The Time Cost Distance Model

Transit corridor performance

- The objective of the model is to propose a methodology to illustrate the cost and time components of door-to-door movement by available routes and modes as well as to illustrate the delays at borders or other inspection points up to the point of destination within a transit transport corridor.

- The cost/time methodology has been adapted from Beresford and Dubey (1990), as improved by Banomyong (2000) and later disseminated by UN.

- The model includes costs and time associated with transport by any mode and with transfers between modes. The methodology is based on the premise that the unit cost of transport varies between modes

Four developmental stages,

- Stage 1: Competition between two modes of transport.

- Stage 2: a combination of transport modes, where the cost of transport by combining both modes is less expensive than just road transport and slightly more expensive than rail transport.

- Stage 3: Combined transport, road-rail-sea.

- Stage 4: Multimodal transport, from origin to destination

Stage 1: Road versus rail alternative
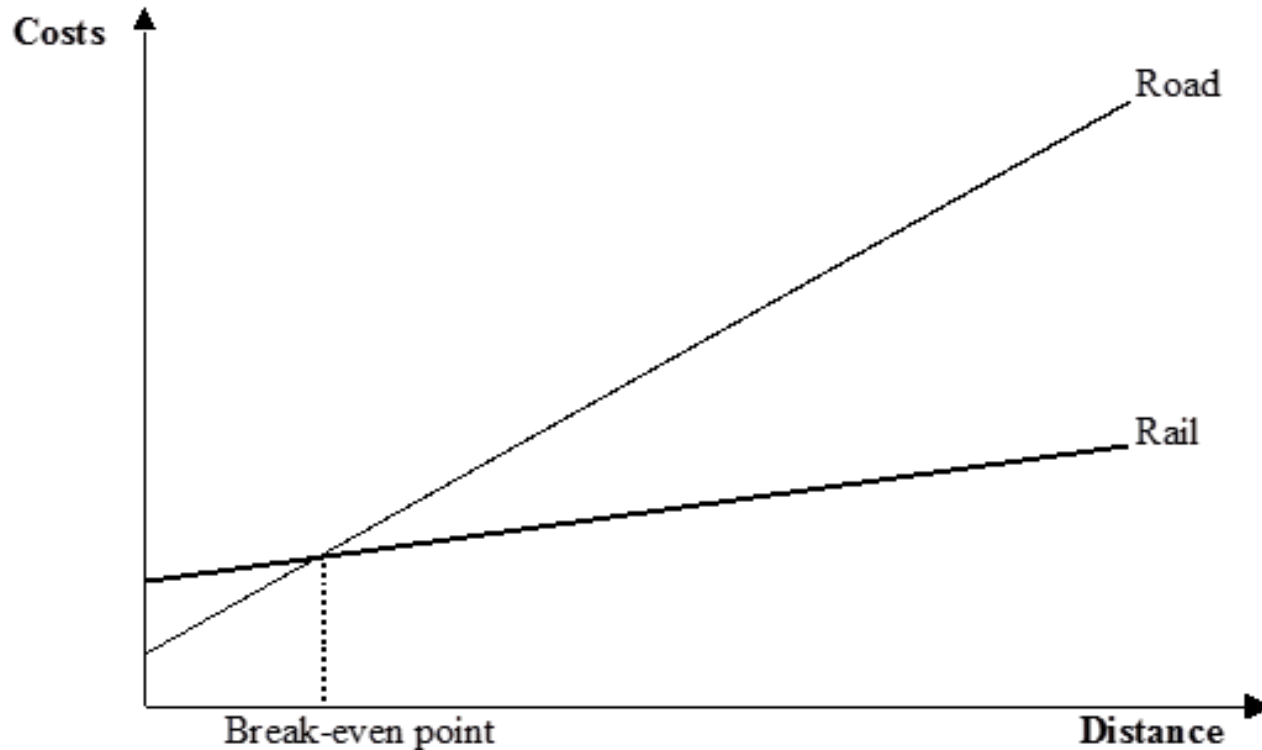
The distance and cost/time data are plotted on the x-axis and y-axis, respectively. Initially road transport may be cheaper than rail transport over shorter distances, due to the initial costs (or time) required to transport the goods to the railway station. However, as the distance increases, the two lines cross and beyond this point, rail transport has a lower per kilometre cost than road transport, as indicated by the flatter slope.

# *Stage 2: Combined transport, road-rail*
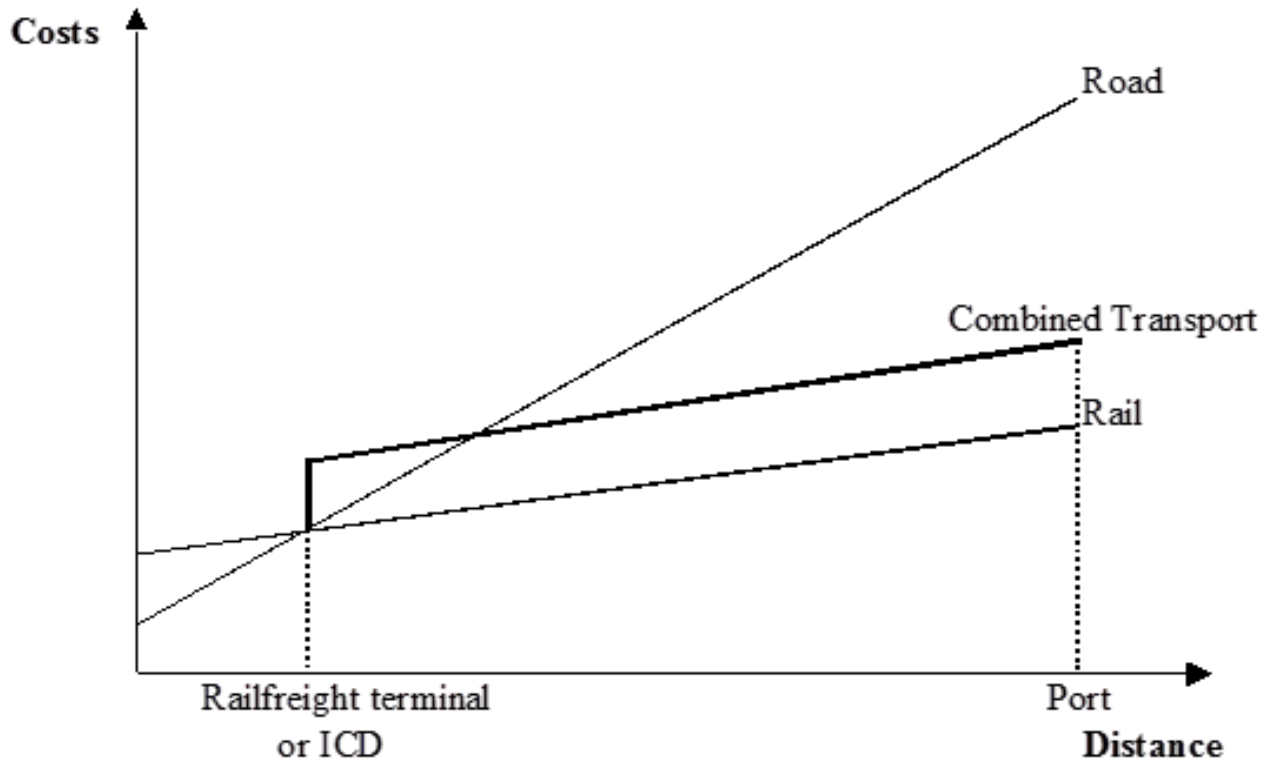
In the first part of the journey, it is cheaper to transport the goods by road rather than by rail. However, if the distance to be travelled is further than the break-even distance, transport by rail becomes more economical. An intermodal transfer can be arranged at the closest rail freight terminal or inland clearance depot (ICD). The vertical step in figure 3 represents the costs (or time) involved when goods are transshipped from road to rail at the rail freight terminal or ICD. The cost of rail transport, in reality, has not increased but the cost of the intermodal transfer is reflected in the combined transport cost from that point on.

