REPUBLIC OF TURKEY
MINISTRY OF TRANSPORT
AND INFRASTRUCTURE

GENERAL DIRECTORATE
of HIGHWAYS

Benchmarking Transport Infrastructure Construction Costs

GENEVA

30 -31 JANUARY 2020

10 th Session

UNECE

1. ROAD TERMINOLOGY
2. ANALYSIS OF DATA
3. SUGGESTIONS FOR FURTHER ACTIONS
4. FOUR OPEN ENDED QUESTIONS
5. QUESTIONS FOR FURTHER STUDIES

ROAD TERMINOLOGY

WHAT HAVE BEEN DONE ON TERMINOLOGY AFTER SESSION 9

THE FOLLOWINGS WERE DONE ON TERMINOLOGY AFTER 9TH SESSION OF MEETING

- Terminology were reviewed
- Some terms were renewed
- Some terms suggested to be deleted since they are so specific and not necessary for construction cost benchmarking study
- New literature added to reference list because of renewed terms

Definition needs to be developed in general part

Asset Management: [definition to be developed].

1) A systematic process of operating, maintaining, and upgrading transportation assets cost effectively by combining engineering practices and analysis with sound business practice and economic theory.

2) The management of the physical infrastructure such as pavements, bridges, and airports, as well as human resources (personnel and knowledge), equipment and materials, and other items of value such as financial capabilities, right-of-way, data, computer systems, methods, technologies, and partners (11).

Definition needs to be developed in general part

Design life of infrastructure: The length of time for which an infrastructure asset is being designed.

Design period of asset: [definition to be developed]. same as design life

Definition needs to be developed in general part

Disposal cost: Costs associated with disposal of the asset at the end of its life cycle, including taking account of any asset transfer obligations. ~~Note 1 to entry: Asset transfer obligations could include bringing the assets up to a predefined condition. Note 2 to entry: Income from selling the asset is part of WLC, where the residual value of the road infrastructure components, materials and appliances can be included~~ (1).

Definitions needs to be transferred from general part to road part

25. Drainage: The removal of water from the highway right-of-way area by use of culverts, ditches, outsell channels and other drainage structures (8).
should be in the road definition, Annex II

28. Edge line: The line used to differentiate the outer edge of the traffic lanes from the shoulder (8).
should be in the road definition, Annex II

Should be added to reference list of General Part

(11) AASHTO Transportation Glossary, 4th edition, 2009.

Definitions suggested to be deleted from road part

Activity
Highway Agency
Alternative contracting
Anionic Bituminous Emulsion
Asphalt pavement
Cationic Bituminous Emulsion
Coarse aggregate
Correlation analysis
Crushed stone
Design period of pavement
Manufactured aggregate
Natural aggregate
Recycled aggregate

Definitions suggested to be deleted from road part

~~4. Activity: The specific action performed by the highway agency or the contractor, such as initial construction or major rehabilitation. An activity is defined by its physical costs, its service life, and its effects on highway users (5).~~

~~5. Highway Agency: Any government organization responsible for initiating and carrying forward a highway program for the general public. (5).~~

~~8. Alternative contracting: The type of contract that is executed in ways other than traditional design-bid-build type (5).~~

Definitions suggested to be deleted from road part

~~10. Anionic Bituminous Emulsion: The emulsion in which the emulsifier imparts negative charges to the dispersed bitumen droplets (8).~~

~~19. Asphalt pavement: The structure consisting of one or more layers of asphalt mix resting on a subgrade (16).~~

~~40. Cationic Bituminous Emulsion: The emulsion in which the emulsifier imparts positive charges to the dispersed bitumen droplets (8).~~

~~42. Coarse Aggregate: The designation given to the larger aggregate sizes with D greater than 4 mm and d greater than or equal to 1 mm (9).~~

Definitions suggested to be deleted from road part

~~48. Correlation Analysis: The statistical technique that is used to study the relationship among variables (5).~~

~~56. Crushed stone: The product excavated from an in-situ deposit of rock, crushed and processed for construction purposes with substantially all faces resulting from the crushing operation (11).~~

~~62. Design period of pavement: The period considered appropriate to the function of the road. It is used to determine the total traffic for which the pavement is designed (14).~~

Definitions suggested to be deleted from road part

~~101. Manufactured Aggregate: The aggregate of mineral origin resulting from an industrial process involving thermal or other modification (9).~~

~~108. Natural Aggregate: The aggregate from mineral sources that has been subjected to nothing more than mechanical processing (9).~~

~~140. Recycled Aggregate: The aggregate resulting from the processing of inorganic or mineral material previously used in construction. Note 1 to Entry: Recycled aggregates can also be obtained from production residues or nonconforming products, e.g. crushed unused concrete (9).~~

Definitions suggested to be changed in road part

23. Balanced cantilever bridge: ~~Prestressed concrete balanced cantilever bridges are often built using segmental construction Balanced cantilever bridges are adopted for comparatively longer spans where simply supported, continuous or rigid frame type superstructures are found unsuitable.~~

The type of bridge that constructed using balanced cantilever technique to attach the segments in an alternate manner at opposite ends of cantilevers supported by piers. (7)

37. Cable stayed bridge: ~~The bridge whose deck is supported at more or less regular distances by cables which are fixed to the top or along a mast protruding from the deck plane. In most cases cable-stayed bridges are self-anchored, i.e. the normal force introduced in the deck by the cables on one side of a mast is compensated by the normal force introduced on the other side (7) [for Turkey to review].~~

A bridge in which the superstructure is directly supported by cables or stays, passing over or attached to towers located at the main piers (21).

Definitions suggested to be developed in road part

49. Corridor: ~~The major area of travel between two points (A corridor may include more than one major route and more than one form of transport) (14).~~

1) A strip of land between two termini within which traffic, topography, environment, and other characteristics are evaluated for transportation purposes. Also for transmission of a utility. 2) A broad geographical band that identifies a general directional flow of traffic. It may encompass streets, highways, and transit alignments (21)

50. Corridor study: ~~The broad geographical band that follows a general directional flow or connects major sources of trips. It may contain a number of streets, highways and transit lines and routes (11).~~ A planning project that defines the relationships between a roadway and its adjacent land. Corridor studies are used to:

- Define acceptable levels of access and mobility,
- Determine transportation system needs to support surrounding land uses,
- Consolidate and control access points,
- Identify operational deficiencies and promote operational efficiency, and
- Promote redevelopment of an underperforming corridor (20).

Definitions suggested to be developed in road part

61. Design life of pavement (~~TR~~ or Design period of pavement): The length of time for which a pavement structure is being designed based on structural distresses and traffic loadings (5).

Add title of the term

Resurfacing by Strengthening: (Added)

Renewing of road surface with reinstalling bituminous layer by removing determined depth of pavement by milling in order to increase bearing capacity of road and to eliminate road defects. (7).

Should be added to reference list of road part

(20)https://www.fdotd7studies.com/altus19studies/what-is-a-corridor-study/

(21) AASHTO Transportation Glossary,4th edition, 2009.

ANALYSIS OF DATA

ANALYSIS OF DATA OBTAINED FROM QUESTIONNAIRE

BENCHMARKING DATA AVAILABILITY

CONSOLIDATED DATA:
5 COUNTRIES

- BULGARIA
- LATVIA
- RUSSIAN FEDERATION
- SWEDEN
- TURKEY

PROJECT BASED DATA:
2 COUNTRIES

- CROTIA
- MOLDOVA

DATA IS NOT AVAILABLE EVEN FOUR QUESTIONS WERE ANSWERED:

4 COUNTRIES

- CYPRUS
- CZECHIA
- FINLAND
- PORTUGAL

ANAYSIS OF BENCHMARKING DATA

PROBABLE MISTAKES ON TABLES

- DECIMAL PROBLEMS
- CURRENCY PROBLEMS
- DATA MISSING
- SOME DATA ARE CONFUSING
- MISREADING OF TABLES BY COUNTRIES
- NOT ENOUGH COST DATA
- NOT ENOUGH SOCIO ECONOMIC DATA
- NOT EHOUGH STATISTICAL DATA AS MAX, MIN, AVE.
- COST UNITS MAY NOT BE REGARDED CORRECTLY AS $/KM AND $/LANEXKM
- PRICES OF YEAR
- OTHER

EXPLANATION ABOUT MISUNDERSTANDINGS

- WE ARE NOT SURE ABOUT DECIMALS
- LOOKS LIKE CURRENCY PROBLEM OR TOTAL COST IS GIVEN NOT PER KM OR PER LANEXKM
- TABLES MOST PROBABLY NOT CORRECTLY READ BY COUNTRIES,

  NEEDS MORE EXPLANATION
- VERY LIMITED DATA WERE COLLECTED
- COUNTRIES FILL EITHER CONSOLIDATED TABLE OR PROJECT BASED ONE. MOST OF THE COUNTRIES FILLED CONSOLIDATED ONE

SOCIAL AND ECONOMIC INDICATORS

ANALYSIS OF QUESTIONNAIRE

Sample to decimal and/or unit problem?

Question 1: Provide the following social and economic indicators			
Length of roads (end of 2016) (km)	High Classified Roads (HCR)-motorways		322,693
	Medium Classified Roads (MCR)-primary roads	Single Carriageway	793,32535
		Double Carriageway	809,71
	Medium Classified Roads (MCR)-secondary roads	Single Carriageway	1336,143
		Double Carriageway	1.048,00
	Other Roads	Single Carriageway	
		Double Carriageway	
Length of Bridges (end of 2016) (M)			19,33006
Length of Tunnels (end of 2016) (M) (**)			4380
HCR_Motorways per 1000 km² (end of 2016)			
MCR_Primary Roads per 1000 km² (end of 2016)			
MCR_Secondary Roads per 1000 km² (end of 2016)			
Annual investment budget of roads (US$) (2016 Fiscal Year)			
Annual Road Investment by PPP (Average of the last five years (2012-2016) (US$)			
Annual Investment Budget of Roads as Percentage of GNP (%) (2016) (Including yearlyy PPP investments)			
Annual constructed roads in length (km) (Average of the last five years (2012-2016))			
Annual constructed double carriageway roads in length (km) (Average of the last five years (2012-2016))			
Annual constructed single carriageway roads in length (km) (Average of the last five years (2012-2016))			
Annual constructed tunnels in length (m) (Average of the last five years (2012-2016))			
Annual constructed bridges in length (m) (Average of the last five years (2012-2016))			
Design Cost as Percentage of Construction Cost (%) (end of 2016 Prices)			

(*) Lakes and dams exclude from the surface area

(**) All tunnels are converted to single tube tunnels

Sample to misunderstanding of the cells!

