Commentary

Linking Afghanistan with Europe Through TRACECA, Pakistan and Russia: A Comparative Analysis and Cataloguing

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Abstract

This study presents the comparative analysis of the overall transport connections between Afghanistan and Europe. The transport routes are compiled with interconnection options and origin/destination points. The overall routes, including stretches and nodes are further compared according to the selected criteria': time, cost, reliability and safety/security. Connection of Afghanistan with Europe via TRACECA is offered through three main options/subsections: from port of Poti to Kabul via Serkhetabad/ Turkmenistan, Termez/Uzbekistan and Nijnii Pyanj/Tajikistan border crossing in comparison with transportation routes/sections via port of Riga and port of Karachi. The TRACECA Route Attractiveness Index (TRAX) has been slightly modified to maintain a consistent and equal approach while measuring attractiveness of main alternative transportation routes for Afghanistan Trade flows. In this regards and for the sake of comparison, the shortest route in each particular case is chosen, both in terms of KM travelled and average transit time. On the basis of assessment and measurement of selected criteria (1) stretches of transportation routes are compared upon their technical characteristics, which include infrastructure technical conditions and its operational capacity, and (2) nodes technical and operational facilities, which are integrate parts of supply chain requirements and main operational barriers of the transportation routes.

Keywords: *TRACECA, Trax Index, Nodes, Streteches, Ports, Reliability*

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Introduction

Today, international trade is part of various globalized production processes that require ever more reliable and timely trade transactions. The speed and reliability of deliveries often become a decisive factor in a country's trade competitiveness. At the same time, environmental sustainability objectives and the impacts of climate change on trade and transport have become priority issues in policy agendas, industry strategies and development partners alike (Precious, 2014). For the measurement and assessment of attractiveness of selected transportation routes TRACECA methodology for measuring Corridor attractiveness TRACECA Route Attractiveness Index (TRAX) was chosen and extended for Afghanistan. It shows comparable calculations for the attractiveness of the TRACECA routes through the Caucasus and the alternative routes through the Pakistan and Russian Federation. The methodology considers the attractiveness of the transport corridor as such for the logistics chain and not on country by country basis. Based on the World Bank definition, the transport corridors are defined from a physical perspective, as a collection of stretches "constructed from the transport networks of adjoining countries and bounded by gateways". For present study the gateways are in many cases multi modal and transshipment and mainly are the border crossings Points. Transport costs also influence modal choice, the commodity composition of trade and the organization of production, particularly as 'just-in-time' methods get extended to the global level. In turn, these new production methods are placing increasing demands on the transport system (Laussel, 2004).

In order to maintain a holistic, consistent and equal approach to the measurement of attractiveness of alternative transportation routes for Afghanistan, the TRACECA Route Attractiveness Index (TRAX) application was slightly modified, customized and extended for measuring attractiveness of main alternative transportation routes for Afghanistan trade flows, including the main stretches and nodes in Afghanistan and Pakistan as well. For carrying out a comparative analysis of alternative transportation corridors, including railway transportation, on the basis of TRAX road index, the rail attractiveness index has been developed, specifically for Afghanistan. Taking into consideration existing Shipping rate of pre-selected transportation routes, assessment and measurements of Multimodal transport index was measured and carry out for each pre-selected transportation routes. It should be noted for the calculation railway and shipping transportation costs the current r/w tariff and shipping rate were considered. The calculation of the Multimodal Index for

Afghanistan was made by adding the adjusted values of stretches and nodes along the pre-selected alternative routes separately.

As per TRAX methodology in presented study, the main and significant criteria' (Time/Cost/Reliability/ Safety/Security) from point of view of traders, road operators and freight forwarding companies were assessed and measured not only for stretches and nodes as well as along the entire transportation route/corridor. In comparison with World Bank Logistics Performance Index and various other methodologies, such as CAREC (Corridors Performance Measurement and Monitoring), UN Time-Cost/Distance Approaches and Methodologies, TRAX measures the attractiveness of a physical logistic transportation routes (corridor), based on:

- Real and verifiable information,
- Adjusted data' to the length of the stretches,
- Supplemented by specific weight (α), and
- Introduction of risk index (ric);

It should be stated that the transportation route attractiveness index reflects the attractiveness of the route (or corridor) from prospective not only of traders, freight forwarders and road operators as well as from potential investors point of view. The higher the Index the less attractive the transportation route will be. The Consolidate table of comparison of multimodal attractiveness' index of alternative transportation route for Afghanistan is presented in table 1 as follows:

Table 1: Consolidate table of Multimodal Attractiveness Index for Alternative Transportation Routes

S.N	Rotterdam-Kabul O/D	Index for Stretches	Index for Nodes	Multimodal Index	Ranking
1	TRACECA Turkmenbashi/Serkhetabad/Tourgundi/Herat	724	918	1660	2
2	TRACECA Aktau/Termez/Haratan/ Mazari Sharif	742	1106	1808	3
3	TRACECA Aktau/Dushambe/Shirkhan Bandar/Kundus	774	1515	2289	9
4	Pakistan Karachi/Torkham	854	1156	2010	7
5	Pakistan Karachi/Peshawar	841	1290	2131	8
6	Pakistan Karachi/Spin Bouldak	826	1161	1987	6
7	Pakistan Gwadar/GuulamKhan	809	1156	1965	5
8	Pakistan Gwadar/Weesh	648	1156	1824	4
9	Riga Latvia/Russia/Kazakhstan/ Uzbekistan	639	770	1409	1

Source: Author's Calculations

Table 2: Consolidate Table of Comparative Analysis of Transportation Costs and Time Delivery between the Alternative Transportation Routes (USD/TEU)

	Rotterdam-Kabul O/D	Distance (km)	Delivery Time (days)	Transportation costs (USD/TEU)	Number of BCP/ Transhipments
1	TRACECA Turkmenbashi/Serkhetabad/Tourgundi/Herat	11 385	26-30	5710 - 6000	7/2
2	TRACECA Aktau/Termez/Haratan/ Mazari Sharif	12 262	30-34	5180-5650	9/2
3	TRACECA Aktau/Dushambe/Shirkhan Bandar/Kundus	11 832	36-40	5920-6650	11/2
4	Pakistan Karachi/Torkham	14 704	40-44	6450-6850	3/1
5	Pakistan Karachi/Peshawar	14 704	42-46	6650-7200	3/2
6	Pakistan Karachi/Spin Bouldak	14383	38-42	6150-6600	3/1
7	Pakistan Gwadar/GuulamKhan	14426	n/a	n/a	3/1
8	Pakistan Gwadar/Weesh	14450	n/a	n/a	3/1
9	Riga Latvia/Russia/Kazakhstan/Uzbekistan	7 615	22-24	4465-5070	7/2