Stage 3: Combined transport, road-rail-sea
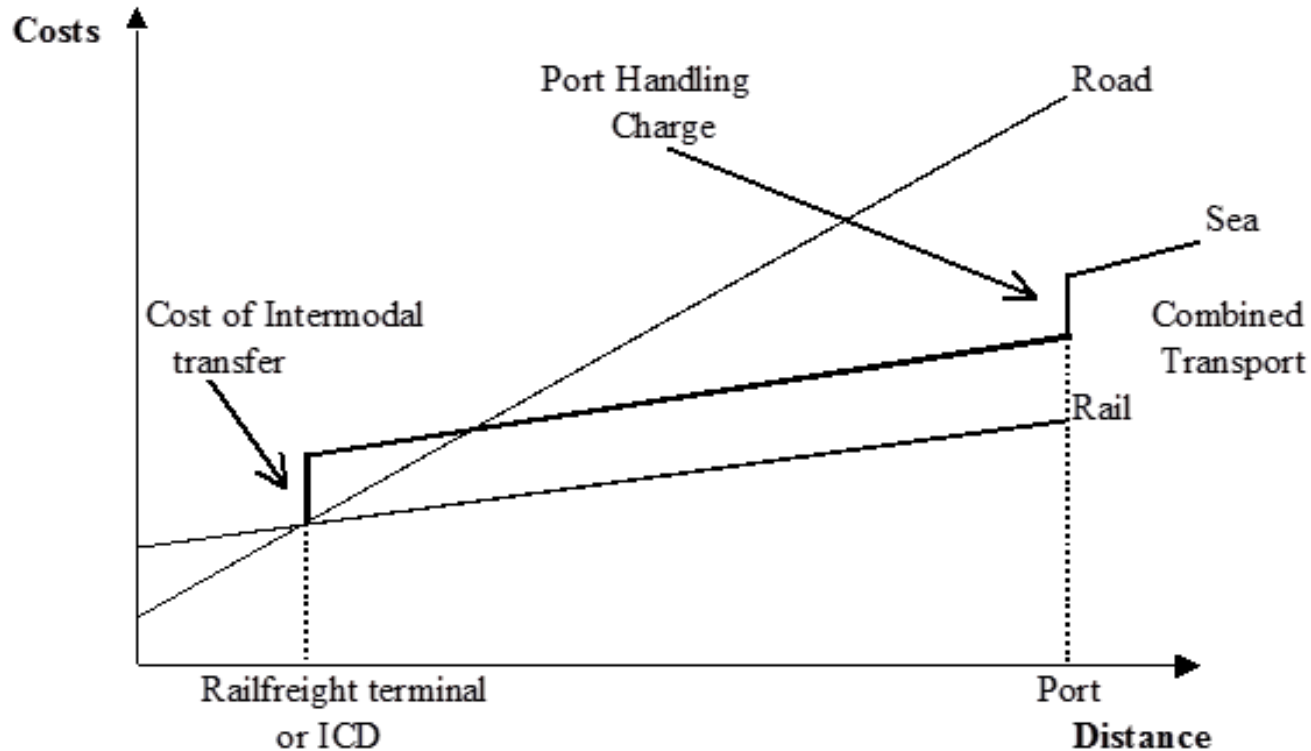
Since the overwhelming majority of traded goods are transported by sea, the most likely destination for the freight in transit will be a seaport, where the goods will be transferred onto seagoing vessels. The additional costs (or time) incurred at the port are represented by the second vertical step. Thus, cumulative costs from the origin to the port are the sum of the cost of rail transport to the ICD plus the cost of intermodal transfer at the ICD plus the cost of rail transport from the ICD to the port plus the handling charge at the port.