Question 1: Provide the following social and economic indicators			
Length of roads (end of 2016) (km)	High Classified Roads (HCR)-motorways		918,5
	Medium Classified Roads (MCR)-primary roads	Single Carriageway	7,3
		Double Carriageway	N/A
	Medium Classified Roads (MCR)-secondary roads	Single Carriageway	N/A
		Double Carriageway	N/A
	Other Roads	Single Carriageway	N/A
		Double Carriageway	N/A
Length of Bridges (end of 2016) (M)			8,51
Length of Tunnels (end of 2016) (M) (**)			31,63
HCR_Motorways per 1000 km² (end of 2016)			N/A
MCR_Primary Roads per 1000 km² (end of 2016)			N/A
MCR_Secondary Roads per 1000 km² (end of 2016)			N/A
Annual investment budget of roads (US$) (2016 Fiscal Year)			N/A
Annual Road Investment by PPP (Average of the last five years (2012-2016) (US$)			N/A
Annual Investment Budget of Roads as Percentage of GNP (%) (2016) (Including yearlyy PPP investments)			N/A
Annual constructed roads in length (km) (Average of the last five years (2012-2016))			N/A
Annual constructed double carriageway roads in length (km) (Average of the last five years (2012-2016))			5
Annual constructed single carriageway roads in length (km) (Average of the last five years (2012-2016))			0,5
Annual constructed tunnels in length (m) (Average of the last five years (2012-2016))			1300
Annual constructed bridges in length (m) (Average of the last five years (2012-2016))			500
Design Cost as Percentage of Construction Cost (%) (end of 2016 Prices)			2,5-3,0

Probably understood as in the year not end of and total

Sample to well understood data

Question 1: Provide the following social and economic indicators			
Length of roads (end of 2016) (km)	High Classified Roads (HCR)-motorways		N/A
	Medium Classified Roads (MCR)-primary roads	Single Carriageway	1.565
		Double Carriageway	107
	Medium Classified Roads (MCR)-secondary roads	Single Carriageway	5.466
		Double Carriageway	N/A
	Other Roads	Single Carriageway	12.984
		Double Carriageway	N/A
Length of Bridges (end of 2016) (M)			315,210
Length of Tunnels (end of 2016) (M) (**)			N/A
HCR_Motorways per 1000 km² (end of 2016)			N/A
MCR_Primary Roads per 1000 km² (end of 2016)			25,89
MCR_Secondary Roads per 1000 km² (end of 2016)			84,65
Annual investment budget of roads (US$) (2016 Fiscal Year)			316.609.200
Annual Road Investment by PPP (Average of the last five years (2012-2016) (US$)			N/A
Annual Investment Budget of Roads as Percentage of GNP (%) (2016) (Including yearlyy PPP investments)			1,03%
Annual constructed roads in length (km) (Average of the last five years (2012-2016))			440
Annual constructed double carriageway roads in length (km) (Average of the last five years (2012-2016))			N/A
Annual constructed single carriageway roads in length (km) (Average of the last five years (2012-2016))			440
Annual constructed tunnels in length (m) (Average of the last five years (2012-2016))			N/A
Annual constructed bridges in length (m) (Average of the last five years (2012-2016))			242
Design Cost as Percentage of Construction Cost (%) (end of 2016 Prices)			

(*)	Lakes and dams exclude from the surface area
(**)	All tunnels are converted to single tube tunnels

Sample to well understood data

Question 1: Provide the following social and economic indicators			
Length of roads (end of 2016) (km)	High Classified Roads (HCR)-motorways		0
	Medium Classified Roads (MCR)-primary roads	Single Carriageway	783
		Double Carriageway	59
	Medium Classified Roads (MCR)-secondary roads	Single Carriageway	2525,8
		Double Carriageway	0
	Other Roads	Single Carriageway	6017,9
		Double Carriageway	0
Length of Bridges (end of 2016) (M)			26856
Length of Tunnels (end of 2016) (M) (**)			0
HCR_Motorways per 1000 km² (end of 2016)			0
MCR_Primary Roads per 1000 km² (end of 2016)			24,9
MCR_Secondary Roads per 1000 km² (end of 2016)			74,6
Annual investment budget of roads (US$) (2016 Fiscal Year)			81.236.913
Annual Road Investment by PPP (Average of the last five years (2012-2016) (US$)			0
Annual Investment Budget of Roads as Percentage of GNP (%) (2016) (Including yearlyy PPP investments)			1,2
Annual constructed roads in length (km) (Average of the last five years (2012-2016))			9,8
Annual constructed double carriageway roads in length (km) (Average of the last five years (2012-2016))			0
Annual constructed single carriageway roads in length (km) (Average of the last five years (2012-2016))			9,8
Annual constructed tunnels in length (m) (Average of the last five years (2012-2016))			0
Annual constructed bridges in length (m) (Average of the last five years (2012-2016))			0
Design Cost as Percentage of Construction Cost (%) (end of 2016 Prices)			1,07

(*) Lakes and dams exclude from the surface area

(**) All tunnels are converted to single tube tunnels

Sample to missing data

Question 1: Provide the following social and economic indicators			
GNP (US$) (end of 2018)			221.226.563.400,00 USD
Population (end of 2016)			
GNP per capita (US$) (end of 2016)			
Surface area (km²) (*)			
Density (end of 2016) Person/km²			
Length of roads (end of 2016) (km)	High Classified Roads (HCR)-motorways		
	Medium Classified Roads (MCR)-primary roads	Single Carriageway	
		Double Carriageway	
	Medium Classified Roads (MCR)-secondary roads	Single Carriageway	
		Double Carriageway	
	Other Roads	Single Carriageway	
		Double Carriageway	
Length of Bridges (end of 2016) (M)			
Length of Tunnels (end of 2016) (M) (**)			
HCR_Motorways per 1000 km² (end of 2016)			
MCR_Primary Roads per 1000 km² (end of 2016)			
MCR_Secondary Roads per 1000 km² (end of 2016)			
Annual investment budget of roads (US$) (2018 Fiscal Year)			35.653.289,20 USD
Annual Road Investment by PPP (Average of the last five years (2012-2018) (US$)			1.096.438.910,90 USD
Annual Investment Budget of Roads as Percentage of GNP (%) (2018) (Including yearly PPP investments)			0,50%
Annual constructed roads in length (km) (Average of the last five years (2012-2016))			
Annual constructed double carriageway roads in length (km) (Average of the last five years (2012-2016))			
Annual constructed single carriageway roads in length (km) (Average of the last five years (2012-2016))			
Annual constructed tunnels in length (m) (Average of the last five years (2012-2016))			
Annual constructed bridges in length (m) (Average of the last five years (2012-2016))			
Design Cost as Percentage of Construction Cost (%) (end of 2016 Prices)			

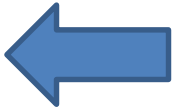
(*) Lakes and dams exclude from the surface area
(**) All tunnels are converted to single tube tunnels

Sample

Вопрос 1: Предоставить данные по следующим социальным и экономическим показателям

Протяженность (длина) дороги по состоянию на конец 2016 г., км	Дороги высокой категории (ДВК) – автомагистрали		N/A
	Дороги средней категории (ДСК) – основные дороги	Одна проезжая часть	N/A
		Две проезжие части	N/A
	Дороги средней категории (ДСК) – второстепенные дороги	Одна проезжая часть	N/A
		Две проезжие части	N/A
	Другие дороги	Одна проезжая часть	N/A
		Две проезжие части	N/A
Длина мостов (по состоянию на конец 2016 г.), м			2.361.196,671
Длина тоннелей (по состоянию на конец 2016 г.), м **			58.752,360
Автомагистрали (ДВК) на 1000 [км]^2 (по состоянию на конец 2016 г.)			N/A
Основные дороги (ДСК) на 1000 [км]^2 (по состоянию на конец 2016 г.)			N/A
Второстепенные дороги (ДСК) на 1000 [км]^2 (по состоянию на конец 2016 г.)			N/A
Годовой инвестиционный бюджет на дороги (в долл. США) за 2016 финансовый год			4794254078
Годовой инвестиционный бюджет на основе государственно-частного партнерства (среднее значение за последние пять лет с 2012-2016 гг. в долларах США)			1692353733
Годовой инвестиционный бюджет на дороги, процент от ВНП (%) (2016 г.), включая годовые инвестиции государственно-частного партнерства			0,38
Протяженность построенных за год дорог (км) среднее значение за последние пять лет с 2012-2016 гг.			2.736,615
Длина построенных за год дорог с двумя проезжими частями (км) среднее значение за последние пять лет с 2012-2016 гг.			N/A
Длина построенных за год дорог с одной проезжей частью (км) среднее значение за последние пять лет с 2012-2016 гг.			N/A
Длина построенных за год тоннелей с (км) среднее значение за последние пять лет с 2012-2016 гг.			2,740
Длина построенныхза год мостов с (км) среднее значение за последние пять лет с 2012-2016 гг.			50,485
Стоимость проектирования в процентном соотношении от стоимости строительства (%) (цены по состоянию на конец 2016 г.)			12%

(*) Озера и плотины не учитываются при расчете площади поверхности
(**) Данные по всем тоннелям предоставляются (пересчитываются) как данные по однотрубным тоннелям



Probably understood as in the year not end of and total

Sample to units in the table is not regarded but given in the cells

Length of roads (end of 2016) (km)	High Classified Roads (HCR)-motorways		2101 Km
	Medium Classified Roads (MCR)-primary roads	Single Carriageway	10559 Km
		Double Carriageway	3022 Km
	Medium Classified Roads (MCR)-secondary roads	Single Carriageway	10441 Km
		Double Carriageway	300 Km
	Other Roads	Single Carriageway	72041 Km
		Double Carriageway	115 Km
Length of Bridges (end of 2016) (M)			588 Km
Length of Tunnels (end of 2016) (M) (**)			29 Km
HCR_Motorways per 1000 km² (end of 2016)			52,3 km²
MCR_Primary Roads per 1000 km² (end of 2016)			183,4 km²
MCR_Secondary Roads per 1000 km² (end of 2016)			80,5 km²
Annual investment budget of roads (US$) (2016 Fiscal Year)			
Annual Road Investment by PPP (Average of the last five years (2012-2016) (US$)			
Annual Investment Budget of Roads as Percentage of GNP (%) (2016) (Including yearlyy PPP investments)			
Annual constructed roads in length (km) (Average of the last five years (2012-2016))			227,2 km/year
Annual constructed double carriageway roads in length (km) (Average of the last five years (2012-2016))			125,2 km/year
Annual constructed single carriageway roads in length (km) (Average of the last five years (2012-2016))			102 km/year
Annual constructed tunnels in length (m) (Average of the last five years (2012-2016))			1113,8 m/year
Annual constructed bridges in length (m) (Average of the last five years (2012-2016))			10499,2 m/year
Design Cost as Percentage of Construction Cost (%) (end of 2016 Prices)			

(*) Lakes and dams exclude from the surface area

(**) All tunnels are converted to single tube tunnels

Good Sample

Social and Economic Indicators			
GNP (US $) (end of 2016)			856.791.000.000
POPULATION (end of 2016)			79.814.871
GNP Per Capita (US $) (end of 2016)			10.807
Surface Area (Km2)*			769.604
Density (end of 2016) Person/Km2			104
LENGTH OF ROADS (end of 2016) (Km)	High Classified Roads (HCR)-MOTORWAYS		2.542
	Medium Classified Roads (MCR)-PRIMARY ROADS	Singe Carriageway	11.316
		Double Carraigeway	19.790
	Medium Classified Roads (MCR)-SECONDARY ROADS	Singe Carriageway	32.015
		Double Carraigeway	1.498
	OTHER ROADS	Singe Carriageway	175.429
		Double Carraigeway	N.A.
Length of Bridges (end of 2016) (m)			520.934
Length of Tunnels (end of 2016) (m)**			345.851
HCR_Motorways per 1000 Km2 (end of 2016)			3,3
MCR_Primary Roads per 1000 Km2 (end of 2016)			40,4
MCR_Secondary Roads per 1000 Km2 (end of 2016)			43,5
ANNUAL INVESTMENT BUDGET OF ROADS (US $) (2016 Fiscal Year)			6.080.901.283
ANNUAL ROAD INVESTMENT BY PPP (US $) (Average of the last five years 2012-2016)			1.657.913.741
Annual Investment Budget of Roads as Percentage of GNP (%) (including yearly PPP investment)			0,90
ANNUAL CONSTRUCTED ROADS IN LENGTH (KM) (end of 2016)			1.761
ANNUAL CONSTRUCTED DOUBLE CARRIAGEWAY ROADS IN LENGTH (KM) (Average of the last five years 2012-2016)			794
ANNUAL CONSTRUCTED SINGLE CARRIAGEWAY ROADS IN LENGTH (KM) (Average of the last five years 2012-2016)			967
ANNUAL CONSTRUCTED TUNNELS IN LENGTH (M) (Average of the last five years 2012-2016)**			39.339
ANNUAL CONSTRUCTED BRIDGES IN LENGTH (M) (Average of the last five years 2012-2016)			26.395
Design Cost as Percentage of Construction Cost (%) (end of 2016)			3-5

* Lakes and dams are excluded from the surface area.

