing Shipping Documents in Kandla Port

The Receiving Institution	Unit	Amount (\$)	Charges
Shipping line or agent	B/L	52.58	Local charges

Assumptions:

- Each B/L is considered to consist of about 100 containers.

Note. B/L: Bill of Lading.

Table 8. Local Charges for Issuing Shipping Documents in Shahid Rajaei Port

The Receiving Institution	Unit	Amount (IRR)	Type of Charges
Shipping line or agent	B/L	1180000	Information uploading in the integrated system
Shipping line or agent	TEU	360000	Issuing temporary container entry license
Shipping line or agent	TEU	493000	Issuing container ID
Shipping line or agent	D/O	12500000	Issuing delivery order
Shipping line or agent	TEU	300000	Insurance of container damage insurance (With respect to VAT)

Assumptions:

- Each B/L is taken to consist of about 100 containers.

Note. VAT: Value-added tax.

Table 9. Local Charges for Issuing Shipping Documents in Amirabad Port

The Receiving Institution	Unit	Amount (IRR)	Charges
Shipping line or agent	B/L	10000000	Charges of issuing B/L and export documents
Shipping line or agent	B/L	1180000	Information uploading in the integrated system

Assumptions:

Each B/L is taken to consist of about 100 containers.

Table 10. Local Charges for Issuing Shipping Documents in the Port of Aktau

The Receiving Institution	Unit	Amount (Tenges)	Charges
Shipping line or agent	D/O	8450	Local charges

Assumptions:

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Each B/L is taken to consist of about 100 containers.

4.1.4. Demurrage/Detention

These charges, which are typically taken for granted in calculating the international transit cost and are the hidden part of international transit charges, are classified into ship demurrage and container detention charge.

The cargo owner will pay off the lay time charges to the shipping company. The charges are normally levied in calculating the ship demurrage when the loading and unloading limit exceeds the envisioned figure in the contract. It should be noted that the demurrage charge depends on the agreement between the ship owner and the renter or cargo owner rather than following a particular formula. The rate can typically be 90-110% of the daily rent of the ship. Moreover, it is usually double the dispatch rate paid to the renter or cargo owner if the loading and unloading operations precede the deadline. It is worth mentioning that the ship lay time is mainly due to a lack of coordination in exchanging documents between the consigner and consignee and partly because of a failure to prepare the proper portal infrastructure. Regarding the currently available statistics, the norm of the unloading and loading of the container in Shahid Rajaei and Amirabad Ports is at a favorable level. Thus, no demurrage is levied on the ship due to the insufficiency of the port infrastructure.

The charges of container detention (demurrage) are received based on the tariff announced by the SAOI. Additionally, they are received from the cargo owner in case of any delay in the delivery of the empty container to the shipping company after the free time. The base of starting the calculation of the charges of the import container detention is the final day of container unloading operations in ports, and that of the starting calculation of the export container detention will be the day of delivering the container from the shipping agent to the cargo owner.

The detention charges of each 20-foot container are calculation for 40 days concerning the time of the empty container's return to Shahid Rajaei

Port considering the 10-day exemption period. The results are presented in Table 11.

Table 11. Approximate Charges of Container Detention Received by Shipping Lines or Agents in Shahid Rajaei Port

Charges	Amount (\$)	Unit	Recipient Institution
Container demurrage	300	TEU	Shipping line or agent

Assumptions:

- The dwell time of the container in Shahid Rajaei Port is assumed to be 10 days.
- Dwell time of the container in Amirabad Port is assumed to be 10 days.
- The round-trip time by the sea on the Amirabad-Aktau Port route is assumed to be 10 days.
- The round-trip time in the road using the Bandar Abbas-Bandar Amirabad Port route is assumed to be 10 days.