Stage 4: Multimodal transport, from origin to destination
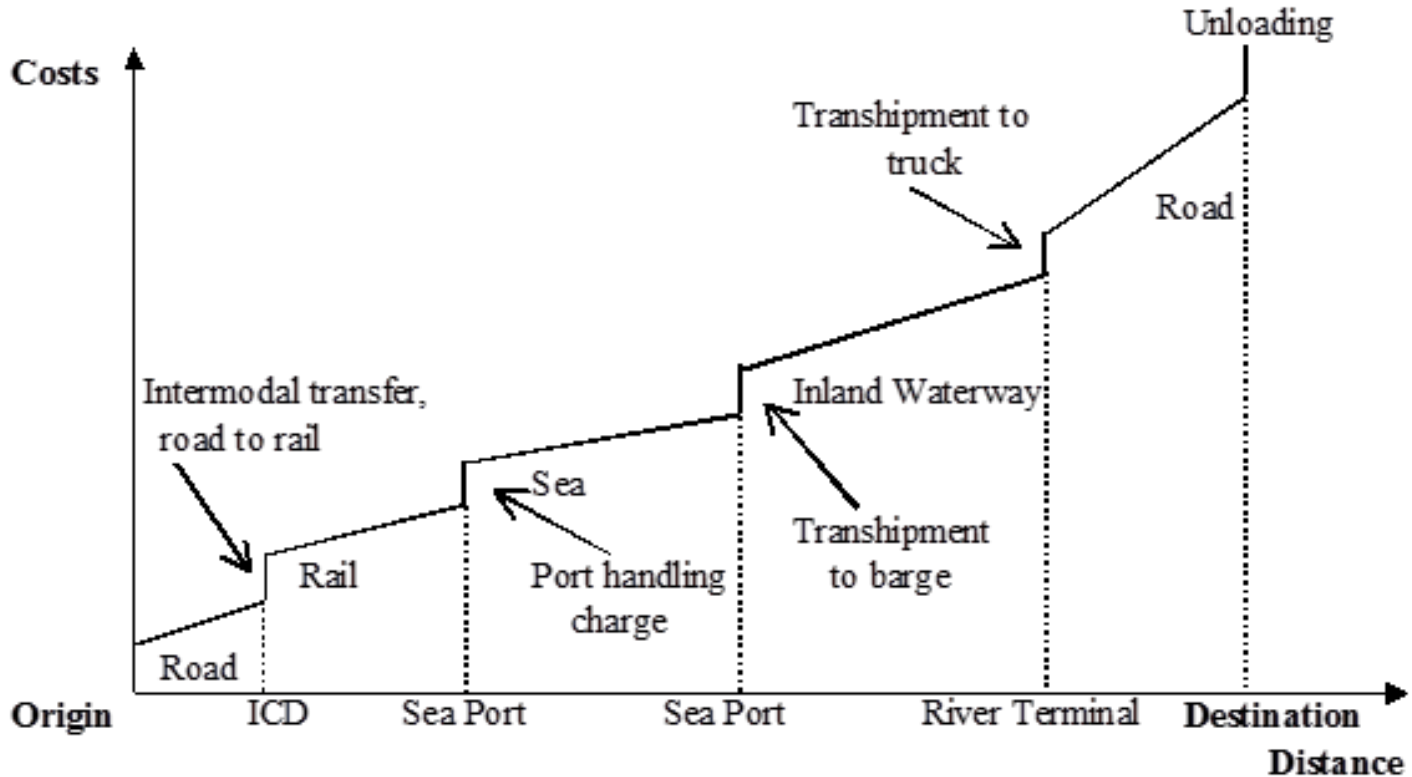
The final stage shows that numerous modes of transport may be involved for goods to be moved door-to-door. At each intermodal transfer point there will be a cost (or time) increase represented by a vertical step. Should a border crossing occur along the route, the border crossing charges (and time spent) can be represented by another vertical shift upwards in the cost curve at that point, which can then be cumulated with other costs.
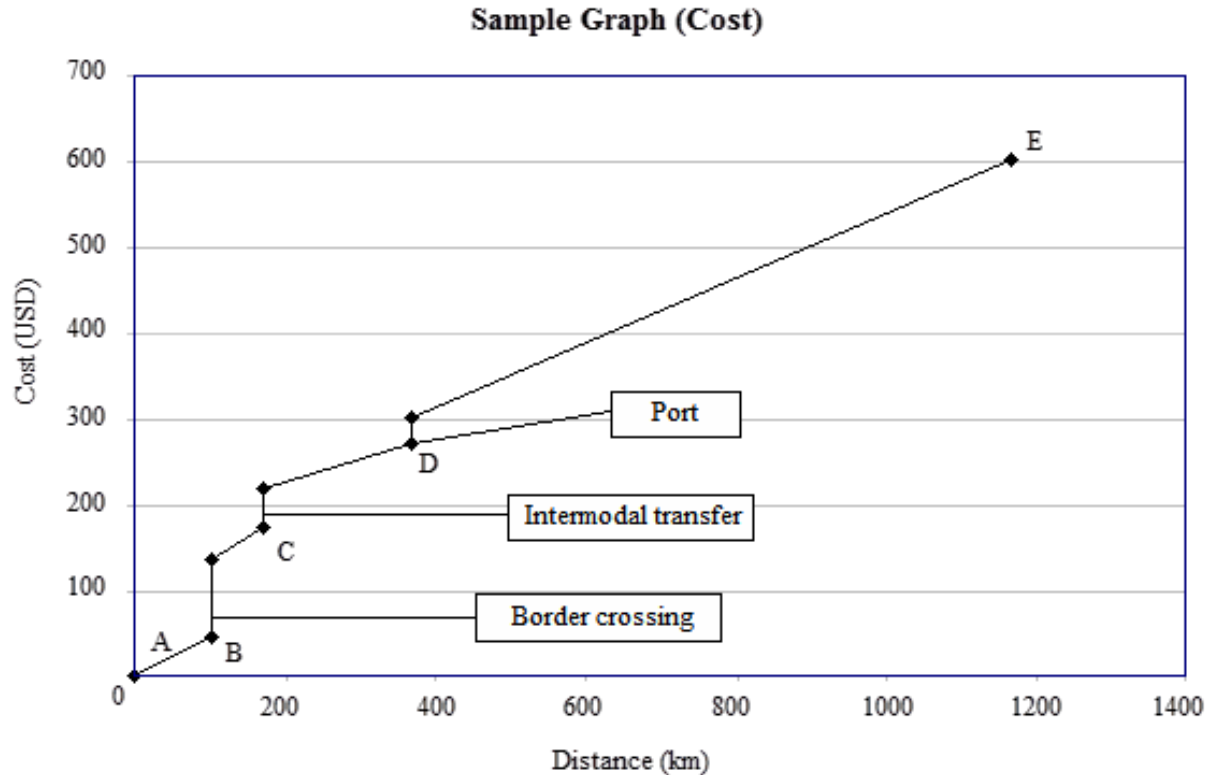
Source and Units of Information

- **Source:** The data utilised are obtained during interviews with transit and transport service providers, traders and governmental officials.
- **Units:** A unit of analysis must be agreed upon. Data such as cost or quotes should concern the shipment of one TEU on a freight-all-kind basis or for a shipment of a particular product.
- **Information needed:**
  - Origin and destination of the cargo;
  - Full route details including border crossings and modal transfers;
  - Mode of transport for each leg;
  - Distance for each leg;
  - Transit time for each leg (in hours or days); and
  - Cost or quotes for each leg.