** All tunnels are converted to single tube tunnels.

CONSTRUCTION COSTS OF BRIDGES AND TUNNELS

ANALYSIS OF QUESTIONNAIRE

Sample to missing data

Construction costs of bridges and tunnels				
Please remember:	**All costs should be provided in US$ 2016 prices**			
	Values should be calculated as mean values for all relevant projects started in the priod 2007-2016			
	The costs should exclude design costs, land acquisition costs and value added cost			
Please indicate N/A (not applicable) if data is not available				

		values	length of regarded projects (km)	Number of projects
Unit Construction Cost of Tunnels	single tube tunnel (US$/m)			
	twin tube tunnel (US$/m)	N/A	2,19	2
	Under water tunnels (US $/M)			
Unit Construction Cost Of Bridges	Precasted and pre-stressed simple beam (US$/m^2)	N/A	19,33006	9
	balanced cantiliver bridge (US$/m^2)			
	cable stayed bridge (US$/m^2)			
	suspension bridge (US$/m^2)			
	Pedestrian bridge (US$/m^2)			

Sample

Construction costs of bridges and tunnels

Please remember: **All costs should be provided in US$ 2016 prices**

Values should be calculated as mean values for all relevant projects started in the priod 2007-2016

The costs should exclude design costs, land acquisition costs and value added cost

Please indicate N/A (not applicable) if data is not available

		values	length of regarded projects (km)	Number of projects
Unit Construction Cost of Tunnels	single tube tunnel (US$/m)	N/A	N/A	N/A
	twin tube tunnel (US$/m)	N/A	N/A	N/A
	Under water tunnels (US $/M)	N/A	N/A	N/A
Unit Construction Cost Of Bridges	Precasted and pre-stressed simple beam (US$/m^2)	***	N/A	N/A
	balanced cantiliver bridge (US$/m^2)	N/A	N/A	N/A
	cable stayed bridge (US$/m^2)	N/A	N/A	N/A
	suspension bridge (US$/m^2)	N/A	N/A	N/A
	Pedestrian bridge (US$/m^2)	1050	0,291	1

*** - In Latvia we don't use precasted elemets (beams, slabs) to build new bridges. All bridges built in more than last 20 year are in-situ poured reinforced concrete bridges. Average costs for small and medium size (length L<50m, and span <30m) bridge reconstruction is 2250 (US$/m2) and for bridge rehabilitation is 750 (US$/m2).

Good Sample

Construction costs of bridges and tunnels

Please remember: **All costs should be provided in US$ 2016 prices**

Values should be calculated as mean values for all relevant projects started in the priod 2007-2016

The costs should exclude design costs, land acquisition costs and value added cost

Please indicate N/A (not applicable) if data is not available

		values	length of regarded projects (km)	Number of projects
Unit Construction Cost of Tunnels	single tube tunnel (US$/m)			
	twin tube tunnel (US$/m)			
	Under water tunnels (US $/M)			
Unit Construction Cost Of Bridges	Precasted and pre-stressed simple beam (US$/$m^2$)	1534	0,183	3
	balanced cantiliver bridge (US$/$m^2$)			
	cable stayed bridge (US$/$m^2$)			
	suspension bridge (US$/$m^2$)			
	Pedestrian bridge (US$/$m^2$)	16542	0,126	1

Good Sample

Construction Costs of Bridges and Tunnels

		AVERAGE	LENGTH OF REGARDED PROJECTS (KM)
UNIT CONSTRUCTION COST OF TUNNELS (2016 Prices)	SINGLE TUBE TUNNEL (US $/M)	9.922	6,6
	TWIN TUBE TUNNEL (US $/M)	19.827	20,5
	UNDER WATER TUNNELS (US $/M)	86.562	28,2
UNIT CONSTRUCTION COST OF BRIDGES (2016 Prices)	PRECASTED AND PRESTRESSED SIMPLE BEAM (US $/M^2)	698	30,9
	BALANCED CANTILIVER BRIDGE (US $/M^2)	2.303	2,5
	CABLE STAYED BRIDGE (US $/M^2)	3.006	0,6
	PEDESTRIAN BRIDGES (US $/M2)	1.128	N.A
	SUSPENSION BRIDGE (US $/M^2)	9.644	5,3
	SUSPENSION + CABLE STAYED BRIDGE (US $/M^2)	6.827	2,2

CONSTRUCTION COSTS OF ASPHALT ROADS AS SINGLE CARRIAGEWAY

ANALYSIS OF QUESTIONNAIRE

Sample to misunderstanding of the cells!

Problem looks like the total value is given not as per km.

Question 3: Construction costs of asphalt roads — Single Carriageway Asphalt Roads						
Please remember:	**All costs should be provided in US$ 2016 prices, US$/km**					
	The costs should exclude costs of superstructures (tunnels, viaducts and bridges), design costs, land acquisition costs and value added cost					
	Values should be calculated as mean values for 'Average', maximum value for 'Maximum', and minimum value for 'Minimum' for all relevant projects started in the period 2007-2016					
Please indicate N/A (not applicable) if data is not available						

Work title	*Road class*	*Maximum*	*Average*	*Minimum*	*length of regarded projects*	*Number of projects*
Resurfacing	MCR_Primary Roads					
	MCR_Secondary Roads					
Resurfacing by strengthening	MCR_Primary Roads					
	MCR_Secondary Roads	548.363,00	321.127,00	123.223,00	593	38
Pavement Replacement	MCR_Primary Roads	N/A	N/A	N/A	8,2	1
	MCR_Secondary Roads					
Reconditioning	MCR_Primary Roads	N/A	N/A	287.704.948,61	741,6568	10
	MCR_Secondary Roads	N/A	N/A	289.454.253,16	740,743	12
Reconstruction	MCR_Primary Roads	N/A	N/A	N/A	1,1	1
	MCR_Secondary Roads					
New construction	MCR_Primary Roads	N/A	N/A	56.144.341,31	42,3686	2
	MCR_Secondary Roads	N/A	N/A	N/A	2,4	1

Good Sample

Question 3: Construction costs of asphalt roads — Single Carriageway Asphalt Roads

Please remember:	**All costs should be provided in US$ 2016 prices, US$/km**
	The costs should exclude costs of superstructures (tunnels, viaducts and bridges), design costs, land acquisition costs and value added cost
	Values should be calculated as mean values for 'Average', maximum value for 'Maximum', and minimum value for 'Minimum' for all relevant projects started in the period 2007-2016
Please indicate N/A (not applicable) if data is not available	

Work title	*Road class*	*Maximum*	*Average*	*Minimum*	*length of regarded projects (km)*	*Number of projects*
Resurfacing	MCR_Primary Roads	73804	44449	34543	33,22	5
	MCR_Secondary Roads	122159	43110	17597	523,14	81
Resurfacing by strengthening	MCR_Primary Roads	2251714	763966	377469	450,65	34
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
Pavement Replacement	MCR_Primary Roads	1761989	434215	124649	244,68	38
	MCR_Secondary Roads	1390314	211666	82641	240,65	69
Reconditioning	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
Reconstruction	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	952710	579553	262189	452,26	50
New construction	MCR_Primary Roads	7838778	4013278	1660910	127,4	3
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A

Questions about tables/ Not sure about data

Currency, Decimals, Units, etc.

Вопрос 3: Стоимость строительства дорог с асфальтобетонным покрытием – Дороги с асфальтобетонным покрытием с одной проезжей частью

Обратите внимание:

Все цены должны быть указаны в долл. США в ценах 2016 г., долл. США/км

Стоимость не должна включать в себя стоимость строительства пролетных строений (тоннели, виадуки и мосты), стоимость проектирования, стоимость приобретения участка (земли) и затраты, увеличивающие общую стоимость проекта.

При расчете стоимости должны браться средние значение стоимости для графы «В среднем», максимальное значение стоимости для графы «Максимум» и минимальные значения стоимости для графы «Минимум» всех соответствующих проектов, которые были начаты в период 2007-2016 гг.

Пожалуйста, ставьте «N/A» (нет данных), если данные отсутствуют.

Наименование вида работ	*Класс дороги*	*Максимум*	*В среднем*	*Минимум*	*Длина участка рассматриваемого проекта (км)*	*Количество проектов*
Устройство верхнего слоя покрытия	Основные дороги_ДСК	N/A	N/A	N/A	N/A	N/A
	Второстепенные дороги_ДСК	N/A	N/A	N/A	N/A	N/A
Устройство верхнего слоя покрытия путем усиления	Основные дороги_ДСК	N/A	N/A	N/A	N/A	N/A
	Второстепенные дороги_ДСК	N/A	N/A	N/A	N/A	N/A
Замена дорожного покрытия	Основные дороги_ДСК	167.566	41.961	9.827	1.680	206
	Второстепенные дороги_ДСК	192.946	47.098	40	396	118
Восстановительный ремонт	Основные дороги_ДСК	1.298.268	102.142	323	7.547	1212
	Второстепенные дороги_ДСК	1.296.667	91.412	50	5.702	2637
Реконструкция	Основные дороги_ДСК	2.130.193	325.361	5.024	1.962	267
	Второстепенные дороги_ДСК	889.366	177.877	3.382	1.191	284
Новое строительство	Основные дороги_ДСК	1.144.512	613.188	48.724	157	20
	Второстепенные дороги_ДСК	855.919	192.578	14.769	818	214

Sample to limited data, no statistical data

Question 3: Construction costs of asphalt roads — Single Carriageway Asphalt Roads

Please remember:

All costs should be provided in US$ 2016 prices, US$/km
The costs should exclude costs of superstructures (tunnels, viaducts and bridges), design costs, land acquisition costs and value added cost
Values should be calculated as mean values for 'Average', maximum value for 'Maximum', and minimum value for 'Minimum' for all relevant projects started in the period 2007-2016

Please indicate N/A (not applicable) if data is not available

Work title	*Road class*	*Maximum*	*Average*	*Minimum*	*length of regarded projects*	*Number of projects*
Resurfacing	MCR_Primary Roads		61000			
	MCR_Secondary Roads		41000			
Resurfacing by strengthening	MCR_Primary Roads		170000			
	MCR_Secondary Roads		170000			
Pavement Replacement	MCR_Primary Roads					
	MCR_Secondary Roads					
Reconditioning	MCR_Primary Roads					
	MCR_Secondary Roads					
Reconstruction	MCR_Primary Roads					
	MCR_Secondary Roads					
New construction	MCR_Primary Roads					
	MCR_Secondary Roads					

CONSTRUCTION COSTS OF ASPHALT ROADS AS DOUBLE CARRIAGEWAY

ANALYSIS OF QUESTIONNAIRE

Make a checklist to be sure about data

Стоимость строительства дорог с асфальтобетонным покрытием – Дороги с асфальтобетонным покрытием с двумя проезжими частями

Обратите внимание: **Все цены должны быть указаны в долл. США в ценах 2016 г., долл. США/полоса км**

Стоимость не должна включать в себя стоимость строительства пролетных строений (тоннели, виадуки и мосты), стоимость проектирования, стоимость приобретения участка (земли) и затраты, увеличивающие общую стоимость проекта.

При расчете стоимости должны браться средние значение стоимости для графы «В среднем» максимальное значение стоимости для графы «Максимум» и минимальные значения стоимости для графы «Минимум» всех соответствующих проектов, которые были начаты в период 2007-2016 гг

Пожалуйста, ставьте «N/A» (нет данных), если данные отсутствуют.