2 Selection and Segmentation of the Transportation Routes for Comparative Analysis

For the sake of efficient comparison, the shortest route in each particular case is chosen, both in terms of KM travelled and average transit time. Consecutively nodes along the selected transportation routes were assessed and measured. For the identification of physical bottlenecks and operational constrains prior to the pre-selection of Stretches and Nodes along the transportation routes, technical survey and operational capacities were assessed. For r/w transportation route/sections towards to Afghanistan for all r/w stretches/subsections and r/w nodes assessment and measurement were curry out separately on the basis of newly developed r/w attractiveness index. For the road transportation routes in Afghanistan and Pakistan assessment and measurement of stretches and nodes were carry out on the basis of Road attractiveness index, which was already developed under the TRACECA programme financed by European Union. Especially for the Road and Rail Nodes, which are a main border crossing and transshipment points between Afghanistan and Turkmenistan, Uzbekistan, Tajikistan and Pakistan, application of relevant regulations of tariff policy were analyzed.

As mentioned above, the comparative analysis was prepared between the three alternative transportation routes for Afghanistan for transportation Twenty-foot equivalent Unit (TEU) container. Transportation of garments, consumer goods and agricultural products in container were given as a type of good to evaluation and assessment. On the basis of preliminary analysis, including interviews with traders, transport operators

and for assessment and measurement of multimodal attractiveness index the Transportation route via TRACECA (A) was divided by modes of the transport (Shipping, Rail and Road) by three sections, eight (8) Sub sections/Stretches and twenty-one (21) Nodes:

I. Stretches:

1. Shipping Stretch:

a. Port of Rotterdam – Port of Poti;

2. Rail/Road Stretches (TRACECA):

a. Port Poti – TRACECA - Turkmenistan – Serkhetabad;
b. Port Poti – TRACECA – Turkmenistan – Uzbekistan – Termez/Hayratan - Mazari Sharif;
c. Port Poti – TRACECA – Kazakhstan – Uzbekistan - Termez/Hayratan – Mazari Sharif;
d. Port Poti – TRACECA – Kazakhstan – Uzbekistan – Dushanbe;
e. Dushanbe – Shirkhan Bandar (road);

3. Road Stretches in Afghanistan:

a. Tourgundi – Heart – Kabul;
b. Mazari Sharif – Kabul;
c. Sirkhan Bandar – Kabul;

II. Nodes along the Transportation route (A):

R/W subsection 2, a:

a. Port of Poti: BCP and Transshipment;
b. Gardabani: r/w Border crossing point (Geo/Az);
c. Beyk-Kyasik: r/w Border crossing point (Geo/Az);
d. Port of Baku;
e. Port of Turkmenistan;
f. Serkhetabad: r/w BCP (Turk/Afg);
g. Tourgundi: BCP and transshipment terminal (Afg.)

R/W subsection 2, b:

a. Farap: r/w BCP (Turk/Uz);
b. Alat: r/w BCP (Uzb/Tukr);
c. Galaba-Termez: BCP (Uzb/Afg);
d. Hayratan: BCP (Uzb/Afg);
e. Mazari Sharif: Transhipment terminal (Afg).

R/W subsection 2, c:

a. Port of Aktau;
b. Beynau: r/w BCP (Kz/Uzb);
c. Oazis:r/w BCP (Uz/Kz);
d. Galaba-Termez: r/w BCP (Uzb/Afg);
e. Hayratan: r/w BCP (Uzb/Afg);
f. Mazari Sharif: r/w BCP Transhipment terminal (Afg).

R/W subsection 2, d:

a. Oazis: r/w BCP (Uz/Kz);
b. r/w BCP (Uzb/Taj);
c. Dushanbe: r/w Transshipment terminal (Taj);
d. Shirkhan bandar: Transhipment terminal (Afg).

A. Transportation Route: Port of Rotterdam – Port of Karachi - Kabul (via Pakistan)

To assess the multimodal attractiveness index Transportation route via Pakistan (B), the process was divided by modes of the transport (Shipping, Road/Pakistan and Road/Afghanistan) by three sections, eleven (11) sub sections/stretches and eight (8) nodes:

I. Stretches:

1. Shipping Stretches:

a. Port of Rotterdam – Port of Karachi;
b. Port of Rotterdam – Port of Gwadar

2. Road stretches in Pakistan:

a. Port of Karachi – Chaman/Spinboldak;
b. Port of Karachi – Pesawar;
c. Port of Karachi – Torkham;
d. Port of Gwadar – Guulam Khan;
e. Port of Gwadar – Weesh;

3. Road Stretches in Afghanistan

a. Spinboldak – Kandahar - Kabul;
b. Torkham – Jalalabad - Kabul;
c. Gulam Khan –Khowst - Kabul;
d. Weesh – Kandahar - Kabul;
e. Peshawar – Jalalabad – Kabul;

II. Nodes along the Transportation route (B):

Road subsection 2, a:

a. Port of Karachi;
b. BCP Chaman (Pak);
c. BCP Spinboldak (Afg);

Road subsection 2, b and 2, c:

a. BCP Landi Kotal (Pak);
b. Pesawar: Transshipment terminal (Pak);
c. BCP Torkham

Road subsection 2, d and 2, e:

a. BCP Goolam Khan (Afg);
b. BCP Weesh (Afg);

B. Transportation Rout: Port of Rotterdam – Port of Riga - Kabul (via Latvia/Russia/Kazakhstan/Uzbekistan)

Multimodal attractiveness index measurement Transportation route via Riga (C) was divided by modes of the transport (Shipping, Rail and Road) by three Sections, Three (3) Sub sections/Stretches and Seven (7) Nodes:

I. Stretches:

1. Shipping Stretch:

a. Port of Rotterdam – Port of Riga;

2. Rail Stretch:

a. Port Riga – Russia –Kazakhstan – Uzbekistan - Termez/Hayratan - Mazari Sharif;

3. Road Stretch:

a. Mazari Sharif – Kabul;

II. Nodes along the Transportation Route (C):
Rail subsection 2, a:

a. Port of Riga: BCP and Transshipment;
b. r/w BCP Lat/Rus;
c. r/w BCP Rus/Kz;
d. r/w BCP Kz/Uz;
e. r/w Galaba-Termez: BCP (Uzb/Afg);
f. r/w Hayratan: BCP (Uzb/Afg);
g. r/w Mazari Sharif: Transhipment terminal (Afg).