4.2. Port Service Sector

The rate of tariffs on the port and marine services all over the country is classified with respect to the notebook of port and marine service tariffs issued by the Ports and Maritime Organization (PMO). The rates are tariffs on cargo (Port services) and ships (Marine services). Many factors are effective in deciding the tariff for each of the above-mentioned services, including the geographical location of ports (the northern, southern ports, and the like), and the type and weight of ships, type of cargos (full container, empty container, general cargos, oil substances, and the like). Other influential factors were the type of transportation (i.e., imports, exports, re-exports, transit, or transship), type of port (free zone, and special economic zone), the extent of delays, time of servicing (ordinary date, holiday, and the like), the loading and unloading norm, the nationality of the ship, the origin, and destination of travel, annual volume of operations, and the like. The charges on ships are divided into four types, namely, the port duties, port dues, port charges, and other charges. The charges on cargos are also divided into port charges (the drayage and stevedoring charges on general cargos and the terminal

handling charges (THC), container side services, and other container charges for container cargos) and common charges of the container and non-container cargos (the warehousing charges, duties, and other charges). As mentioned earlier, charges on ships are generally considered in calculating the marine freight rates and are received from the cargo owner within the framework of the shipping invoice/bill. Additionally, charges on cargo, depending on the contract type, may be separately put in the shipping bill and received

from the cargo owner prior to issuing the D/O and/or the cargo owner may directly pay it off to the port operator. Tables 12 and 13 provide the breakdown of charges related to cargos in the ports of Kandla and Shahid Rajaei, Amirabad, and Aktau. Costs related to Shahid Rajaei and Amirabad Ports have been determined in accordance with the tariffs announced by the PMO, as well as the application of discounts and incentives granted to these ports.

Table 12. Port Service Charges in Kandla (Origin) and Shahid Rajaei (Destination) Ports

The Receiving Institution	Unit	Amount	Type of Charges	
Kandla Port	TEU	125 \$	THC for full container	Charges of port services in origin (Kandla Port)
Kandla Port	TEU	19 \$	Lift on empty container	
Shahid Rajaei Port	TEU	129.2 \$	THC for full container	Charges of port services in destination (Shahid Rajaei Port)
Shahid Rajaei Port	TEU	904000 IRR	The charges of transportation from CY to exclusive yard	
Shahid Rajaei Port	TEU	1056000 IRR	Container unloading from/to truck	
Shahid Rajaei Port	TEU	443850 IRR	Warehousing charges	
Shahid Rajaei Port	TEU	0	Port dues	
Shahid Rajaei Port	TEU	0	Unloading/Loading duties	
Shahid Rajaei Port	TEU	0	Port health duties	
Shahid Rajaei Port	TEU	225720 IRR	Charges of general and infrastructural Services in special economic zone	
Shahid Rajaei Port	TEU	250000 IRR	Charges of issuing bill and document services	
Shahid Rajaei Port	TEU	6394 IRR	Demand (Extra work)	

Assumptions:

- The dwell time of the container in Shahid Rajaei Port is assumed to be 10 days.
- Each 20-foot container contains 12 tons of cargos on average.

Table 13. Port Service Charges Related to Containerized Goods in Amirabad and Aktau Ports

The Receiving Institution	Unit	Amount	Type of Charges	
Aktau Port	TEU	27,230 Tenges	THC of full container	Charges of port services in destination (Aktau Port)
Amirabad Port	TEU	90.5 \$	THC for Full Container	

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Amirabad Port	TEU	225720 IRR	The charges of general and infrastructural Services in special economic zone	Charges of port services in origin (Amirabad Port)
Amirabad Port	TEU	110965 IRR	Warehousing charges	
Amirabad Port	TEU	0	Port dues	Port Dues and Duties levied on goods
Amirabad Port	TEU	0	Unloading/Loading duties	
Amirabad Port	TEU	0	Port health duties	
Amirabad Port	TEU	6394 IRR	Demand (Extra payment)	

Assumptions:

- Dwell time of the container in Amirabad port is assumed to be 10 days.
- Each 20-foot container contains 12 tons of cargos on average.