Sample data table

Leg	Mode	Distance (km)	Cum. distance (km)	Cost (US$)	Cum. cost (US$)	Transit time (hours)	Cum. Time (hours)
A to B	Road	100	100	50	50	4	4
Border Crossing	-		-	100	150	6	10
B to C	Road	70	170	30	180	3	13
Intermodal transfer	-		-	40	220	3	16
C to D	Rail	200	370	60	280	18	34
Port	-		-	20	300	6	40
D to E	Sea	800	1 170	300	600	72	112
TOTAL		1 170		600		112	

Sample graph

Sample Graph (Cost)

For costs or quotes, the figure shows the relative cost of each leg (or mode, where applicable), and the approximate proportion of non-transport costs in relation to transport costs.
A breakdown of costs at border crossings or ports, can highlight areas for action.
By plotting time against distance, the relative speed of transit transport for each leg (or mode) can be compared, and bottlenecks at transshipment points can be identified.
As a rule of thumb, the higher the vertical step the more likely that the border crossing or the nodal link is a bottleneck.
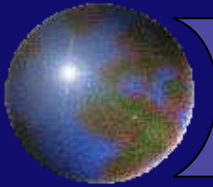
Results of Demo Run Tianjin - Ulaanbaatar
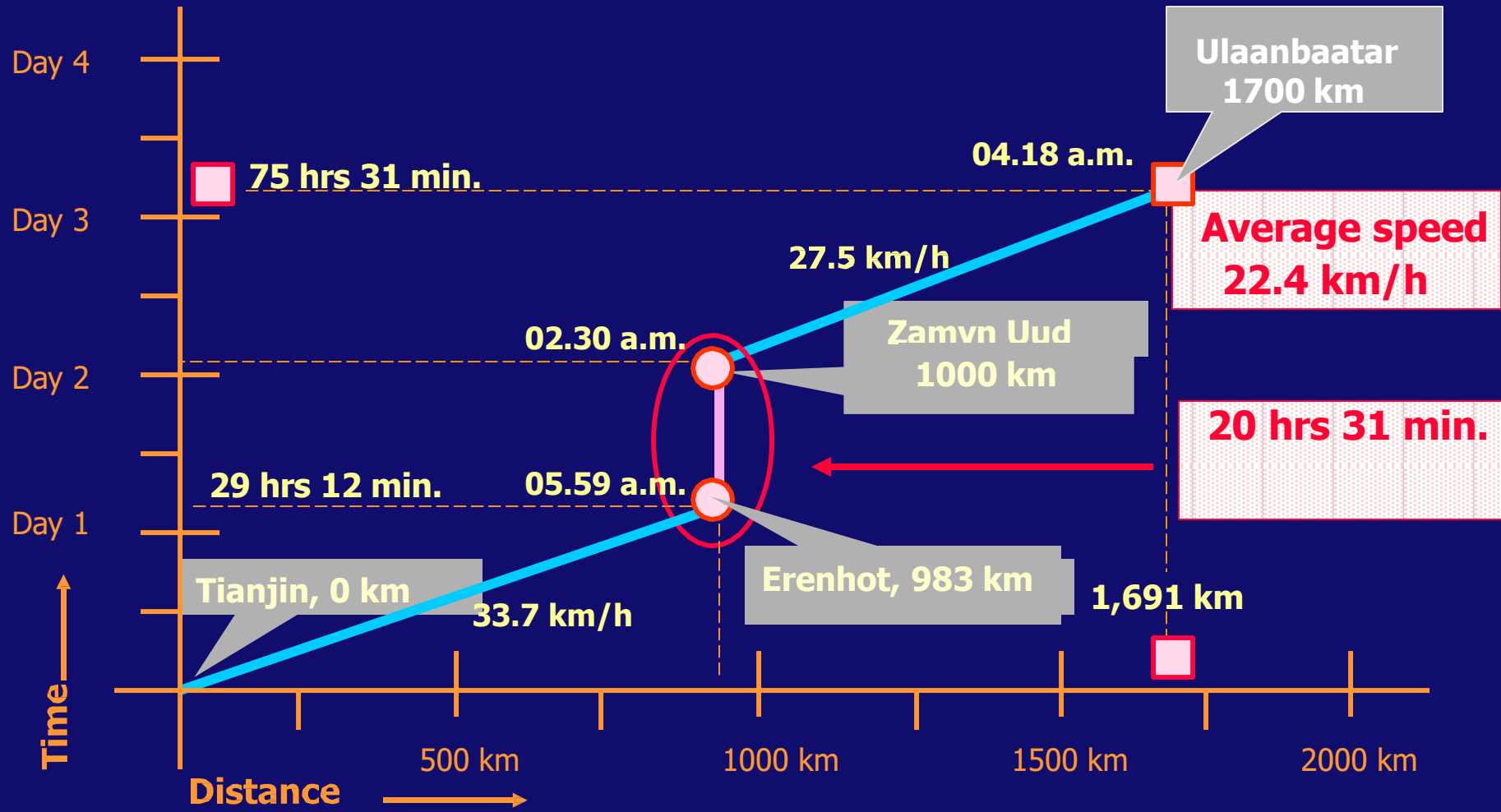
Comparison of average speed per section of the route

Average speed on EATL Route 5 (Rail): Bandar Abbas to Anzali

EXAMPLE

Dimensions not included

- In addition to transportation time and costs, traders and transit service operators must also take into consideration the reliability of the transit corridor, in terms of:

    - All year consistency of transit times;
    - Frequency and quality of services;
    - Competition between service providers
    - Balance of freight volumes; (empty returns)
    - Predictability of costs;
    - Informal controls and check points;
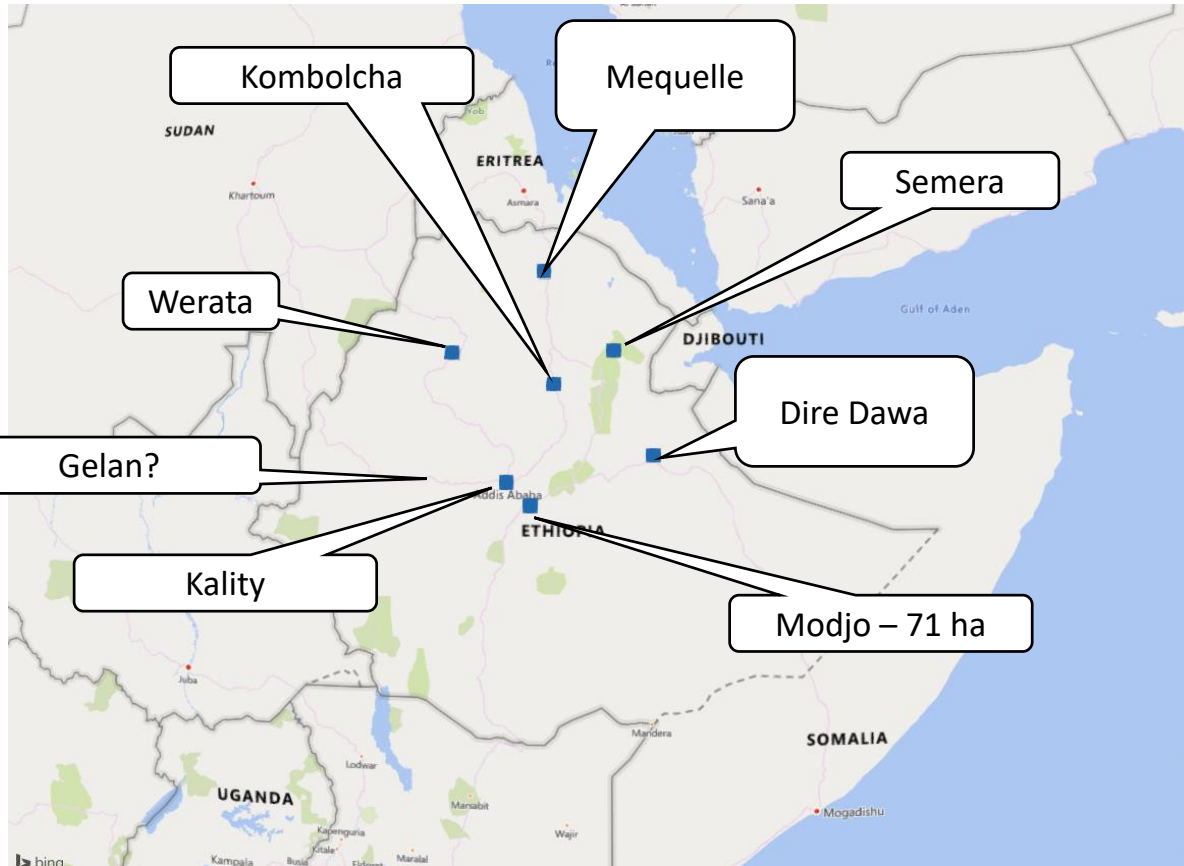   - Transport safety and security, etc.