Respectively, as a result of given above segmentation of transport routes by section and subsection, 22 Stretches and 36 Nodes were assessed in terms of its Crossing Time, Transportation Costs, Reliability and Safety/Security.

3 Methodology for Measurement of Attractiveness' of Transportation Routes for Afghanistan

3.1 Transportation Route Attractiveness Index for Afghanistan.

Transportation routes attractiveness index methodology illustrates the attractiveness indications of a route chosen by freight forwarders and transport operators. The set of criteria utilized is in accordance with the views of the freight forwarders and road operators. The weighing of the criteria also reflects the priorities and weights considered by the transport operators, freight forwarders and traders.

Table 3: Selected Criteria

Time	The transport time needed to move cargo from its origin to the final destination (O/D);
Costs	The transport costs used to move cargo from its origin to the final destination;
Reliability	The transport reliability as an essential pre-condition for state-of the art logistics transport providers in the global business;
Safety and security	Cargo safety and security also as an essential pre-condition for state-of-the art logistics transport providers;

Source: Author's Compilation

The selection/weighing of the criteria are based on universally applied means of measurement that makes the result less of an issue. The Reliability, Criterion Validity, and Time Cost of Alternate Measures for Curriculum-Based Measurement in writing.

a. Approach

After some modification and necessary customizing measures application of TRACECA Route Attractiveness Index (TRAX) was extended for the assessment and analysis of the selected main Stretches and Nodes

of Afghanistan linking with Turkmenistan, Uzbekistan and Tajikistan, as well as with Pakistan (Karachi and Gwadar ports) and comparative analysis was carried out between the North (via TRACECA and Russia) and South (via Pakistan) transportation routes/corridor towards to Afghanistan, including shipping lines as well. Measurement of transportation routes for further comparative analysis of alternative transportation routes in Afghanistan were deployed in a 4-step approach, as described below.

Step 1): Data Collection

Step of collected data and overview of reports from the following sources like IRU – "IRU"s New Eurasian Land Transport Initiative (NELTI) framework projects; EC TRACECA IDEA I Project; TRACECA Permanent Secretariat; EC RACECA Studies; WB and IFC Reports; ADB/CAREC Reports; UN ESCAP study; EC DG TREN RETRACK Study; OECD working papers for Shipping rates for haulage of containers by deep sea; CIS Countries R/W Tariff policy (2011); Georgia and Azerbaijan R/W Tariff policy (2011); and Afghanistan Ministry of Commerce and Industry, State Customs Department and Afghanistan Chamber de commerce.

Step 2): Interaction with The Transport Industry and State Authorities

In this step, interviews were carried out with representatives of transport industry, road operators and freight forwarding agents and traders in Afghanistan and Pakistan in order to determine the weight of various criteria.

The main subjects of interviews were:

a. Insight on how the route choice decisions are made;
b. Routes identified for analysis;
c. Time: Minimum and maximum time spent across each route, border crossing points and transshipment terminals (travelling/waiting/rest time, including the border procedures);
d. Cost: Minimum and Maximum actually money spent along the route and nodes, including official, unofficial expenditures incurred during the journey and at the border as well.
e. Assessment of the criteria as transportation cost, time, reliability and security through the pair wise judgment of these criteria;
f. Qualitative indication of safety and security aspects (Risk);
g. Identification of other topics of the special importance from the business standpoint.

Step 3): Running the Calculation

Each entire route for comparative analysis was disaggregated into a number of sections stretches and nodes, where:

- Stretches are roads, rails routes and shipping lines;

- Nodes are border crossing points, ports, and transshipment terminals.

The Attractiveness Index (Index – Index) comprises two sub-indices: Stretch sub-index (Index [S]) and Node sub-index (Index [N]):

Index [S]: Is calculated as a sum of the main Stretch criteria (Adjusted weights of Transportation Costs/Time/Reliability/Safety and Security) multiplied by the specific weight of each these criteria, noting that stretches are roads, rail, shipping lines and ferries.

Index [N]: Is calculated as a sum of the main Node criteria (Average Total costs/Time and Reliability throughout the node) multiplied by the specific weight of each these criteria.

Therefore, for comparative analysis between the transportation routes initially the Attractiveness Index was calculated for each by different modes of transport for each entire alternative transportation routes separately (shipping, railways and road) for selected transportation routes and further were summarized, adjusted according the total length of transportation.

Taking into consideration each alternative routes equally consist of three sections (Shipping, Rail and Road Stretches) for comparative analysis Multimodal Attractiveness' Index was calculated only as a sum of adjusted road, railway and shipping attractiveness Indexes:

Multimodal Index = Multimodal Index (S) + Multimodal Index (N);

Multimodal Index (S) = adjRoad (R) INDEX + adjRailway (Rw) INDEX + adjShipping (Ship) INDEX;

Where:

INDEX (R) = adjINDEX (S) + ∑INDEX (N):

- ROAD INDEX (S) = [TrC(S) * α(S)TrC] + [TiC(S) * α(S)TiC] + [ReC(S) * α(S)ReC] + [SeC(S) * α(S)SeC],
- ROAD INDEX (N) = $[^{Av}C_{(n)} * \alpha_{(n)}C_{(n)}] + [TiC_{(n)} * \alpha_{(n)}TiC_{(n)}] + [ReC_{(n)} * \alpha_{(n)}ReC_{(n)}]$;

INDEX (RW) = adjINDEX (S) +∑ INDEX (N):

- R/W INDEX (S) = [TrC(S) * α(S)TrC] + [ReC(S) * α(S)ReC] + [SeC(S) * α(S)SeC],
- R/W INDEX $_{(n)} = [^{Av}C_{(n)} * \alpha_{(n)}C_{(n)}] + [TiC_{(n)} * \alpha_{(n)}TiC_{(n)}] + [ReC_{(n)} * \alpha_{(n)}ReC_{(n)}]$;

INDEX (SHIP) = ShR (S);

Further for all three alternative routes/sections data's adjustment were made in accordance with the length of the transportation corridors/section.