4.3. Road Transportation Sector

This section focuses on analyzing the charges of road transportation from Shahid Rajaei Port to Amirabad Port. The road transportation of goods may be conducted in two ways as follows:

- A- Using the domestic freight B/L for the domestic fleet
- B- Employing the international freight bill of way (CMR) for foreign fleets

Given the use of the domestic fleet, the charges on goods can be divided into charges on the base fare (the total fare of cargo transportation and the wage of issuing transportation documents), cargo movement duties (terminal duties), loading charges, and the truck demurrage. The charges can be received as a unified company and/or as two separate forwarder and carrier companies (or the driver himself). Moreover, assuming using a foreign fleet, the charges of passing the road (the road pass), the charges of a difference in the fuel price, and charges of mutual border duties (in road borders) should be considered in calculations. Supposing the use of the domestic fleet, the article has not considered the intended charges in computations.

4.3.1. Base Fare of Road Carriage

The amount of base fare for road transportation is calculated based on the estimations of the

carriers and/or the truck owners concerning various factors such as the charges of driver wage, the charges of using the vehicle, consumption of fuel, insurance (health, third party, and the like), and other charges. Table 14 presents the charges of the base fare of container transportation from Shahid Rajaei Port to Amirabad Port.

It is noteworthy that the base fare of road carriage includes the total fare of cargo transportation and the fee for issuing the B/L. It is mentioned as the total transportation fare in the B/L and is obtained from the owner of the cargo. The driver pays part of the fare to the forwarder for issuing the B/L plus the related VAT (8% wage for issuing the B/L). Per paragraph 1 of the approval of the 166th session of the National Transportation Coordination High Council and the following amendments, the wage for issuing the B/L in the country's general terminals (e.g., ports) is now 8% of the total transportation fare. It is 10% outside general terminals, and as for the groupage consignments, it is 15% of the total transportation fare as mentioned in the B/L. Furthermore, it is 6% of the total transportation fare when cement consignments are considered.

Table 14. Container Base Fare of Road Carriage from Shahid Rajaei Port to Amirabad Port

Charges	Amount (IRR)	Unit	Recipient Institution
Base fare	53850000	Container	Carrier

4.3.2. Cargo Transportation / Terminal Duties

The charges are received per Article 163 of the Law on the 5th Five-Year Economic Development Plan of the IRI and the approval of the Economy Council. The sum is 150 Rials per ton-kilometer traffic of the cargo transportation fleet from Iranian roads, excluding the rural and tribal roads. Further, the sum is obtained from the foreign fleet passing

Iranian roads as road pass duties. The carriers will have to pay off the duties for each ton-kilometer cargo transported by the cargo owners and deposit it into the account of the RMTO. Only 4% of the total transportation fare, which is put in the B/L, is now obtained from the cargo owner as the share of the RMTO due to the executive problems in specifying the ton-kilometer taken for the transportation of domestic goods.

Table 15. Cargo Transportation/Terminal Duties from Shahid Rajaei Port to Amirabad Port Path

Charges	Amount (IRR)	Unit	Recipient Unit
Using bascule to weigh consignment	5625000	TEU	RMTO

Assumptions:

- The distance from Bandar Abbas to Amirabad is taken to be 1500 kilometers.
- Each 20-foot container is considered to approximately weigh 25 tons.

Note. RMTO: Iran Road Maintenance and Transportation Organization.

4.3.3. Truck Loading and Unloading

The charges are obtained on both the origin and destination of loading for the loading and unloading of the cargo by a transportation vehicle. The charges are generally determined based on the salary of workers working in the loading and unloading operations, and the cargo owner has to pay it off. Given that the loading and unloading operations occur in the origin and destination ports (Shahid Rajaei and Amirabad Ports), the charges are considered part of the THC container charges in sections related to port service charges.