Наименование вида работ		*Класс дороги*	*Максимум*	*В среднем*	*Минимум*	*Длина участка рассматриваемого проекта (км)*	*Количество проектов*	*Длина участка рассматриваемого проекта в 1 полосу (км)*
Resurfacing	Устройство верхнего слоя покрытия	Автомагистрали-скоростные авт. дороги_ДВК	N/A	N/A	N/A	N/A	N/A	
		Основные дороги_ДСК	N/A	N/A	N/A	N/A	N/A	
		Второстепенные дороги_ДСК	N/A	N/A	N/A	N/A	N/A	
Resurfacing by strengthening	Устройство верхнего слоя покрытия путем усиления	Автомагистрали-скоростные авт. дороги_ДВК	N/A	N/A	N/A	N/A	N/A	
		Основные дороги_ДСК	N/A	N/A	N/A	N/A	N/A	
		Второстепенные дороги_ДСК	N/A	N/A	N/A	N/A	N/A	
Pavement replacement	Замена дорожного покрытия	Автомагистрали-скоростные авт. дороги_ДВК	143.012	43.340	21.597	194	14	194
		Основные дороги_ДСК	73.133	68.581	54.256	13	2	13
		Второстепенные дороги_ДСК	N/A	N/A	N/A	N/A	N/A	N/A
Reconditioning	Восстановительный ремонт	Автомагистрали-скоростные авт. дороги_ДВК	1.174.983	105.238	37.289	1.320	109	1.320
		Основные дороги_ДСК	196.153	105.017	53.836	384	59	384
		Второстепенные дороги_ДСК	203.856	126.382	49.759	20	158	20
Reconstruction	Реконструкция	Основные дороги_ДСК	991.429	300.455	102.330	699	28	699
		Второстепенные дороги_ДСК	215.902	201.346	195.966	2	2	2
Expansion (capacity improvement)	Уширение (увеличение пропускной способности)	Автомагистрали-скоростные авт. дороги_ДВК	1.398.603	635.830	125.710	1.043	22	1.043
		Основные дороги_ДСК	N/A	N/A	N/A			
		Второстепенные дороги_ДСК	N/A	N/A	N/A			
New construction	Новое строительство	Автомагистрали-скоростные авт. дороги_ДВК	2.225.891	846.862	701.277	74	6	74
		Основные дороги_ДСК	991.429	523.355	134.716	37	8	37
		Второстепенные дороги_ДСК	530.187	530.187	530.187	0	1	0

Sample to limited data

Construction costs of asphalt roads — Double Carriageway Asphalt Roads

Please remember: All costs should be provided in US$ 2016 prices, US$/lane km
The costs should exclude costs of superstructures (tunnels, viaducts and bridges), design costs, land acquisition costs and value added cost
Values should be calculated as mean values for 'Average', maximum value for 'Maximum', and minimum value for 'Minimum' for all relevant projects started in the

Please indicate N/A (not applicable) if data is not available

Work title	*Road class*	*Maximum*	*Average*	*Minimum*	*length of regarded projects (km)*	*Number of projects*
Resurfacing	HCR_Motorways-Expressways	N/A	N/A	N/A	N/A	N/A
	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
Resurfacing by strengthening	HCR_Motorways-Expressways	N/A	N/A	N/A	N/A	N/A
	MCR_Primary Roads	2236,65	2236,65	2236,65	10,1	1
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
Pavement replacement	HCR_Motorways-Expressways	N/A	N/A	N/A	N/A	N/A
	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
Reconditioning	HCR_Motorways-Expressways	N/A	N/A	N/A	N/A	N/A
	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
Reconstruction	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
Expansion (capacity improvement)	HCR_Motorways-Expressways	N/A	N/A	N/A	N/A	N/A
	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A
New construction	HCR_Motorways-Expressways	N/A	N/A	N/A	N/A	N/A
	MCR_Primary Roads	N/A	N/A	N/A	N/A	N/A
	MCR_Secondary Roads	N/A	N/A	N/A	N/A	N/A

Sample to limited data

Construction costs of asphalt roads — Double Carriageway Asphalt Roads

Please remember: **All costs should be provided in US$ 2016 prices, US$/lane km**
The costs should exclude costs of superstructures (tunnels, viaducts and bridges), design costs, land acquisition costs and value added cost
Values should be calculated as mean values for 'Average', maximum value for 'Maximum', and minimum value for 'Minimum' for all relevant projects started in the

Please indicate N/A (not applicable) if data is not available

Work title	*Road class*	*Maximum*	*Average*	*Minimum*	*length of regarded projects (km)*	*Number of projects*
Resurfacing	HCR_Motorways-Expressways		40000			
	MCR_Primary Roads		48000			
	MCR_Secondary Roads		47000			
Resurfacing by strengthening	HCR_Motorways-Expressways		N/A			
	MCR_Primary Roads		N/A			
	MCR_Secondary Roads		N/A			
Pavement replacement	HCR_Motorways-Expressways					
	MCR_Primary Roads					
	MCR_Secondary Roads					
Reconditioning	HCR_Motorways-Expressways					
	MCR_Primary Roads					
	MCR_Secondary Roads					
Reconstruction	MCR_Primary Roads					
	MCR_Secondary Roads					
Expansion (capacity improvement)	HCR_Motorways-Expressways					
	MCR_Primary Roads					
	MCR_Secondary Roads					
New construction	HCR_Motorways-Expressways					
	MCR_Primary Roads					
	MCR_Secondary Roads					

Sample to Good Data

Construction Costs of Asphalt Roads

DOUBLE CARRIAGEWAY ASPHALT ROADS

ROAD INFRASTRUCTURE CONSTRUCTION COSTS (2016 Prices) (US $/LanexKm) (For Asphalt Roads)

COUNTRIES

Work Title	Road Class	MAXIMUM	AVERAGE	MINIMUM	LENGTH OF REGARDED PROJECTS (KM)
Resurfacing	HCR_Motorways-Expressways	32.045	23.726	15.684	25
	MCR_Primary Roads	19.384	11.807	4.231	2.807
	MCR_Secondary Roads	17.500	10.442	3.385	312
Resurfacing by Strengthening	HCR_Motorways-Expressways	105.163	85.100	65.037	925
	MCR_Primary Roads	99.431	76.814	54.197	1.051
	MCR_Secondary Roads	87.966	65.662	43.358	117
Pavement Replacement	HCR_Motorways-Expressways	186.709	146.259	105.809	370
	MCR_Primary Roads	170.783	129.479	88.174	1.949
	MCR_Secondary Roads	149.125	109.832	70.540	217
Reconditioning	HCR_Motorways-Expressways	N.A	N.A	N.A	N.A
	MCR_Primary Roads	196.907	169.275	141.643	2.214
	MCR_Secondary Roads	190.528	165.836	141.143	246
Reconstruction	HCR_Motorways-Expressways	N.A	N.A	N.A	N.A
	MCR_Primary Roads	277.571	223.638	169.705	495
	MCR_Secondary Roads	271.191	220.198	169.205	55
Expansion (Capacity Improvement)	HCR_Motorways-Expressways	N.A	N.A	N.A	N.A
	MCR_Primary Roads	690.907	352.232	150.879	1.091
	MCR_Secondary Roads	539.963	275.279	117.917	109
New Construction	HCR_Motorways-Expressways	1.696.339	841.578	371.013	613
	MCR_Primary Roads	1.310.338	644.577	216.472	180
	MCR_Secondary Roads	443.721	291.922	160.557	30

SUGGESTIONS FOR FURTHER ACTIONS

SUGGESTIONS FOR FURTHER ACTIONS

CHECK THE POSSIBILITY TO GET MORE DATA FROM COUNTRIES

IF THE ANSWER IS YES

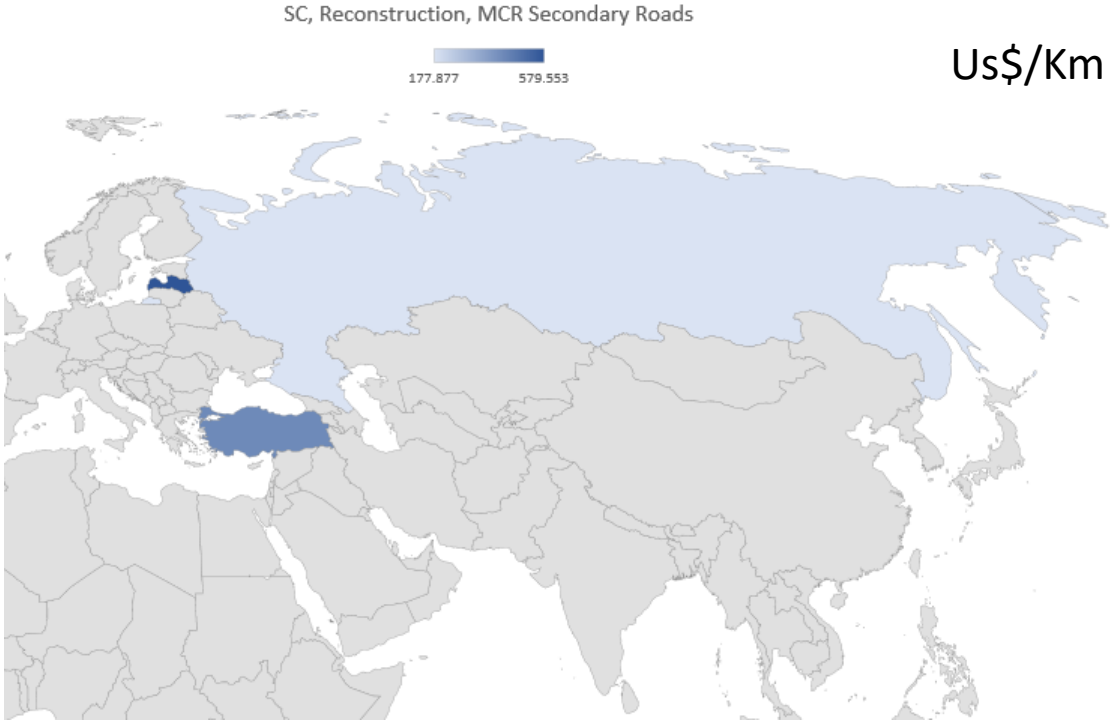
- PREPARE A CHECK LIST REGARDING FOR ALL DATA
- MAKE MORE EXPLANATION ON DATA TABLES FOR EACH CELLS REGARDING THE MISTAKES
- ASK MORE COUNTRIES AGAIN TO FILL THE TABLES