Step 4): Analysis

In this final step, the outcome of the index application was analyzed and prepared for communication:

a. Overall comparison of Index' for the alternative transportation routes for Afghanistan;
b. Assessment of Time and Reliability on Stretch;
c. Assessment of Time and Reliability on Node;
d. Transportation costs on Stretch and Node;
e. Time costs on Stretch and Node;
f. Reliability costs on Stretch and Node;
g. Safety and Security costs on the transportation route;
h. Comparison of the transportation routes in terms of Transportation Costs/Time, Reliability and Risk.

4 Generation of Alternative Routes for Analysis

Based on the interview with road operators and freight forwarders the paths along the transportation routes were constructed and plotted on a map. This allowed efficient exploitation of the information obtained. The routes driven within EU territories were eliminated to avoid bias of the routes. The transportation routes started and ended at the EU borders (port of Rotterdam). The transportation nodes represent state border crossing points, transshipment terminals and ports. For the above constructed routes, information was incorporated into a specially developed calculation tool. Tables 1 and 2 illustrate the input structure of the information for the stretches and nodes, respectively. Each line of the table reflects the information received from Road operators and Freight forwarding companies. For Road Index calculation cost for fuel was not included into the transportation costs at that stage.

5 Consideration of Risk Criteria

Best option to consider the risks of transportation would use the insurance premium. During the measurement of TRAX, insurance companies were not willing to share their experience in transport chain risk, i.e. safety and security of cargo rating of TRACECA countries. For this, the freight forwarders in TRACECA countries and Afghanistan were interviewed and were asked to rate this risk based on their experience for each country. Risk was classified in the categories "High Risk", "Average Risk", "Minor Risk" / "Low Risk" or "No Risk". The risk assessment was done solely for the stretches. According to the freight forwarders and road operators, risk hazards were limited to the road and rail stretches and did not indicate any risk hazards at the shipping lines and rail and road nodes.

Using the questionnaire/Interviews the "estimation" of the operators on the risk of cargo transport within a specific country was obtained. Despite the fact that the risk may increases with the value of goods, the judgment was requested for a base type of goods. As an example, Garments, food and consumer goods transported in container was given as

a type of good to evaluate. Not all companies evaluated all countries. Evaluators were asking to limit their evaluations to the countries in which they have operational experience. Risk percentage was calculated for every country. The calculation was based on an exponential function with a base of 1.26. While risk free receives a base weight value of 1, the High risk receives a weight of 2. Low risk receives a weight of 1.26 and medium risk a weight of 1.59. Based on the above, the share of the countries in the risk classes for the transportation is calculated by the percentage of the risk class by the class weight. This represents the absolute value for risk. In next step, the risk of the different countries was referenced to Western Europe as a benchmark. The "risk factor" for every country along the comparative routes is calculated by dividing the absolute value for each country by the benchmark of Western Europe give. The value of risk is usually expressed in monetary term and in order to obtain the monetary value for every stretch, the cost of transport along this stretch further was multiplied by Risk Index.

Table 4: Calculation of Risk Factor

Country	Total Votes	High Risk		Average Risk		Low Risk		No Risk		Total	Relative Value		Risk Index
		Marks & %		Marks & %		Marks & %		Marks & %			(W.Eu)		
Armenia	8	5	63%	3	38%	0	0%	0	0%	1,85	1,53	1,53	0,5
Azerbaijan	12	6	50%	2	17%	3	25%	1	8%	1,66	1,38	1,38	0,4
Bulgaria	16	0	0%	3	19%	8	50%	5	31%	1,24	1,03	1,03	0,0
Georgia	21	8	38%	9	43%	2	10%	2	10%	1,66	1,38	1,38	0,4
Kazakhstan	20	3	15%	8	40%	4	20%	5	25%	1,44	1,19	1,19	0,2
Kyrgyzstan	12	5	42%	3	25%	3	25%	1	8%	1,63	1,35	1,35	0,4
Moldova	15	1	7%	5	33%	7	47%	2	13%	1,38	1,15	1,15	0,1
Tajikistan	13	6	46%	3	23%	4	31%	0	0%	1,68	1,39	1,39	0,4
Turkey	18	0	0%	5	28%	6	33%	7	39%	1,25	1,04	1,04	0,0
Turkmenistan	12	4	33%	1	8%	6	50%	1	8%	1,51	1,26	1,26	0,3
Ukraine	17	1	6%	4	24%	5	29%	7	41%	1.27	1,06	1,06	0,1
Uzbekistan	12	3	25%	2	17%	3	25%	4	33%	1,41	1,17	1,17	0,2
Iran	10	4	40%	1	10%	2	20%	3	30%	1,51	1,25	1.25	0,3
Russia	21	1	5%	8	38%	7	33%	5	24%	1,36	1,13	1,13	0,1
Rumania	10	0	0%	2	20%	6	60%	2	20%	1,27	1,06	1,06	0,1
Belarus	9	0	0%	5	56%	2	22%	2	22%	1,38	1,15	1,15	0,1
Baltic Countries	6	0	0%	1	17%	2	33%	3	50%	1,18	0,98	1,00	0,0
Western Europe	7	0	0%	2	29%	1	14%	4	57%	1,21	1,00	1,00	0,0
Eastern Europe	8	0	0%	2	25%	3	38%	3	38%	1,24	1,03	1,03	0,0
China	9	0	0%	0	0%	3	33%	6	67%	1,09	0,90	1,00	0,0
South Korea	1	0	0%	0	0%	1	100%	0	0%	1,26	1,05	1,05	0,0
India	1	0	0%	1	100%	0	0%	0	0%	1,59	1,32	1,32	0,3
Pakistan	6	4	66%	2	32%	0	0%	0	0%	1.87	1.65	1.65	0.65

Source: Author's Calculations

5 Weighing of the Evaluation Criteria for Road, Rail and Shipping Index'

5.1 Evaluation of Specific Weight Criteria for Rail Index

The questionnaire and interviews were utilized to obtain the transport industry's views on the relative importance of the four evaluation criteria for the transportation route choice. To allow objective capture of the criteria, paired judgment approach was pursued. In this approach every two criteria are judged. Based on this judgment; the rank of the criteria was calculated. This approach utilized the Analytic Hierarchy Process (AHP). The Analytic Hierarchy Process (AHP) through its structured approach best fits dealing with the complex decisions of setting the ranking of the criteria based on paired judgment rather than prescribing the weights.