4.3.4. Demurrage/Sleep

The charges are received to cut the time span of loading and unloading by the road vehicles and prevent unjustified stoppage in the origin and destinations and the borders of the country. The sum is paid in case of the excessive stoppage of a vehicle (12 hours extra stoppage for loading and 7 hours for unloading). The charges are received based on an agreement between the cargo owner and the transportation company and in case of no agreement per the tariffs announced by the International Transportation Companies Association of Iran (ITAIR).

Assuming that container loading and unloading are within the authorized time limit, this item has not taken into consideration such charges in calculations.

4.4. Customs Service Sector

The charges are received at the Iranian ports for the customs services offered to the cargo owners by the service-providing organization, including the Iran Public Warehouses and Customs Service (PWCS) Co. and/or the PMO. The services include weighing, plumping, sealing, farewell, laying tariffs, warehousing, scanning, loading and unloading, transportation, inspection (if needed), customs demand, and extraordinary services. Some items are taken for the cargo regarding export, import, or transit. As for the goods transited from India to Kazakhstan via Shahid Rajaei and Amirabad Ports, the weighing, plumping, and demand items in customs are inserted in the bill of the shipping company and obtained from the cargo owner. Tables 16 and 17 present customs service charges on the transit cargos in Shahid Rajaei and Amirabad Ports.

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Table 16. Charges of Customs Services in Shahid Rajaei Port

Charges	Amount (IRR)	Unit	Recipient Unit
Using bascule to weigh consignment	100000	Container	IRI Customs
Plumping charges	50000	Container	IRI Customs
Container X-raying	700000	Container	IRI Customs
Custom demand charges	40000	Container	IRI Customs

Table 17. Charges of Customs Services in Amirabad Port

Charges	Amount (IRR)	Unit	Recipient Unit
Using bascule to weigh consignment	100000	Container	IRI Customs

It is worth mentioning that the charges of customs services differ from the customs duties levied because of imports. The mentioned charges include customs dues (4% of the value of goods in terms of CIF), trade profit (a percentage of the value of a commodity's CIF value), the Red Crescent duties (0.5% of the total customs dues, and trade profits), VAT (9% of the total customs duties, trade benefits, and the CIF value of a commodity), and the like.

4.5. Miscellaneous Charges

In addition to the estimated charges in the prior sections, some miscellaneous charges are levied on cargos in the course of transportation, including charges related to the issuance of the warehouse receipt, the printing of custom declaration form, the sealing of the declaration form envelope, issuance of payslip, and the like. The expenses are generally less than 1000000 Rials for the total transit consignment. Compared to the total

transportation charges and logistics, these charges are minor and negligible.

4.6. Total Charges

Regarding the estimates in the prior sections of the paper, the total direct charges of international transit of a 20-foot container from the origin of Kandla Port to the destination in Aktau Port is \$1778 plus \$300 as the charges of container detention (demurrage). It is noteworthy that the charges are merely estimated for the maritime, port, road, and customs sectors. However, part of the port sector (regarding the type of contract that the shipping company has signed) charges are typically estimated in the shipping company bill, including the maritime freight rate. It is obtained from the cargo owner and then deposited in the account of the port and port operators. Table 18 summarizes the total transit cost in proportion to the four maritime, port, road, and customs sectors.

Table 18. The INSTC Transit Cost Breakdown by Maritime, Port, Road, and Customs Sectors

Sectors		Charges (\$ per TEU)	Total Charges (\$ per TEU)
Maritime sector charges (including freight rate, local charges, marine services, and container demurrage)	Kandla Port-Shahid Rajaei Port Path	413.43	1014.75
	Amirabad Port-Aktau Port Path	301.31	
	Demurrage of Container Return to Shahid Rajaei Port	300	
Port sector charges	Kandla Port	144	458.62
	Shahid Rajaei Port	158.06	
	Amirabad Port	93.93	
	Aktau Port	62.63	
Road sector charges	Shahid Rajaei Port-Amirabad Port Path	594.75	594.75
Custom sector charges	Shahid Rajaei Port	8.9	9.9
	Amirabad Port	1	