Group Exercise
on the
Time/Cost-Distance
Methodology

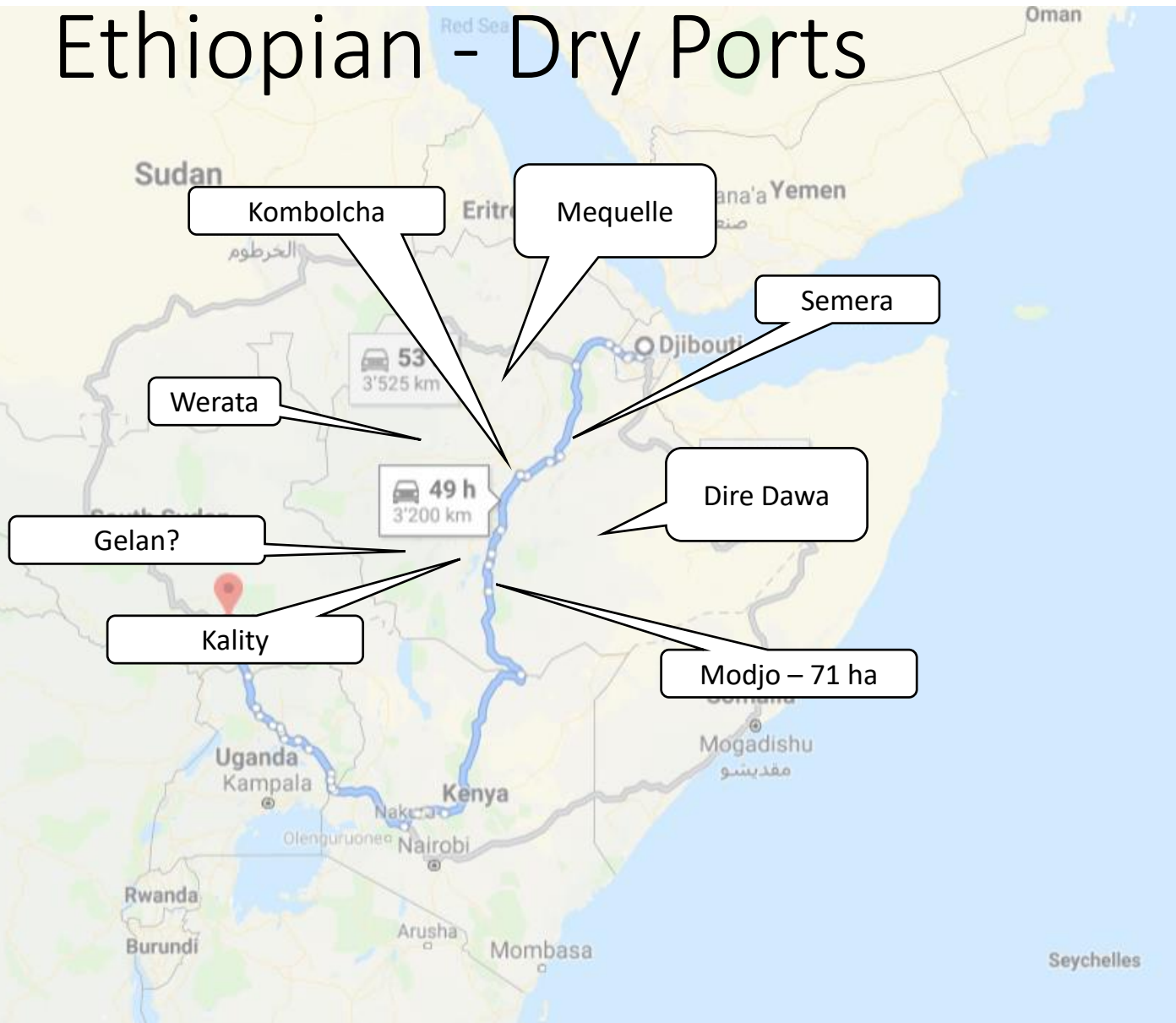---

- Basic Template Version -
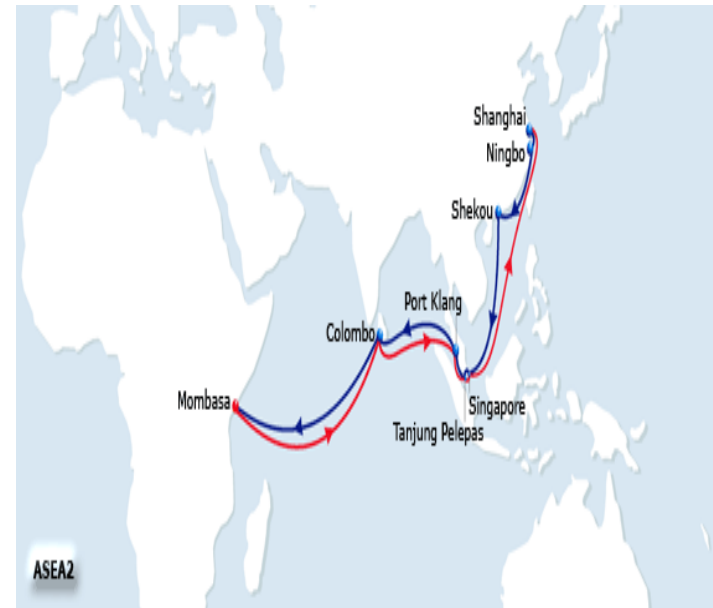
Juba – Djibouti - realistic?
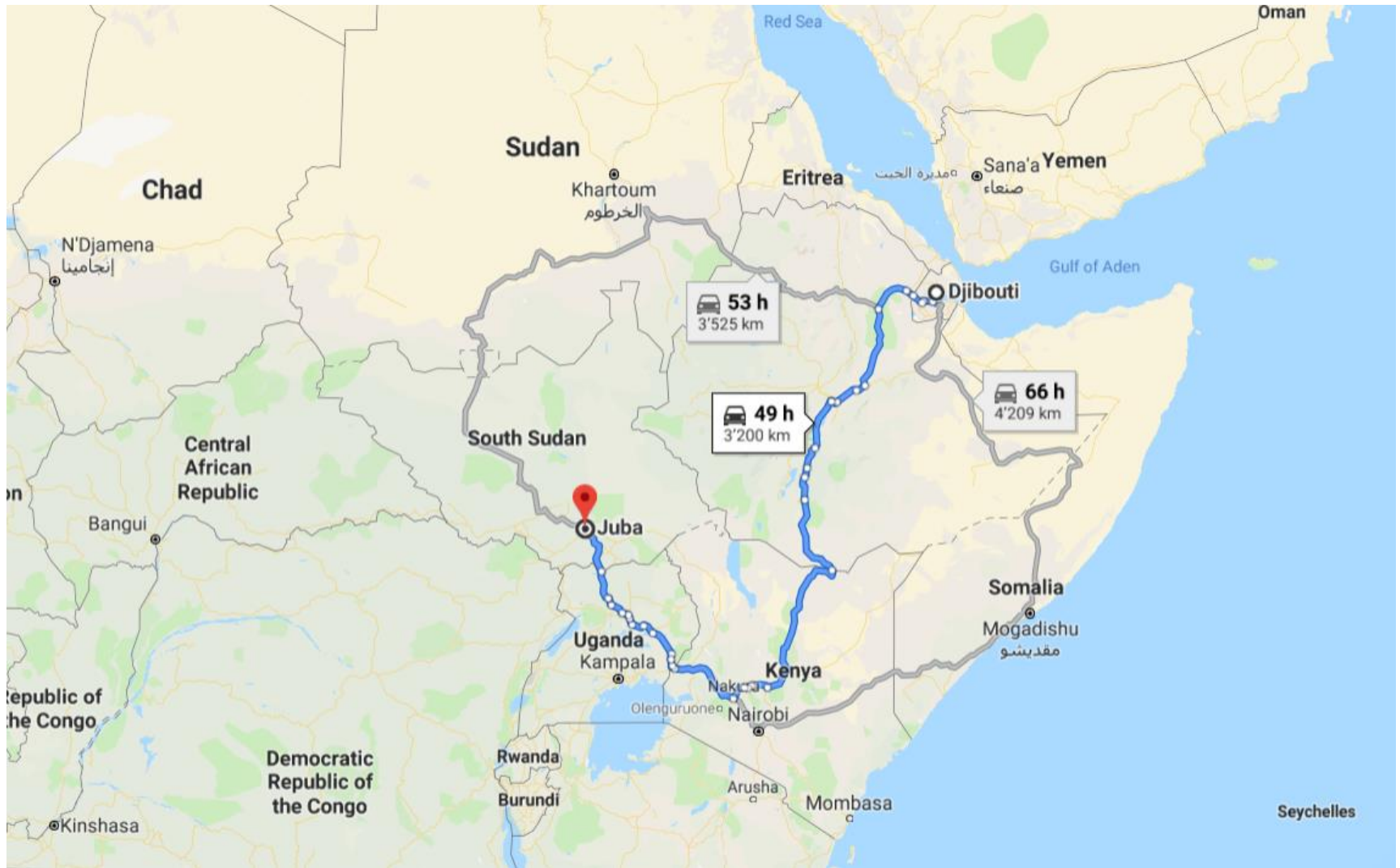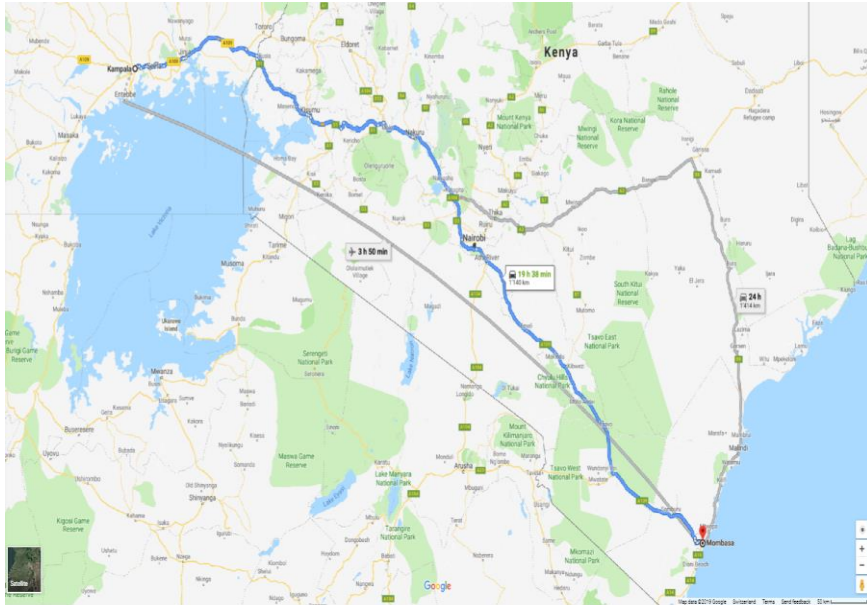
Ethiopian Dry Ports