Table 5: Setting the Relative Importance for the Road Index Criteria

Transport Cost are	(0) less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Transport Time
Transport Cost are	(0)less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Reliability
Transport Cost are	(0)less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Security
Transport Time are	(0)less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Reliability
Transport Time are	(0) less important (1) slightly less important (2) equally important (3) slightly more important (4)more important	Compared to	Safety and Security
Reliability are	(0)less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Safety and Security

Source: Author's Compilation

The judgment scale of 0-4 proves to be practical in this case. Further distinction will not affect the final result in a statistically significant way. For

the Road Index calculation was made for the 4 criteria being compared leading to a total of 6 pair comparisons.

The formula applies here for is 2 P = (N (N – 1),

Where:

P is the number of Paired comparison and N is the number of criteria. The total number of point is obtained by multiplying the P by the scale of judgment scale (0-4). The total number of points in this case is 6 x 4 = 24.

Each pair has therefore a 'weight' of 0.16667 (or 16.70 %) in the explanation of how relevant criteria are. At the same time, the result of each comparison is expressed on a rating scale ("More important", "Slightly more important", "Equally important", "Slightly less important" and "Less important"). To keep this into account, the total weight of each pair has been split between the two criteria as follows:

- When one criteria are rated as "more important" (rate 4) it gets the whole weight (4/24 = 0.16667) while its counterpart gets 0;
- When one criteria are rated as "slightly more important" (rate 3) it gets a weight of 0.125 while its counterpart gets 0.041667;
- When one criteria are rated as "equally important" (rate 2) it gets a weight of 0.08333 and also its counterpart gets 0.08333;
- When one criteria are rated as "slightly less important" (rate 1) it gets a weight of 0.041667 while its counterpart gets 0.125;
- When one criteria are rated as "less important" (rate 0) it gets 0 while its counterpart gets the whole weight 0.16667.
- The final score of each criterion have to be computed through the average of all the answers given by different evaluators.

Table 6: Weight of the criteria for Road Index for TRACECA Countries

Weight (α)	For Stretches (S)	For Nodes (N)
weight of the Cost (αC)	13%	22%
weight of the Transportation Time Costs (αTiC)	17%	29%
weight of the Transportation Reliability Costs (αReC)	29%	49%
weight of the Risk costs (Safety) (αSeC)	41%	-

Source: Author's Compilation

Table 7: Weight of the criteria for Road Index for Afghanistan

Weight (α)	For Stretches (S)	For Nodes (N)
weight of the Cost (αC)	19%	32%
weight of the Transportation Time Costs (αTiC)	36%	34%
weight of the Transportation Reliability Costs (αReC)	28%	36%

weight of the Risk costs (Safety) (αSeC)	16%	-

Source: Author's Compilation

5.2 Evaluation of specific weight criteria for Rail Index

For the Rail Index (both stretches and nodes) calculation was made for the 4 criteria being compared leading to a total of 6 pair comparisons.

Table 8: Setting the Relative Importance for the Criteria for Rail Stretches

Transport Cost are	(0) less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Reliability
Transport Cost are	(0) less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Safety and Security
Reliability are	(0) less important (1) slightly less important (2) equally important (3) slightly more important (4) more important	Compared to	Safety and Security

Source: Author's Compilation

For the Stretches of Rail Index calculation was made for the 4 criteria being compared leading to a total of 6 pair comparisons.

The formula applies here for is **2 P = (N (N – 1)**,

Where:

P is the number of Paired comparison and N is the number of criteria. The total number of point is obtained by multiplying the P by the scale of judgment scale (0-4). The total number of points in this case is 3 x 4 = 12.

Each pair has therefore a 'weight' of 0.33 (or 33.00 %) in the explanation of how relevant criteria are. At the same time, the result of each comparison is expressed on a rating scale ("More important", "Slightly more important", "Equally important" "Slightly less important" and "Less important").

To keep this into account, the total weight of each pair has been split between the two criteria as follows:

- When one criteria are rated as "more important" (rate 4) it gets the whole weight (4/12 = 0.33) while its counterpart gets 0;
- When one criteria are rated as "slightly more important" (rate 3) it gets a weight of 0.25 while its counterpart gets 0.08;

- When one criteria are rated as "equally important" (rate 2) it gets a weight of 0.166 and also its counterpart gets 0.166;
- When one criteria are rated as "slightly less important" (rate 1) it gets a weight of 0.083 while its counterpart gets 0.25;
- When one criteria are rated as "less important" (rate 0) it gets 0 while its counterpart gets the whole weight 0.33.

The final score of each criterion have to be computed through the average of all the answers given by different evaluators:

Table 9: Weight of the criteria for Railway Index for TRACECA

Weight (α)	For Stretches (S)	For Nodes (N)
weight of the Cost (αC)	14%	12%
weight of the Transportation Reliability Costs (αReC)	53%	56%
weight of the Transportation Time costs (αTiC)	34%	32%

Source: Author's Compilation

6 Calculation of Value of Travel Time (VOT) for the Road and Railway Transport Index

The Value of Travel Time refers to the cost of time spent on transport, i.e. travel and waiting times. In this respect VOT was chosen, which is based on the published Monetary Estimates of VOT (2008). This was published by Victoria Transport Policy Institute (www.vtpi.org) as a study on Transportation Cost and Benefit Analysis II.

Travel Time Costs and the Study have been presented at the meeting of International Transport Forum in 2009. This Study use travel surveys to determine the value of travel time for Europe and other regions as well.

The table 10 summarizes typical values of time used for transport project evaluation in Europe. For attractiveness index calculation for Afghanistan for road rail transport the value of time (VOT) 43 EURO (or 53 USD) for load vehicle and 30.00 EURO (36 USD) for load wagons have been used for calculation accordingly.