Sectors	Charges (\$ per TEU)	Total Charges (\$ per TEU)
Total	Kandla Port-Shahid Rajaei Port- Amirabad Port-Aktau Port	2078

Assumptions:

- Each dollar is taken to be equivalent to 100,000 Rials.
- Each dollar is taken to be equivalent to 426.63 Tenges.
- Each dollar is taken to be equivalent to 76.6 Rupees.

Note. INSTC: International North-South Transit Corridor.

5. Results and Conclusion

As shown in Figure 4, on average, the maritime sector accounts for 49% of the international cargo transit cost between Kandla and Aktau Ports via the INSTC. One-third of it is related to the payment of the demurrage of empty containers to the shipping line. Furthermore, 29% of the cost belongs to land (road) transportation. The port section also reserves approximately 22% of the costs (Shahid Rajaei and Amirabad Ports, each reserving 35 and 20% shares in the total port sector cost, respectively). Moreover, the service sector of the customs has less than half a percent share in

the overall cost, which is the least share in the costs.

Figure 5 depicts the cost versus time of the international transit of container cargo via the North-South Corridor. Hence, the cost of the customs clearance process accounts for a relatively slight portion of the direct cost of transit cargo. It practically takes a major portion of the time. This issue increases the direct (warehousing) and indirect (container demurrage) costs and enormous problems and charges imposed to the cargo owners due to the delayed delivery of goods to the customer and the dormancy of the capital of the cargo owner in the ports.

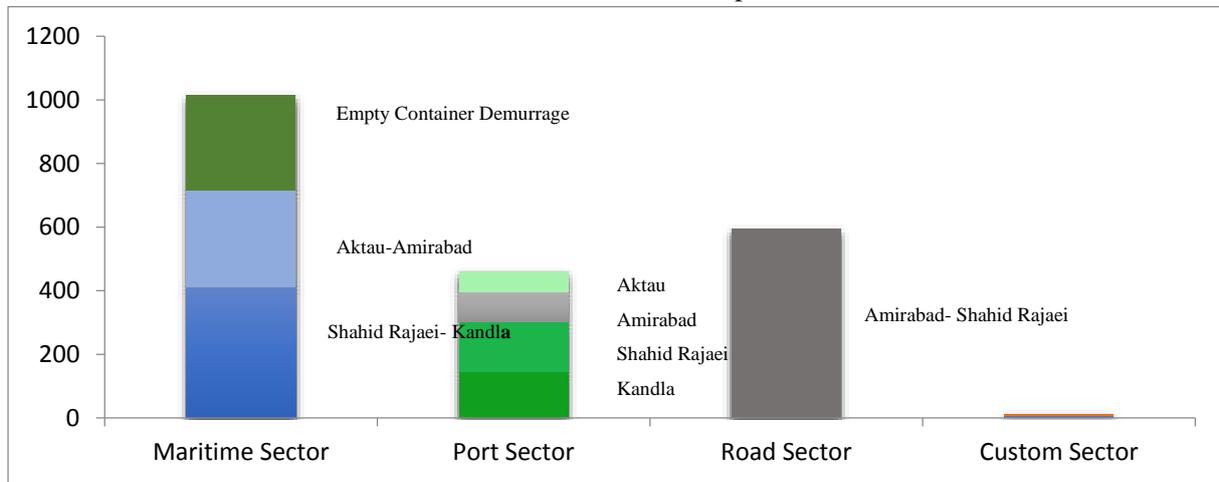
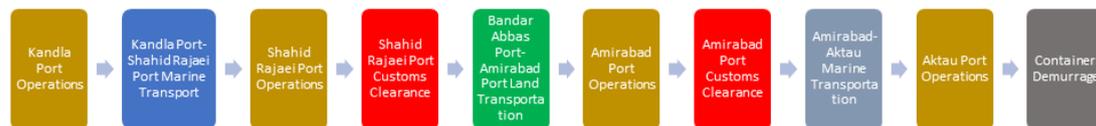