CHECK THE POSSIBILITY TO GET MORE DATA FROM COUNTRIES

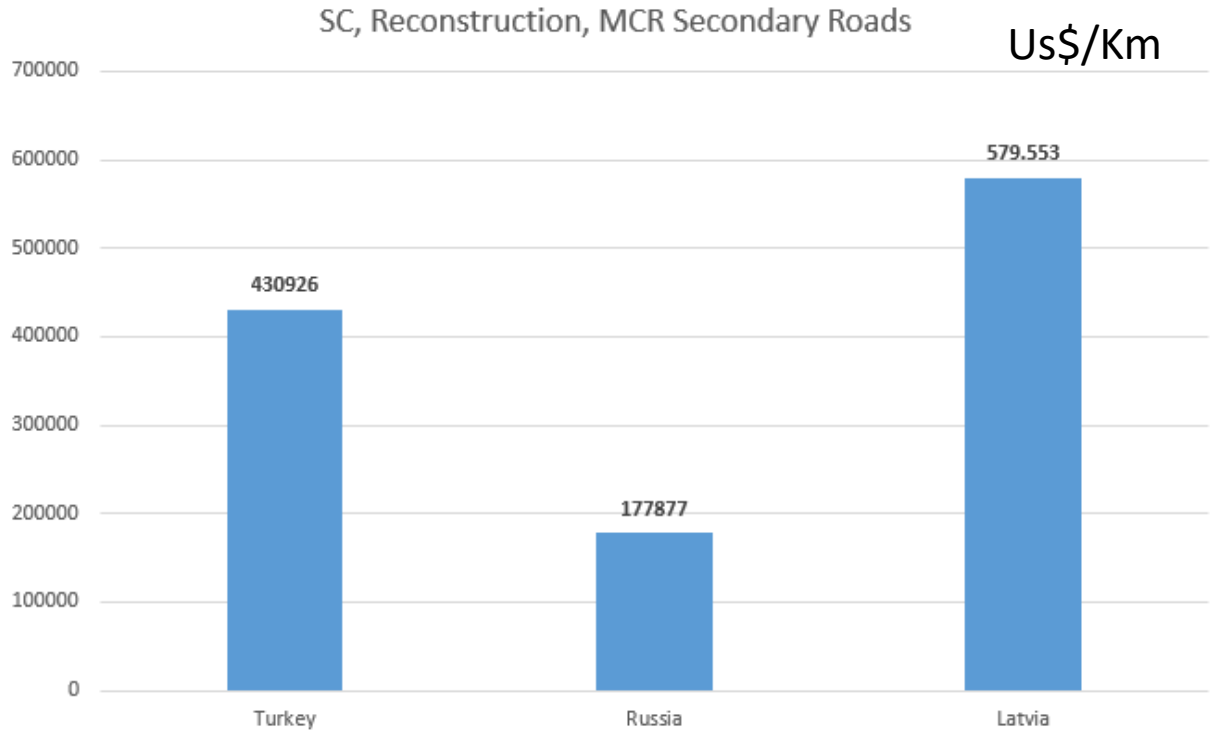
IF THE ANSWER IS NO

- PREPARE A CHECK LIST AND ASK THE COUNTRIES TO CHECK THEIR DATA REGARDING THAT CHECKLIST
- SINCE DATA IS LIMITED, ANALYSIS MAY BE DONE NOT ACCORDING TO WORK TYPE JUST BY ROAD TYPE
- COST ANALYSIS JUST BY ROAD AS COST PER LANEXKM NOT AS DC OR SC
- PREPARE HEAT MAPS
- DRAW CHARTS

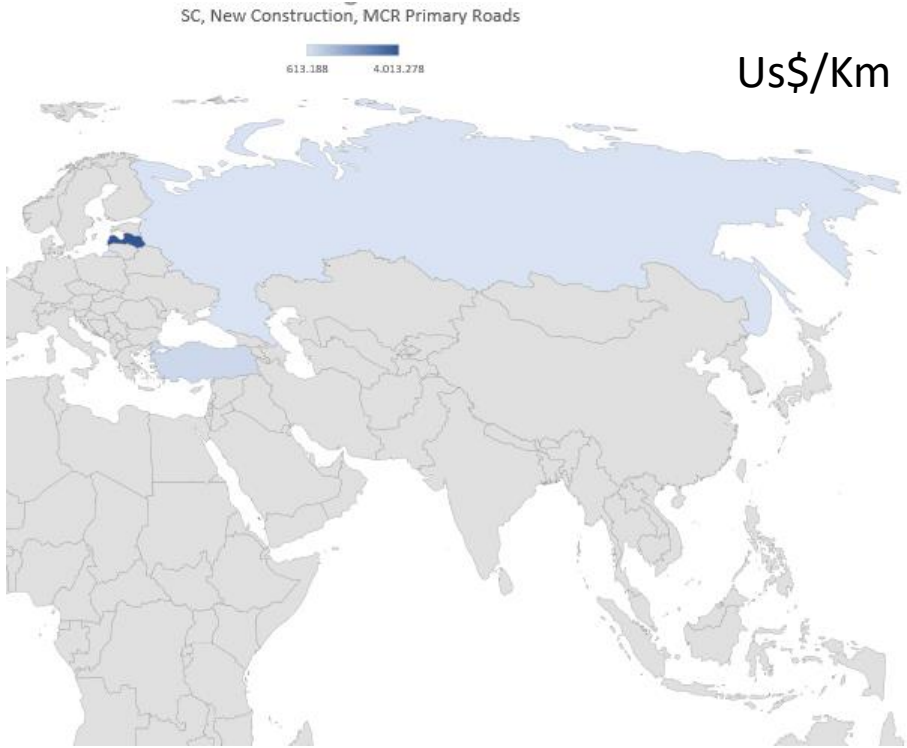
Reconstruction cost of secondary road as single carriageway



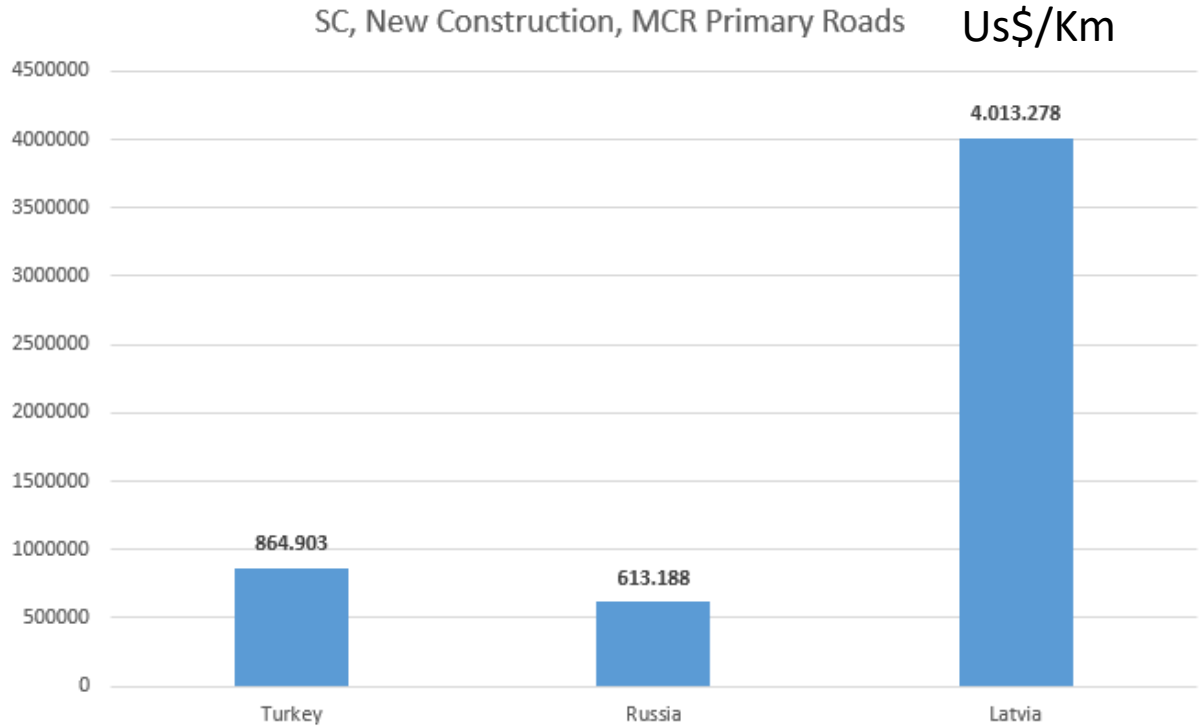
Us$/Km


SC, Reconstruction, MCR Secondary Roads
Us$/Km
700000
600000
500000
400000
300000
200000
100000
0
430926
177877
579.553
Turkey
Russia
Latvia

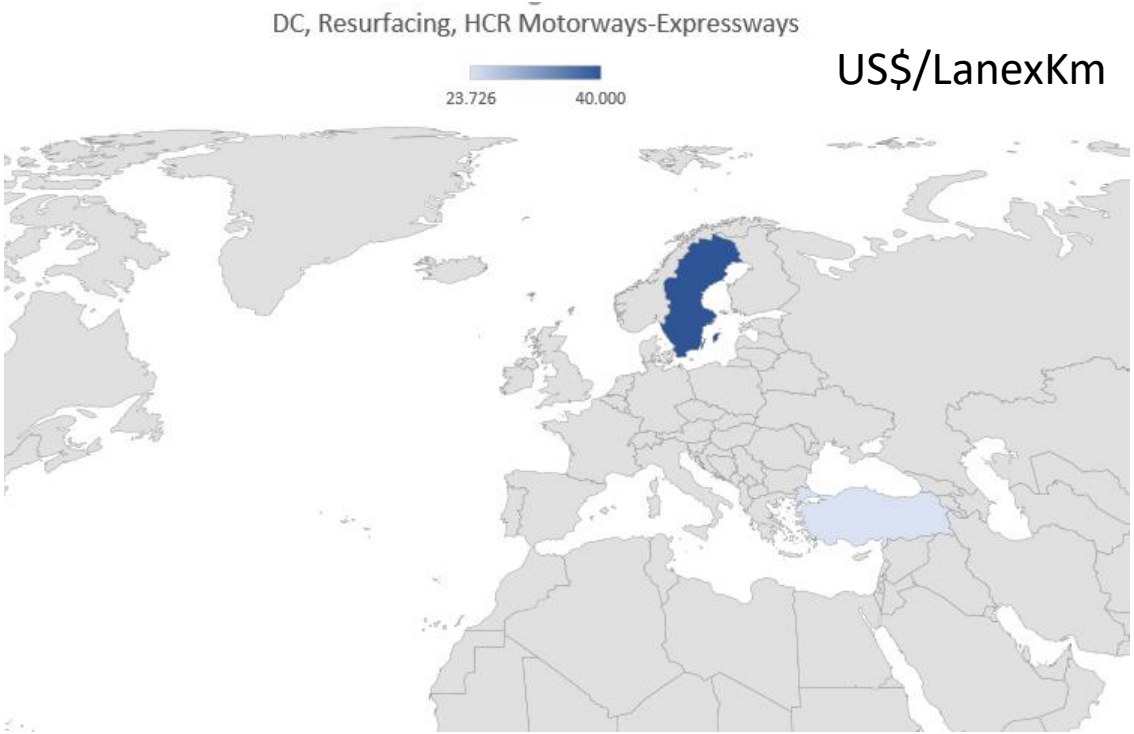
New construction cost of primary road as single carriageway



Us$/Km

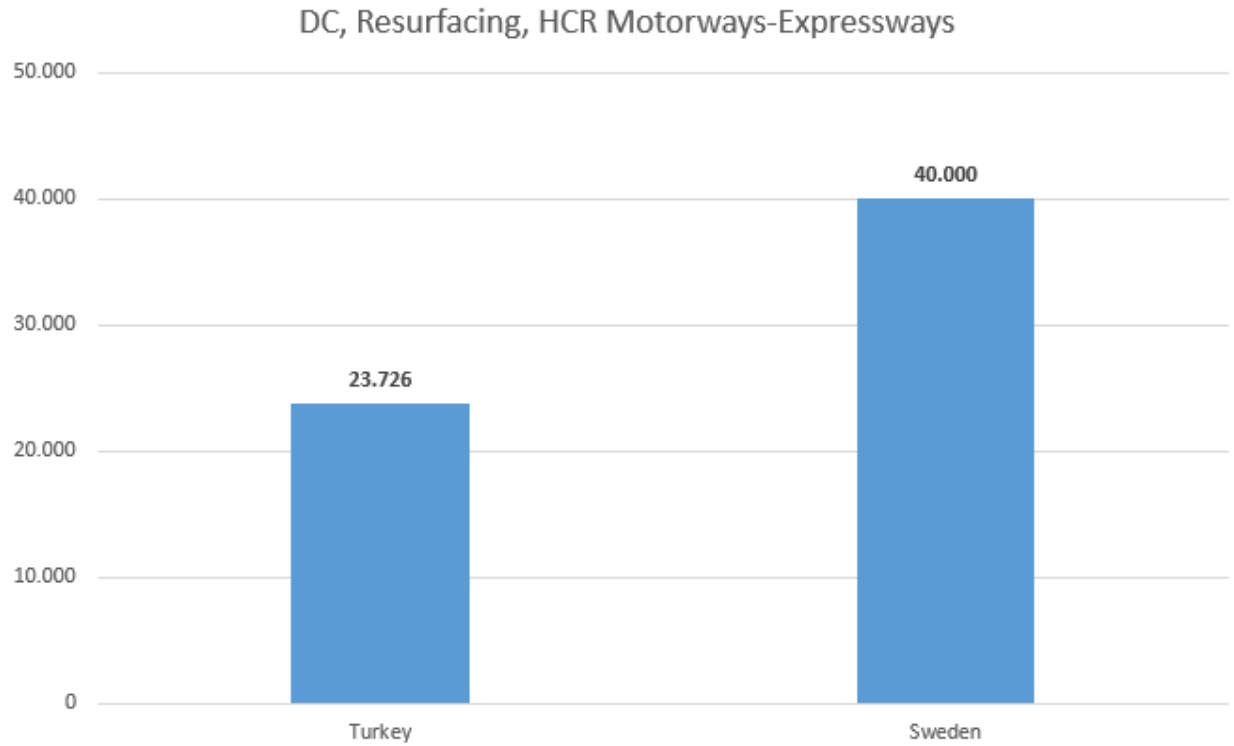

SC, New Construction, MCR Primary Roads
Us$/Km
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
864.903
613.188
4.013.278
Turkey
Russia
Latvia