Table 10: Value of Time for Vehicles

	Passenger Transport	Freight Transport
Interurban Rail	Business: € 21.00 Per person hour Commuting/ Private: € 6.40 per person hour Leisure/Holiday:€ 3.20 per person hour	Full Trainload (950 tonnes): € 725.00 per tonne-hour Wagon Load (40 tonnes): € 30.00 per tonne-hour Average per tonne:€ 0.76 per tonne-hour
Road	Business: € 21.00 per person hour Commuting/Private: € 6.00 per person hour Leisure/Holiday: € 4.00 per person hour	Light Goods Vehicle: € 40.00 per-vehicle hour Heavy Goods Vehicle: € 43.00 vehicle-hour

Source: Author's Compilation

Taking into consideration wagon is loaded by two 20 feet LC and railway tariff is constant in order to calculate Railway VOT for one 20 feet LC is: 36 USD/2 = 18 USD wagon/hour for one 20 feet LC transported by rail;

7 Calculation of Road Index

7.1 Calculation of the Road Index criteria for Stretches

Based on the exploitation of information from road operators and freight forwarders; the set of input data were used for the calculation of each of the criteria for stretches namely Transportation Costs, Risk Costs (Safety), Transportation Time Costs and Transportation Reliability Costs.

Transportation costs for Stretch - **TrC(S)** were calculated by addition of all types of costs incurred throughout the itinerary, including official and unofficial, total cost of fuel being consumed by the vehicle in the average conditions to travel across this stretch. The value of any other costs associated with the transportation prime cost (amortization, interest, driver's salary etc.) was not taken into account.

TrC(S) = FC (S) + AvC(S)

Risk Costs (Safety) - SeC(S) on stretch were calculated by multiplying the cost of transportation across this stretch by the risk coefficient of the same stretch. This criterion enables the assessment of a possible increase in the transportation cost on any stretch in terms of safety and security level (*Risk Premium*).

SeC(S) = TrC(S) * RiC(S)

Transportation Time Costs - TiC(S) was calculated by multiplying the Average Travel Time on stretch by the Travel Time cost factor/hour (53 USD).

TiC(S) = Avt(S) * VOT

Reliability Costs - ReC(S) was calculated by multiplying the Transportation Reliability cost/hour by the Travel Time cost/hour. This criterion reflects the costs of low predictability of cargo delivery time and final costs.

ReC(S) = Re(S) * VOT

The results of calculations of the criteria, main indexes and basic data were brought together in a single Table for each Road stretch.

Calculation of the Criteria for Road Nodes

The INDEX (N) for Nodes is calculated as a sum of the nodes' criteria (Average Total Costs on Node, Time Costs on Node and Reliability Costs on Node) multiplied by the specific weight of each node criteria. Therefore:

Road INDEX (N) = (avC(N) * α(N)C + TiC(N) * α(N)TiC + ReC(N) * α(N)ReC),

Input Data for the Calculations for NODES

Data on Nodes obtained from the various interview, filled questioners and reports are:

1. Average Total Costs on Node, USD/ AvC (n);
2. Average Official Costs on Node, USD/AvC(o) (n);
3. Average Unofficial Costs on Node, USD/(AvC(no) (n);
4. Minimum Waiting Time on Node in hours/Tmin (n);
5. Maximum Waiting Time on Node in hours/Tmax (n);
6. Average Waiting Time on Node in hours/Avt (n);

For the purposes of a unified approach the following assumptions were used

1. Travel Time cost per hour, USD (**VOT**). The value of this index refers to 52 USD (equivalent to Euro 43) / 2 = 26 USD for 20 feet LC transported by road;
2. Average fuel consumption by the vehicle in the standard conditions – 0,3 lt. per 100 km;

Calculation of the basic input values

1. Reliability in hours **Re (n):** this is a difference between the maximum and minimum value of the travel time, i.e. how much time may potentially be lost on a node:

   Re (n) = Tmax (n) - Tmin (n);

2. Level of Unofficial costs, %. **Cno (n)**

   Cno (n) = avC(no) (n) / AvC (n) * 100%

Calculation of INDEX criteria for Road Nodes

Based on the exploitation of information from the transport operators and freight forwarders; the set of input data were used for the calculation of each of the criteria for nodes:

1. Average Total Costs on Node;
2. Time Cost on Node;
3. Reliability Costs on Node;

Average Total Costs on Node, USD **avC(n)**, as already stated, include all types of costs incurred within the node, be it official or unofficial. The value of any other costs associated with the transportation prime cost (amortization, interest, driver's salary etc.) was not taken into account.

Time Costs on node TiC(n) were calculated by multiplying the Average Total time on node by the Travel time cost factor/hour (53 USD).

TiC(n)= avt(n) * Road VOT;

Reliability Costs on Node - **ReC(n)** were calculated by multiplying the node Reliability (Re) hours by the Travel time cost/hour. This criterion reflects any possible losses or gains that could occur on this node in the favorable or unfavorable circumstances resulting to any delays in transit.

ReC(n)= Re(n) * Road VOT for one 20 feet LC;

The results of calculations of the criteria, main indexes and basic data were brought together in a single Table for each stretch.

7.2 Railway index

Railway INDEX (R) = INDEX (S) + INDEX (N);

The Railway INDEX (S) for stretches is calculated as a sum of stretches' criteria (Transportation Costs, Reliability Costs, and Safety Costs) multiplied by the specific weight of each criterion specified earlier.

The following formula applies for the calculation of Road INDEX (S):

Rail INDEX (S) = [TrC(S) * α(S)TrC] + [ReC(S) * α(S)ReC] + [SeC(S) * α(S)SeC];

This necessitates the elaboration of railway attractiveness indices for r/w stretches and r/w nodes which - as opposed to TRACECA road attractiveness indices - have not been developed to date.