Figure 4. The INSTC Transit Cost Breakdown by Maritime, Port, Road, and Customs Sectors (\$)



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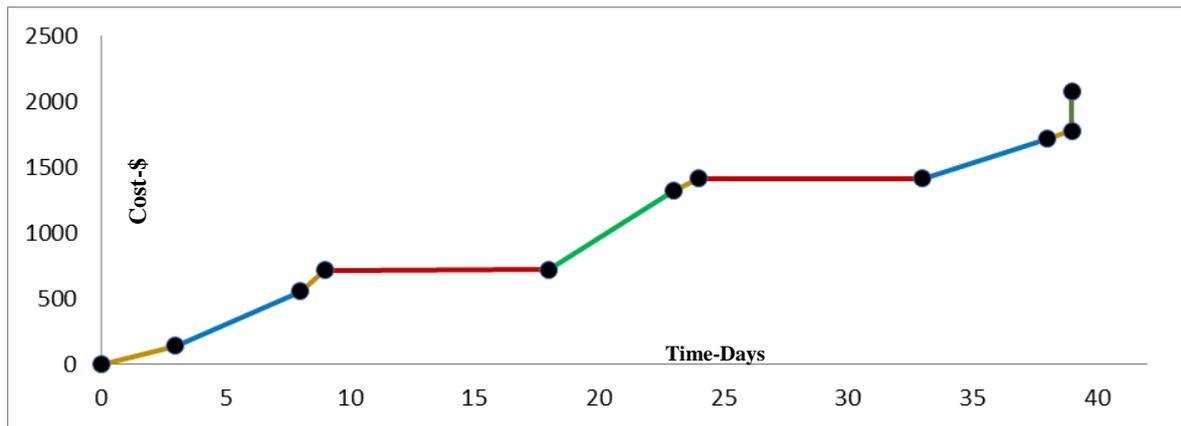


Figure 5. The INSTC Transit Cost and Time Breakdown by Sea, Port, Road, and Customs Sectors

Hence, it can be claimed that the cost of cargo transit between India and Kazakhstan via the INSTC and the time for transportation in different parts of the corridor still need to be cut to compete with rival corridors and routes. In the same vein, regarding the high portion of the cost of maritime transportation and the empty container's demurrage, followed by land transportation, cutting costs in the intended sectors is of priority compared with port section costs. Additionally, despite the least portion of custom service charges in the ports of the country, a high time of custom clearance operations in these ports needs to be effectively minimized by facilitating the customs procedures. Therefore, the results of this research make a holistic, integrated, and precise picture of the cost breakdown structure in each ring of logistics and transportation chain in the INSTC and help managers and decision-makers to make the right decisions regarding policies and tactics of cost and time reduction.

For example, based on the findings of the research, increasing the number of regular container shipping liners on the maritime routes of the INSTC, between the southern ports of Iran and Indian Ports, as well as the northern ports of Iran and CIS ports, can make maritime freight rates more cost-competitive in this corridor.

A comparison of Liner Shipping Bilateral Connectivity Index (LSCBI) between the

selected India's seaborne trade partner countries in the Persian Gulf region is shown in Figure 6, representing low regional ranking of Iranian ports regarding their connections with Indian ports, compared to other rival countries. Figure 7 also depicts the comparison of Liner Shipping Connectivity Index (LSCI) between Iran, the UAE, Oman, and China at both national and port levels. As can be seen, the LSCI index of Shahid Rajaei port is much lower than the two rival ports, namely Jebel Ali and Salalah in the Persian Gulf region. The same holds true for the Shanghai as the most connected port of the world. The same condition exists for the liner shipping connectivity between Iranian northern ports and Kazakhstan/Russian Ports.