Resurfacing cost of motorways as double carriageway



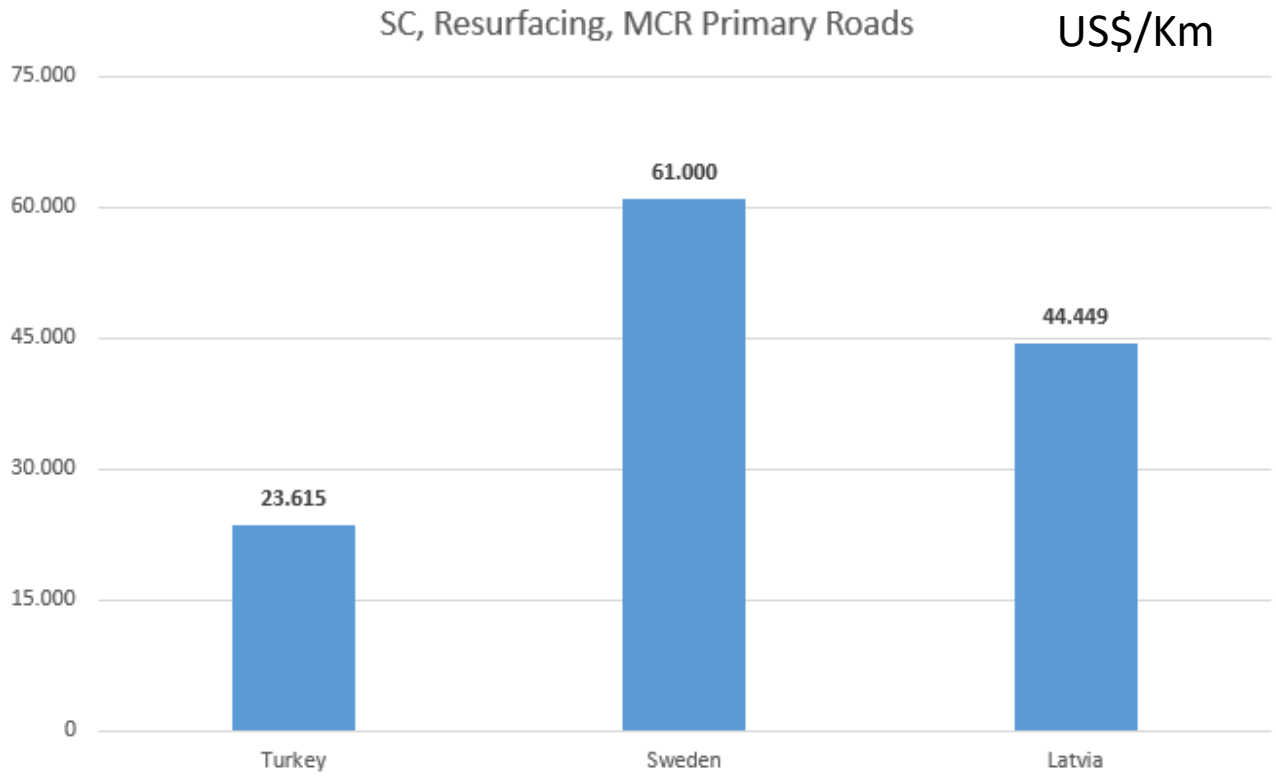
US$/LanexKm

US$/LanexKm


DC, Resurfacing, HCR Motorways-Expressways
50.000
40.000
30.000
20.000
10.000
0
23.726
40.000
Turkey
Sweden

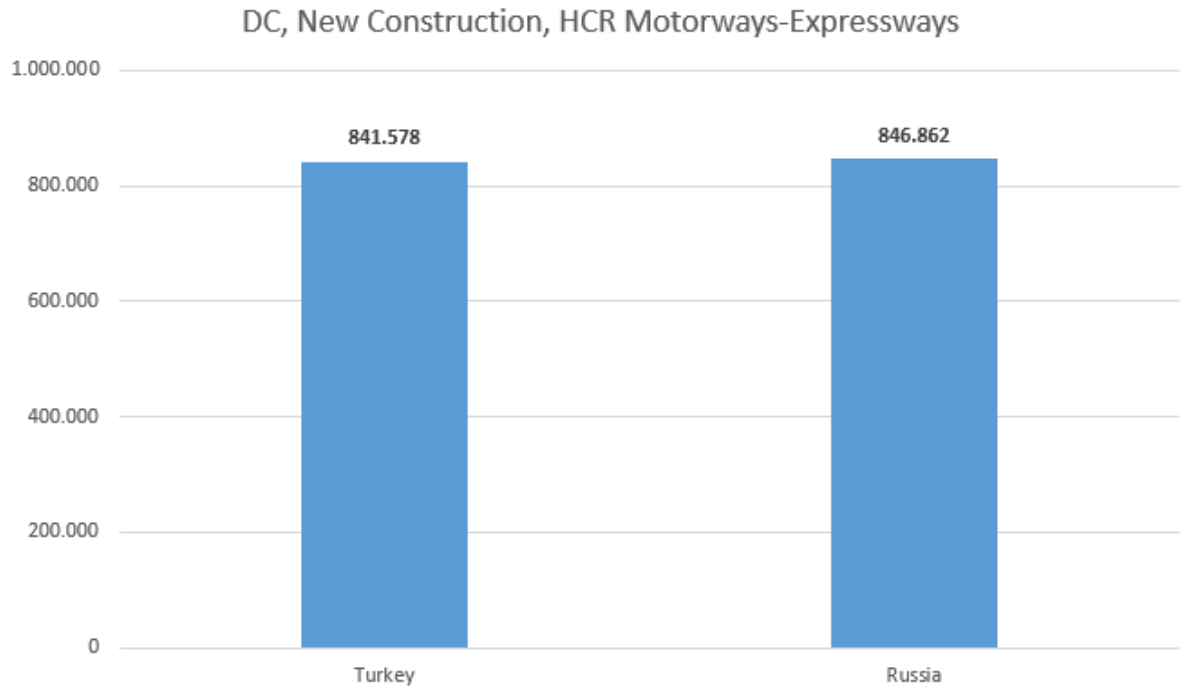
Resurfacing cost of primary roads as single carriageway