In current circumstances was taking into consideration that additionally to the 12 road, there are a number of railway junctions in the vicinity of the border of Afghanistan, such as Termez (Uzbekistan), Serkhetabad (Turkmenistan), Dushanbe (Tajikistan), Chaman (Pakistan) and Peshawar (Pakistan). The elaboration of the railway indices will facilitate the assessment and comparative analysis of alternative railway routes for trade and transport flows, originating from/destined to Afghanistan. Furthermore, the rationale underpinning the need to elaborate the Rail attractiveness index included the following factors:

1. It is well known that in long haul (more than 500-700 Km) transportation railway transport is more competitive than the road transport;
2. Due to existing direct links with TRACECA r/w transport network the government of Afghanistan has expressed its willingness to accede to the MLA, hence highlighting the vital importance of integration of Afghanistan transport system into the TRACECA transport network and facilitate of Afghanistan freight transportation through the railway corridor across TRACECA;

3. Calculation of the rail indices for nodes and stretches will facilitate a more accurate identification of r/w bottlenecks and operational constrains in the process of formulating transport-logistics processes and will allow developing action plans for eradication of the r/w missing links, identified bottlenecks and operational constrains.
4. The railway indices will allow carrying out a more accurate comparative analysis of all railway links adjacent to the borders of Afghanistan (Central Asian countries and Pakistan).

This paper concerns the elaboration of railway node and railway stretch attractiveness indices, denoted hereinafter as $R/W_{(n)}$ and $R/W_{(s)}$, respectively.

The methodology for calculating the TRACECA Road indices (TRAX) has been inherited for the purpose of deriving the Railway indices. While the formula for index calculation on a given road node is directly applicable to the railway node, modification and adjustments were required to derive a meaningful railway stretch index calculation formula, as explained further.

7.3 Railway node attractiveness index ($R/W_{(n)}$)

The formula for calculating the Road node index remains unchanged and directly applicable to the calculation of **Railway node index**, i.e.:

$$R/W_{(n)} = [{}^{Av}C_{(n)} * \alpha_{(n)}C_{(n)}] + [TiC_{(n)} * \alpha_{(n)}TiC_{(n)}] + [ReC_{(n)} * \alpha_{(n)}ReC_{(n)}]$$

Where:

${}^{Av}C_{(n)}$ is the average cost at the railway node (n);

$\alpha_{(n)}$ is the specific weight of criteria' at the railway node (n);

$C_{(n)}$ is the average official and non official costs at the railway node (n);

$TiC_{(n)}$ is the time cost at the railway node (n);

$ReC_{(n)}$ is the reliability cost at the railway node (n);

The results of calculations of the criteria, main indexes and basic data were brought together in a single Table for each stretch.

7.4 Railway stretch attractiveness index ($R/W_{(s)}$)

In order to derive a meaningful railway stretch attractiveness index, the methodology applied to the road stretch attractiveness index calculation had to be adjusted due to the specificity of railway tariff formation, which is the basis of the railway transportation cost.

The formation of the railway tariffs, since 1957-1960, takes place within the framework of Tariff Conference' of Railway Administrations of CIS Countries (whereby - based on the International Transit Tariff (MTT) approved by OSJD - a homogenous approach to tariff formulation is adopted). It is important to note, that for the calculation of the **base costs**

for railway transportation, the Administrations of the Railways of CIS and OSJD countries:

1. take into account all maintenance expenditure, i.e. expenses on labor, materials, fuel, maintenance of locomotives, wagons, and other property, administrative expenses, as well as depreciations and deductions for major repairs of railway transport;
2. include in the base cost the expenses for transportation of freight and passengers;

In case of the road stretch index, expenses related to the calculation (amortization, interest, wages of drivers, etc) cost were not accounted for in the costs.

Therefore, while the road index calculation relies on 4 criteria (TrC, TiC, ReC and SeC), in case of Rail index there is no need to separately calculate the transportation costs (Trc) and time costs (TiC), for the following reasons:

1. The railway tariff for international freight transportation in addition to other overheads includes expenses for energy consumption, fuel costs, labor, etc;
2. The methodology for calculating the base cost of railway transportation is the basis for calculation of the international transit tariff (MTT) and is approved by OSJD and is therefore applied by all railway administrations of the OSJD member countries, including all CIS countries, as a commonly agreed methodology for base cost calculation for railway transportation;
3. The methodology for calculating the base cost of railway transportation for separate types of freight is applied for railway transportation tariff calculation, which subsequently are approved (annually) during the Sessions of the Council of Heads of Railway Administrations of the CIS countries and the Annual Tariff Conference of Railway Administrations of the CIS countries;

It is noted above the configuration of other criteria/components of the Road Stretch Index such as ReC and SeC remain unchanged in case of Railway Index calculation, but in case of Railway Stretch calculation Time cost (TiC) due to railway tariffs includes all expenditure related to the transportation and stop time of the train, including wages and energy/power supply expenses. In this respect, in calculating the Railway Index for Stretches, the configuration of the formula was adjusted in order to avoid duplication of same parameters in different dimensions. Hence, in deriving the Railway Stretch Index, instead of four criteria the following three are applied:

1. Transportation Costs (TrC),
2. Reliability Costs (ReC),
3. Security Costs (SeC);

Where:

Transportation Costs (TrC):

TrC = R/W Tariff + avC;

Where:

R/W Tariff = Current r/w tariff for the freight transportation applied according the Tariff policy for current year, approved by Council of R/W Administration of CIS countries.

avC = avCn + avCn/o spent during the journey on the stretches

Reliability Costs (ReC):

ReC = Re * Railway VOT^{i} for transportation of one 20 feet LC;

Where:

Re = Time $_{max}$ – Time $_{min}$

Security Costs (SeC):

SeC = TrC * RiC;

Where:

Risk Cost was calculated by multiplying the costs of transportation across the stretch by risk coefficient on the same stretch. This criterion enables the assessment of a possible increase in the transportation cost on the stretch in terms of safety and security level (Risk Premium).

The results of calculations of the criteria, main indexes and basic data were brought together in a single Table for each stretch.

Accordingly, the specific weight (**α**) of the criteria will need to be recalculated considering the applicability of three criteria only (instead of four) in case of Railway Index for Stretches, and therefore in deriving the Analytical Hierarchy Processes (AHP) the calculation will have to be done for three pairs, rather than four in case of mean shares in Road Index.

7.5 Shipping Lines Index Calculation

Shipping Index (S) = ShR (S)

Shipping Index = Shipping Rate for respective stretches, which was adjusted to the length when multimodal Index was calculated.