Ethiopian - Dry Ports

Overview
- Kampala - Mombasa - Shanghai

Where to get the data?

Road and Air

- Time and distance

- https://www.google.com
- Waze app

- Average travel time and distance automatically calculated

- Costs
  - Freight forwarder
  - Kenya International Freight and Warehousing Association (KIFWA)

Sea

- Time and distance

- https://sea-distances.org/

- Average ship speed
  - Container ship 18 knots
  - Bulk carrier 14 knots

- Costs
  - https://worldfreightrates.com/freight
  - TEU – Value $k

The questionnaire – One MS Excel worksheet, three parts

-UNCTAD Project "Capacity Building in Trade and Transport Facilitation for Landlocked and Transit Developing Countries"

Part I

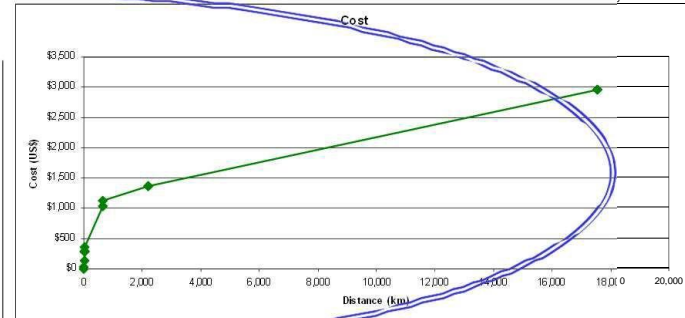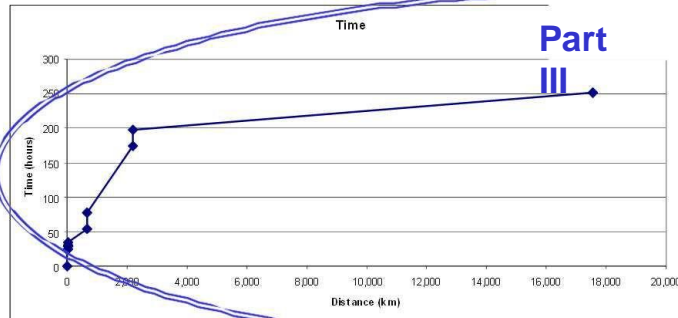Questionnaire for Application of Time/Cost-Distance Model

a Date of questionnaire completion: b   16/02/2007
Route description: Transit Transport from Vientiane (Lao PDR) to Rotterdam (Netherlands) via Bangkok Port Garment
c.Goods: 1 TEU
d.Quantity: not available [Only applicable when road] not available [Only applicable when road] not available
e.Nationality of driver: not available
f.Country of vehicle registration: g
Effective date of transport start: h Effective
delivery date of goods:

i Was the transport performed under an international not available
transit system (e.g. TIR, NCTS)?

e" and

Data table (Please fill in the highlighted cells and scroll down to see how the data translates into the graphs of "Time to Distanc

Part II

Line no.	Place of departure (place and country)	Mode of transport	Distance to next stop (km)	Duration of travel		Costs while en route (in USD)	Place of next stop (place and country)	Reason for stop	Duration of stop		Costs at stop (in USD)	Description of actions taken (e.g. procedures, formalities applicable to the section of the route). Please also provide a break-down of costs as well as a break-down of time used for individual procedures (e.g. customs, fueling).	Cumulative distance (km)	Cumulative time (in hours)	Cumulative costs (in USD)
				hrs	min				hrs	min					
1	Vientiane (Lao PDR)	-	0	0	0	$0.00	Vientiane (Lao PDR)	Place of Departure (Pre-shipment formalities and loading)	24	0	$28.17	Break-down of costs: $18 for customs papers, $10.17 for uploading Break-down of time: 17 hours for uploading, 3 hours waiting, 4 hours customs procedures	0	24.00	$28.17
2	Vientiane (Lao PDR)	road	25	1	30	$112.68	Thanaleng (Lao PDR)	Intermediate Stop	4	0	$140.00	At stop: clearance (1hr, no cost), storage and loading (3 hrs, $140) during travel: $112.68 for operational costs	25 / 25	25.50 / 29.50	$140.85 / $280.85
3	Thanaleng (Lao PDR)	road	0	0	0	$0.00	Friendship Bridge (Lao PDR)	Exit Border Crossing	0	0	$0.00	customs and other formalities	25 / 25	29.50 / 29.50	$280.85 / $280.85
4	Friendship Bridge (Lao PDR)	road	3	0	30	$0.00	Nongkai (Thailand)	Entry Border Crossing	5	0	$85.00	gate fee ($ 20, 2 hrs wait period), weight fee ($20, 1hr), unloading plus transit entry document ($45, 2 hrs)	28 / 28	30.00 / 35.00	$280.85 / $365.85
5	Nongkai (Thailand)	road	630	19	0	$676.00	Bangkok Port (Thailand)	Intermediate Stop	24	0	$92.00	Unloading./loading, storage, seal inspections, clearances	658 / 658	54.00 / 78.00	$1,041.85 / $1,133.85
6	Bangkok Port (Thailand)	ship	1,540	96	0	$230.00	Port of Singapore (Singapore)	Intermediate Stop	24	0	$0.00	waiting for transshipment, feeder connection (24 hrs)	2,198 / 2,198	174.00 / 198.00	$1,363.85 / $1,363.85
7	Port of Singapore (Singapore)	ship	15,359			$1,602.00	Rotterdam Port (Netherlands)	Final Destination	0	0	$0.00		17,557 / 17,557	252.00 / 252.00	$2,965.85 / $2,965.85