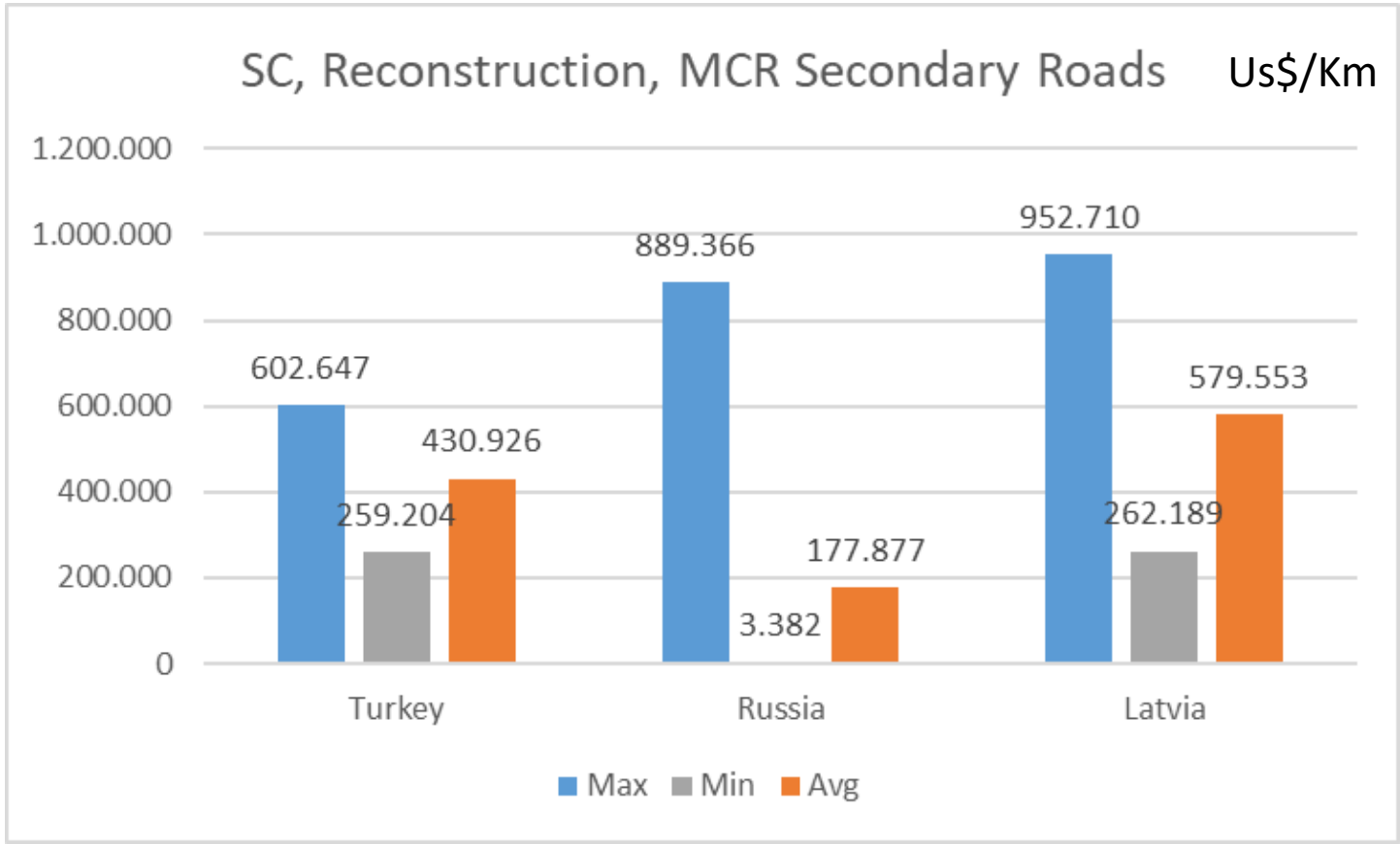
US$/LanexKm

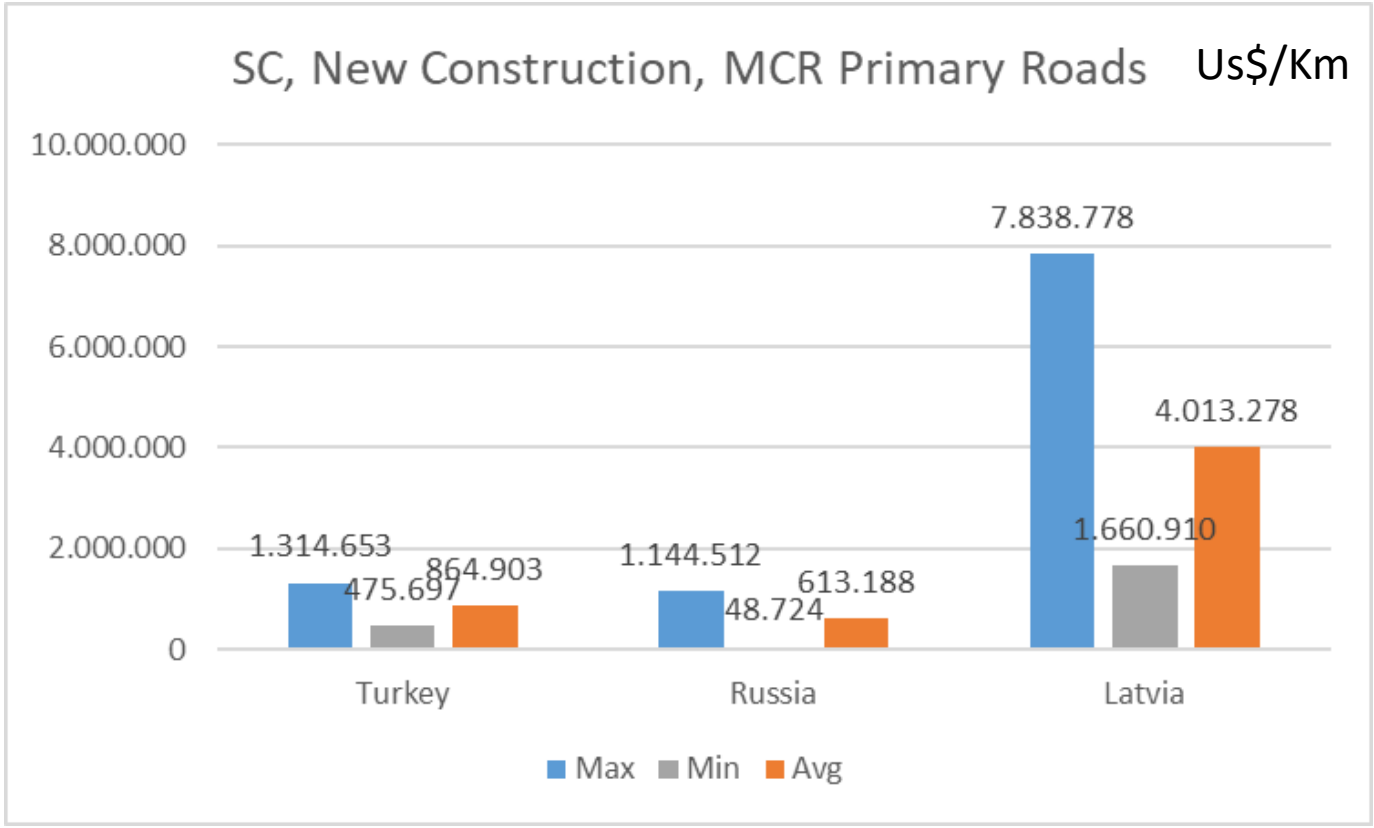

SC, Resurfacing, MCR Primary Roads
US$/Km
75.000
60.000
45.000
30.000
15.000
0
61.000
44.449
23.615
Turkey
Sweden
Latvia

New construction cost of motorways as double carriageway

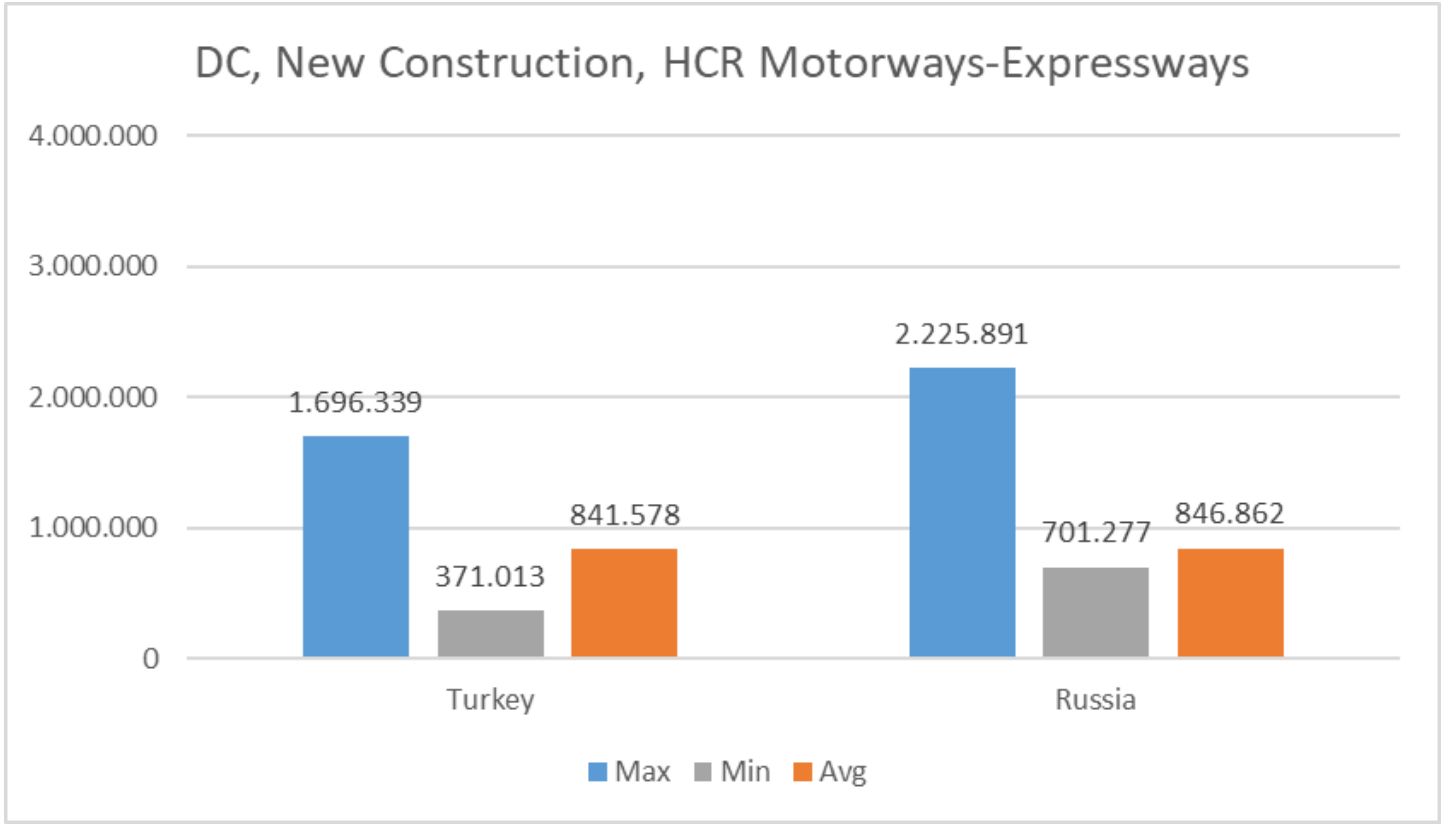
US$/LanexKm


DC, New Construction, HCR Motorways-Expressways
1.000.000
800.000
600.000
400.000
200.000
0
841.578
846.862
Turkey
Russia

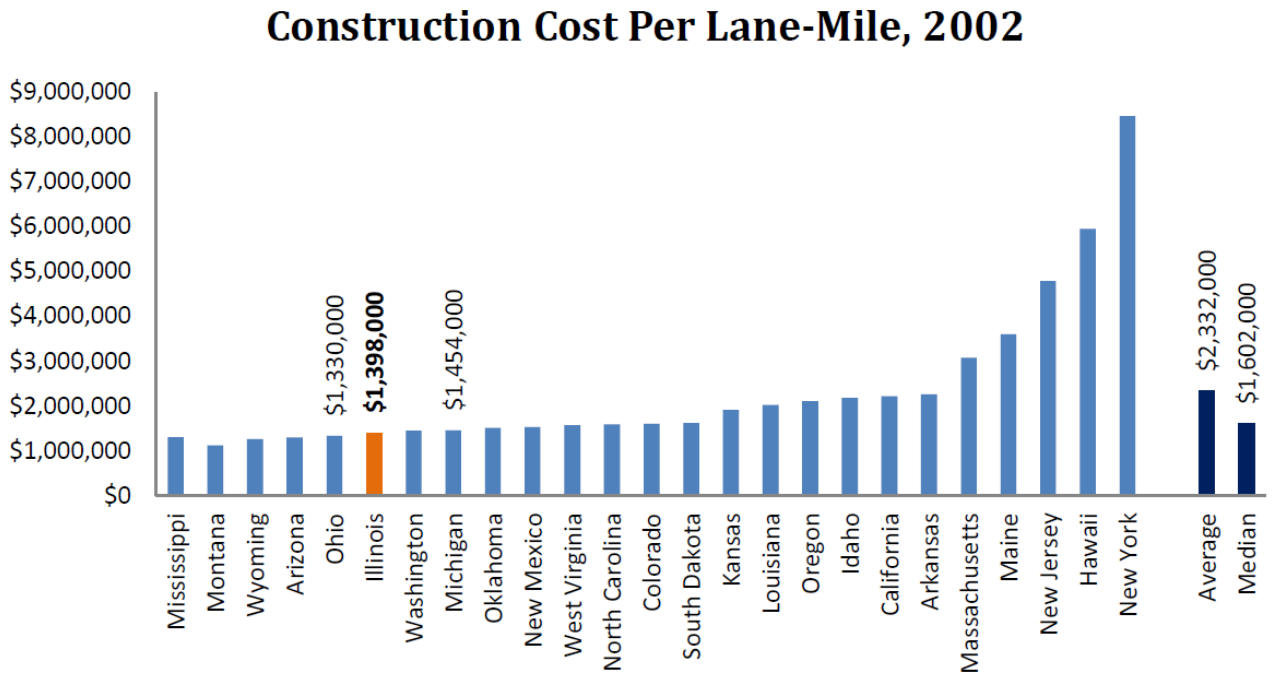

SC, Reconstruction, MCR Secondary Roads
Us$/Km
1.200.000
1.000.000
800.000
600.000
400.000
200.000
0
602.647
259.204
430.926
889.366
3.382
177.877
952.710
262.189
579.553
Turkey
Russia
Latvia
Max
Min
Avg


SC, New Construction, MCR Primary Roads
Us$/Km
10.000.000
8.000.000
6.000.000
4.000.000
2.000.000
0
1.314.653
475.697
864.903
1.144.512
48.724
613.188
7.838.778
1.660.910
4.013.278
Turkey
Russia
Latvia
Max
Min
Avg