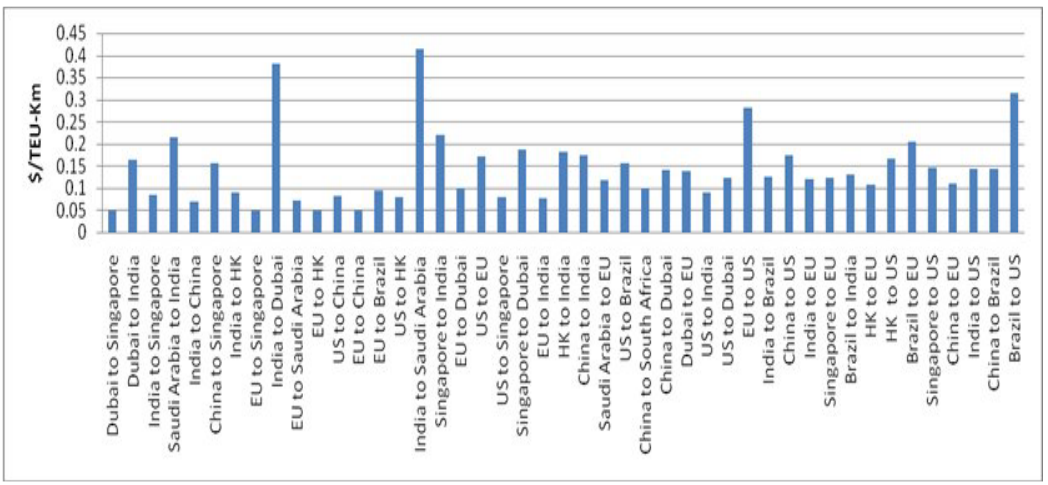
Shipping Index was calculated only as shipping freight. Accordantly all other criteria' TiC, ReC and SeC were not considered because of the following reasons:

1. Fuel Costs and other relevant expenditures usually are included in Shipping rate;

2. AVC - no other official or unofficial cost paid during the hauling of containers by liner ship;
3. SeC was not considered; due to all liner ships as a rule are covered by high quality of insurance by qualified insurance companies;
4. Shipping VOT due to very high fluctuation of shipping rates for container transportation and tariff application varies by region and countries of O/D (please refer to the figure of OECD (TAD/TC/WP, 2009, N7 below);

For Shipping Index only shipping Stretches index was calculated.

Figure 1: Shipping Stretches



Source: Author's Calculations

8 Adjustment of Values for the Road Stretches along the Transportation Routes/Corridor

At the initial stage for Road, Railway and Shipping line' Indexes (stretches and nodes) separately were assessed by value of respective criteria' for three alternative transportation routes on the basis of TRAX methodology. On the later stage the data on these criteria derived from the calculations described above were adjusted to fit the transportation route' approach. The adjustment of Multimodal index relates to the length of each section. There was no adjustment made for the Node data. It is important to mention that the adjustment of the total stretches index value to the length (for comparison reason) was made at the transportation route/corridor level and not for the section (or subsection) level. This approach ensures the comparability of the total index of the entire transportation routes/corridors. Mote on that for each alternative transportation route were assessed and later adjusted equal number of section (3) in order to have common approach to for the calculation of average Length. For the data adjustment purposes, the average length, km

(**AvL(S)**) was specified. The average length of the route is calculated as an average value of all integrated regional sections of this route.

AvL(s) = Σ L(s)i/N, i=1….N (N – number of the section/).

As it was mentioned above, in case of our assessment for all three alternative routes/sections data's adjustment were made in accordance with the length of the section.

Adjusted Transportation costs (**adjTrC**): **adjTrC(s) = TrC(s) / L(s) * AvL (s);**
Adjusted Risk (Security/Safety) costs **(adjSeC): adjSeC(s) = SeC(s)/ L(s) * AvL (s);**
Adjusted Transportation Time costs **adjTiC(S): adjTiC(s) = TiC(s) / L(s) * AvL (s);**
Adjusted Reliability costs **ReC(s): adjReC(s) = ReC(s) / L(S) * AvL (s);**

8.1 Multimodal INDEX' Calculation for Comparative Analysis

As noted above Multimodal Index is calculated as a sum of adjusted Road, Railway and Shipping Indexes multiplied by specific weight of each criterion due to comparative analysis between each to other have to be adjusted to the length of the length.

Multimodal Index = adjRoad (R) Index + adjRailway (Rw) Index + adjShipping (Ship) Index;

Where:

- Index (R) = ∑Index (S/n) + ∑Index (N/n);
- Index (Rw) = ∑Index (S/n) + ∑Index (N/n);
- Index (Ship) = ∑Index (S/n);

Where each Criteria' of the Indexes for Stretches and Nodes have to be multiplied by its specific weight which are different region by region and sometime country by country.

9 Conclusion and Recommendations

As per the discussions, attractiveness index calculation shows that all selected transportation route towards to Afghanistan require further development and substantial improvements in all aspects of the logistics of a corridor. It should be noted the that TRAX is an objective and numeric tool to measure the attractiveness of TRACECA transport corridor in future in terms of its power to attract/ accommodate multimodal freight traffic. Furthermore, TRAX can also be used as a tool to monitor the improvements of Afghanistan transportation routes based over a time series through periodic (e.g. yearly) re-run of TRAX. The transport routes are compiled with interconnection options and origin/destination points. The overall routes, including stretches and nodes are further compared according to the selected criteria': time, cost, reliability and safety/security. As the comparative analysis is focused on the connection of Afghanistan with the Europe, Kabul was chosen as an origin point for all of the transportation

routes and port of Rotterdam as a final destination point as the most optimal interconnection point for Europe because port of Rotterdam is one of major hub in Europe and the regular container traffic (shipping lines) with port of Poti, port of Karachi and port of Riga has already been well organized. Lastly, connection of Afghanistan with Europe via TRACECA is offered through three main options/subsections: from port of Poti to Kabul via Serkhetabad/Turkmenistan, Termez/Uzbekistan and Nijnii yanj/Tajikistan border crossing in comparison with transportation routes/sections via port of Riga and port of Karachi. The TRACECA Route Attractiveness Index (TRAX) has been slightly modified to maintain a consistent and equal approach while measuring attractiveness of main alternative transportation routes for Afghanistan Trade flows.

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[i] Railway VOT was considered only for calculation of ReC in order to avoid duplication with calculation of TsC, which already includes R/W tariff, partly covering the same expenses as per VOT;