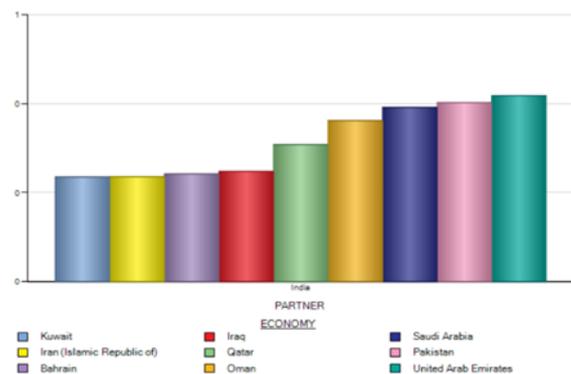


Figure 6. Comparison of LSCBI among India's Seaborne Trade Partner Countries in the Year 2021

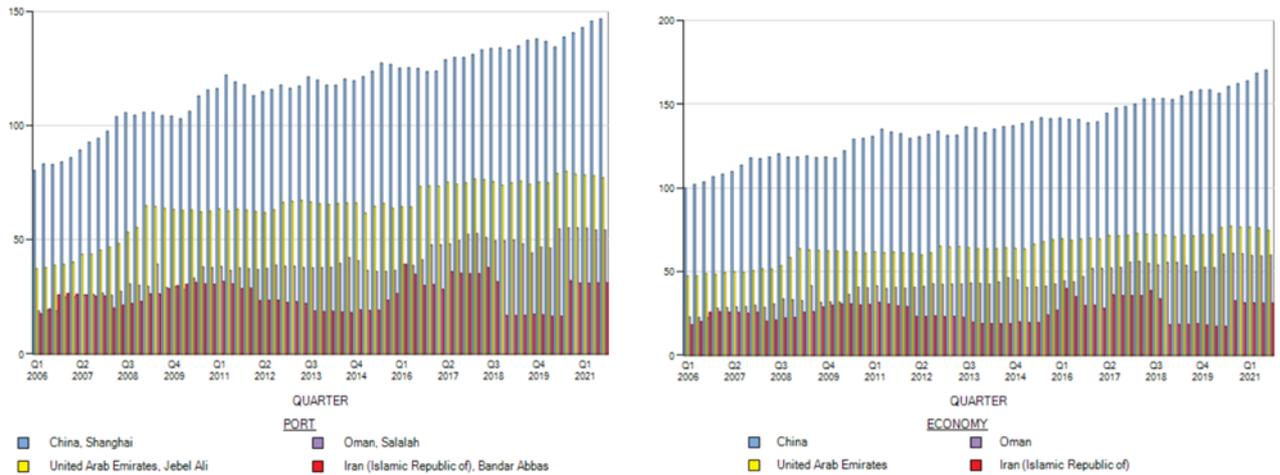


Figure 7. Comparison of the LSCI among Iran, the UAE, Oman, and China in National and Port Levels

Source. UNCTAD: United Nations Conference on Trade and Development [2021]

Two other solutions make the multimodal transportation more cost-effective along the INSTC, including accelerating the completion of the rail Roll on Roll off (Ro-Ro) transportation facilities in northern ports such as Amirabad Port in parallel to expediting the connection of Anzali and Astara Ports to the national railway network.

Another practical solution is to implement the empty container management system to shorten the empty container return time to Shahid Rajaei port and cut the empty container demurrage, which forms a significant portion of international transit costs through the corridor. Trade facilitation strategies such as using the Authorized Economic Operator (AEO) system in the customs or facilitating and promoting the use of the Through Bill of Lading (TBL) and the electronic Transports Internationaux Routiers (e-TIR) system could help cut unnecessary time and costs at borders and boost trade along the INSTC.

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Annex 1