US$/LanexKm

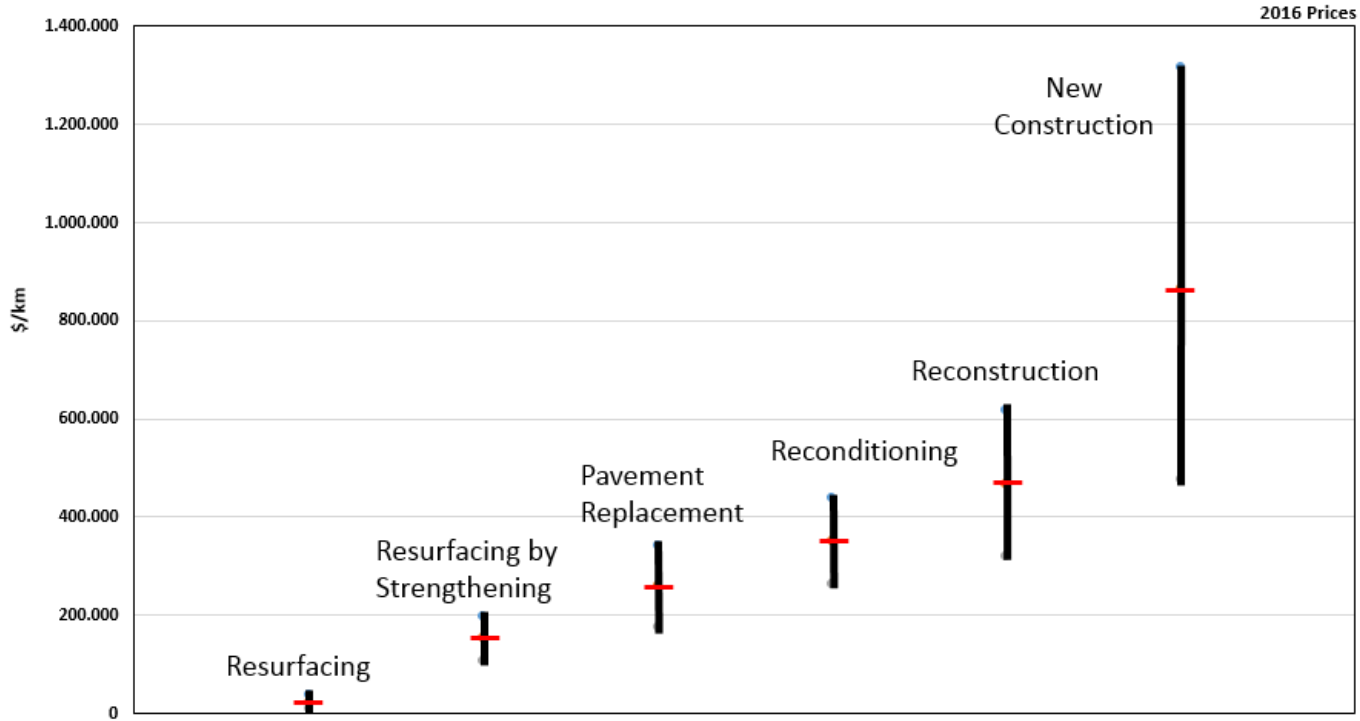

DC, New Construction, HCR Motorways-Expressways
4.000.000
3.000.000
2.000.000
1.000.000
0
1.696.339
371.013
841.578
2.225.891
701.277
846.862
Turkey
Russia
Max
Min
Avg

Sample Graph on Cost Benchmarking Study from literature



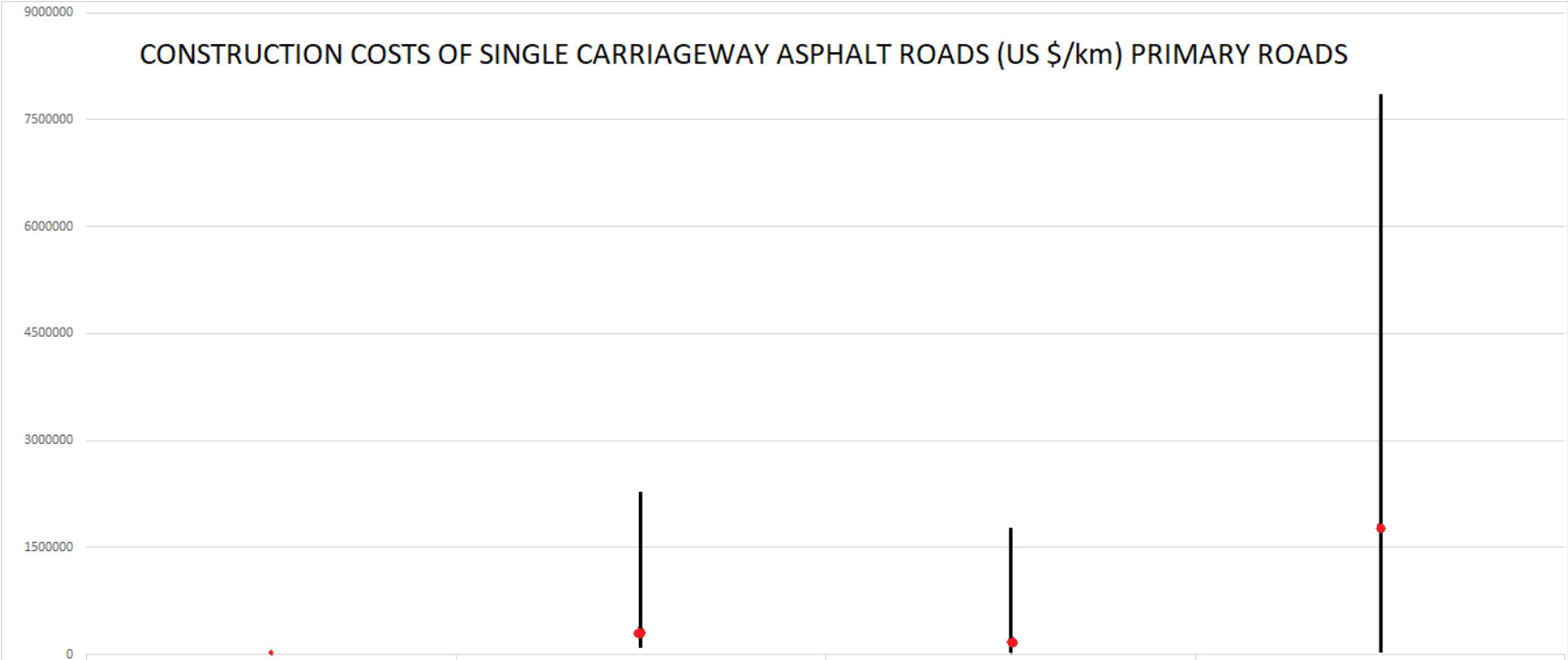
Source: Kishore & Abraham (2009). Average and median are state-level and unweighted.

CONSTRUCTION COSTS OF SINGLE CARRIAGEWAY ASPHALT PRIMARY ROADS (US $/Km)



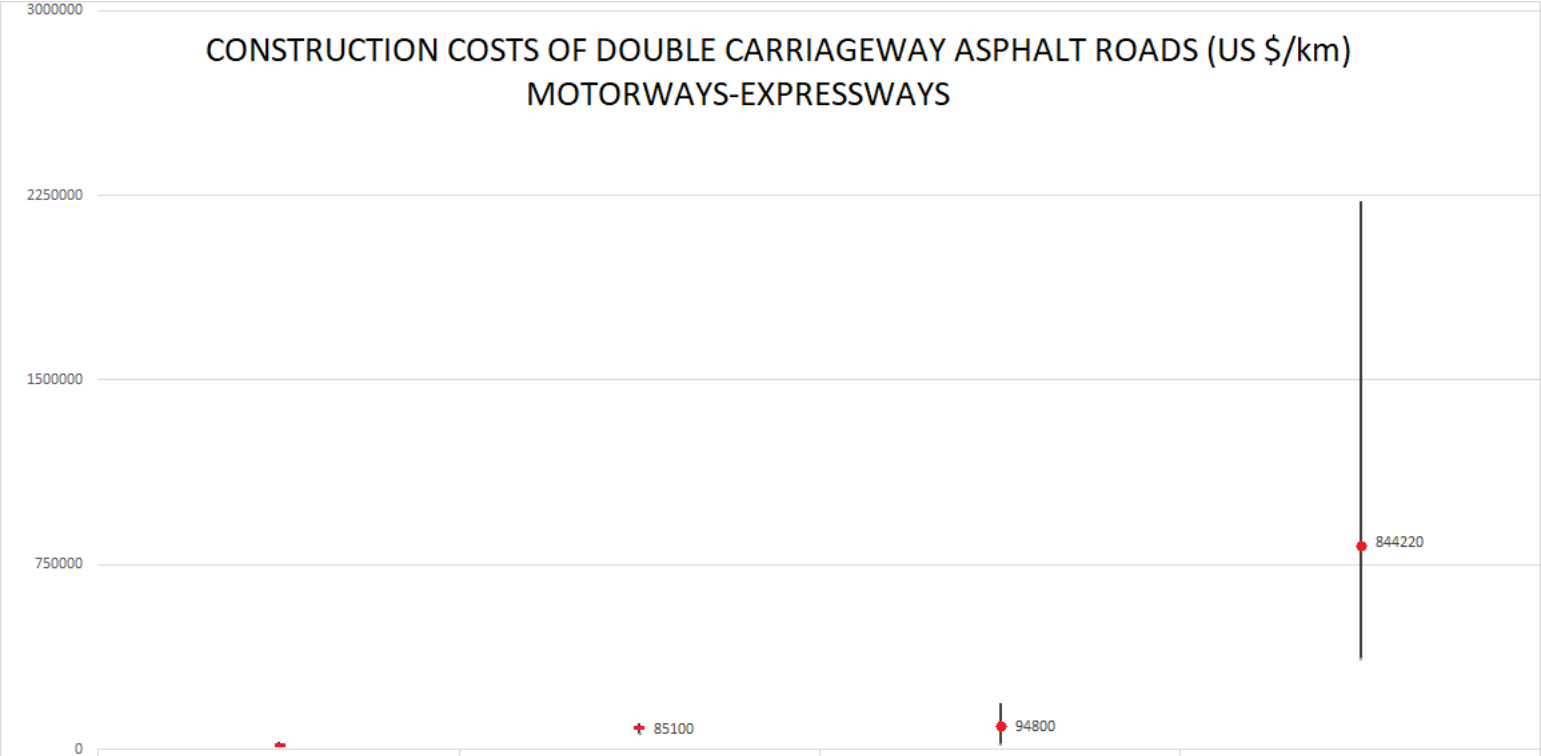
MAXIMUM	38.768	198.862	341.566	437.571	616.823	1.314.653
AVERAGE	23.615	153.628	258.958	350.850	467.679	864.903
MINIMUM	8.461	108.394	176.349	264.130	318.534	475.697

FROM ALL DATA



	Resurfacing	Resurfacing By Strenghtening	Pavement Replacement	New Construction
AVG	43021	362531	245045	1830456
Max	73804	2251714	1761989	7838778
Min	8461	108394	9827	48724

FROM ALL DATA



	Resurfacing	Resurfacing By Strenghtening	Pavement Replacement	New Construction
AVG	31863	85100	94800	844220
Max	32045	105163	186709	2225891
Min	15684	65037	21597	371013

FOUR OPEN ENDED QUESTIONS

HOW IT IS GOING TO BE USED IN REPORT

Four Questions

1. **How do you go about calculating, forecasting and evaluating transport infrastructure construction costs?**
2. **How do you compare transport infrastructure construction costs over time and normalize these costs by region/ time?**
3. **How do you make sure that the mechanism you use to calculate and assess transport infrastructure costs also serve as a tool for costs control?**
4. **Do you use different cost calculation and evaluation methodologies for construction in different modes? If yes, please explain.**

Four Questions

- Are four questions answers going to be used in the report, if yes, how?
- The four questions answered by Turkey regarding that the answers are going to be used in the report
- Therefore especially answer to first question was detailed including scope of cost analysis and so on.

QUESTIONS FOR FURTHER STUDIES

QUESTIONS FOR FURTHER STUDIES

1) Who will do the analysis?
2) Who is going to prepare the report?
3) What are the responsibilities of the group member while preparing the report?
4) There are two different types of data one is consolidated other one is Project based. How they are going to be used in the report?
5) Other than infrastructure project based data, data year is 2016. Whether data is going to be updated, if yes, how?
6) How the infrastructure Project based data is going to be normalized?
7) What is the time table to prepare the report?
8) Since we have very limited data, what will be the report contents, how the report is going to be organized? What are the names of the chapter?


THANK YOU FOR YOUR ATTENTION
Mücahit ARMAN
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Ministry of Transport and Infrastructure