Part III

Time

Cost

How to fill out Part I of the questionnaire?

a	Date of questionnaire completion:		10-May-2019
b	Route description:		Kampala to Shanghai
c	Goods:		Tea
d	Quantity:		1 TEU
e	Nationality of driver:		Ugandan
f	Country of vehicle registration:		Uganda
g	Effective date of transport start:		1-May-2019
h	Effective delivery date of goods:		21-May-2019
i	Was the transport performed under an international transit system (e.g. TIR, NCTS)?		No

Row

A. Please insert the date of questionnaire completion.
B. Please provide a description of the route (e.g. place of departure and destination).
C. Please choose the type of goods and indicate, whether it is only one type or different types of goods.
D. Please indicate the quantity and/or value of the goods transported.
E. [for road only] Please enter the nationality of the driver is important for road transport.
F. [for road only] Please enter country of vehicle registration.
G. Please provide the date when the goods are supposed to leave the place of departure.
H. Please provide the date when the goods are supposed to arrive at their final destination.
I. Please indicate any international transit system which has been used for the chosen transport, if the transport is not an international system then please say so in your response.

How to fill out Part II of the questionnaire? – I/IV

Microsoft Excel - 160207_TC Model Example master file.xls
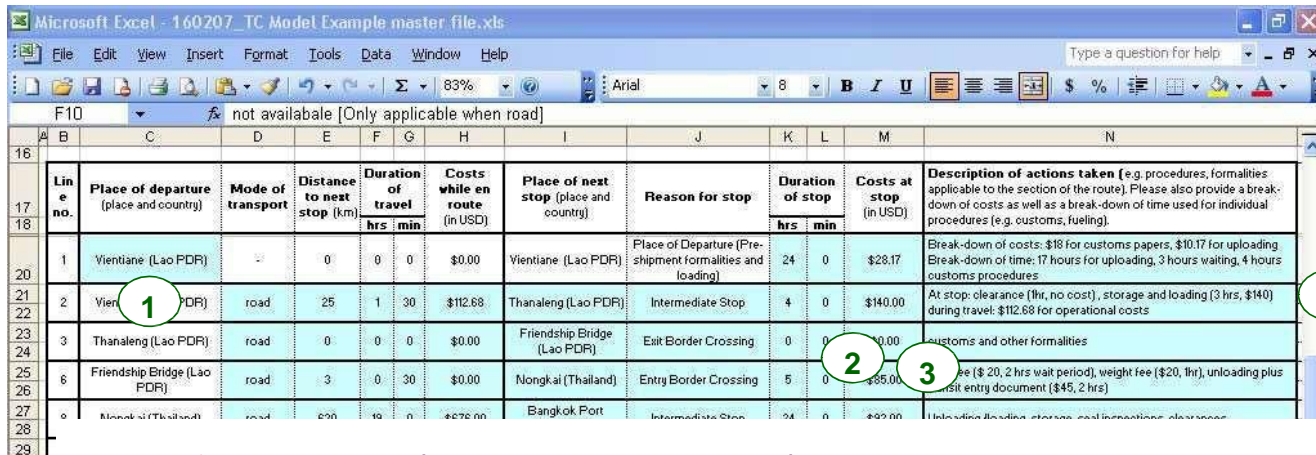
File Edit View Insert Format Tools Data Window Help

J23   Exit Border Crossing

Data table (Please fill in the highlighted cells and scroll down to see how the data translates into the graphs of "Time to Distance" and "Cost to Distance.")

Line no.	Place of departure (place and country)	Mode of transport	Distance to next stop (km)	Duration of travel hrs	min	Costs while en route (in USD)	Place of next stop (place and country)	Reason for stop	Duration of stop hrs	min	Costs at stop (in USD)	Description of actions taken (e.g. procedures, formalities applicable to the section of the route. Please also provide a break-down of costs as well as a break-down of time used for individual procedures (e.g. customs, fueling).
1	Vientiane (Lao PDR)	-	0	0	0	$0.00	Vientiane (Lao PDR)	Place of Departure (Pre-shipment formalities and loading)	24	0	$28.17	Break-down of costs: $18 for customs papers, $10.17 for uploading. Break-down of time: 17 hours for uploading, 3 hours waiting, 4 hours customs procedures
2	Vientiane (Lao PDR)	road	25	1	30	$112.68	Thanaleng (Lao PDR)	Intermediate Stop	4	0	$140.00	At stop: clearance (1hr, no cost), storage and loading (3 hrs, $140) during travel: $112.68 for operational costs
3	Thanaleng (Lao PDR)	road	0	0	0	$0.00	Friendship Bridge (Lao PDR)	Exit Border Crossing [Intermediate Stop / Exit Border Crossing / Entry Border Crossing / Final Destination]		0	$0.00	customs and other formalities
6	Friendship Bridge (Lao PDR)	road	3	0	30	$0.00	Nongkai (Thailand)			0	$85.00	gate fee ($ 20, 2 hrs wait period), weight fee ($20, 1hr), unloading plus transit entry document ($45, 2 hrs)
8	Nongkai (Thailand)	road	630	19	0	$676.00	Bangkok Port (Thailand)	Intermediate Stop		0	$92.00	Unloading,/loading, storage, seal inspections, clearances
9	Bangkok Port (Thailand)	ship	1,540	96	0	$230.00	Port of Singapore (Singapore)	Intermediate Stop	24	0	$0.00	waiting for transshipment, feeder connection (24 hrs)
10	Port of Singapore (Singapore)	ship	15,359	54	0	$1,602.00	Rotterdam Port (Netherlands)	Final Destination	0	0	$0.00	

- Please fill out all of the highlighted cells in Part II of the questionnaire.

- Please read each line from left to right. Each line captures one section of the journey (i.e. from one stop to another).

- Please note that the cells circled contain drop-down menus, which you see when clicking on the cell. Please choose your answers from the drop-down menu.

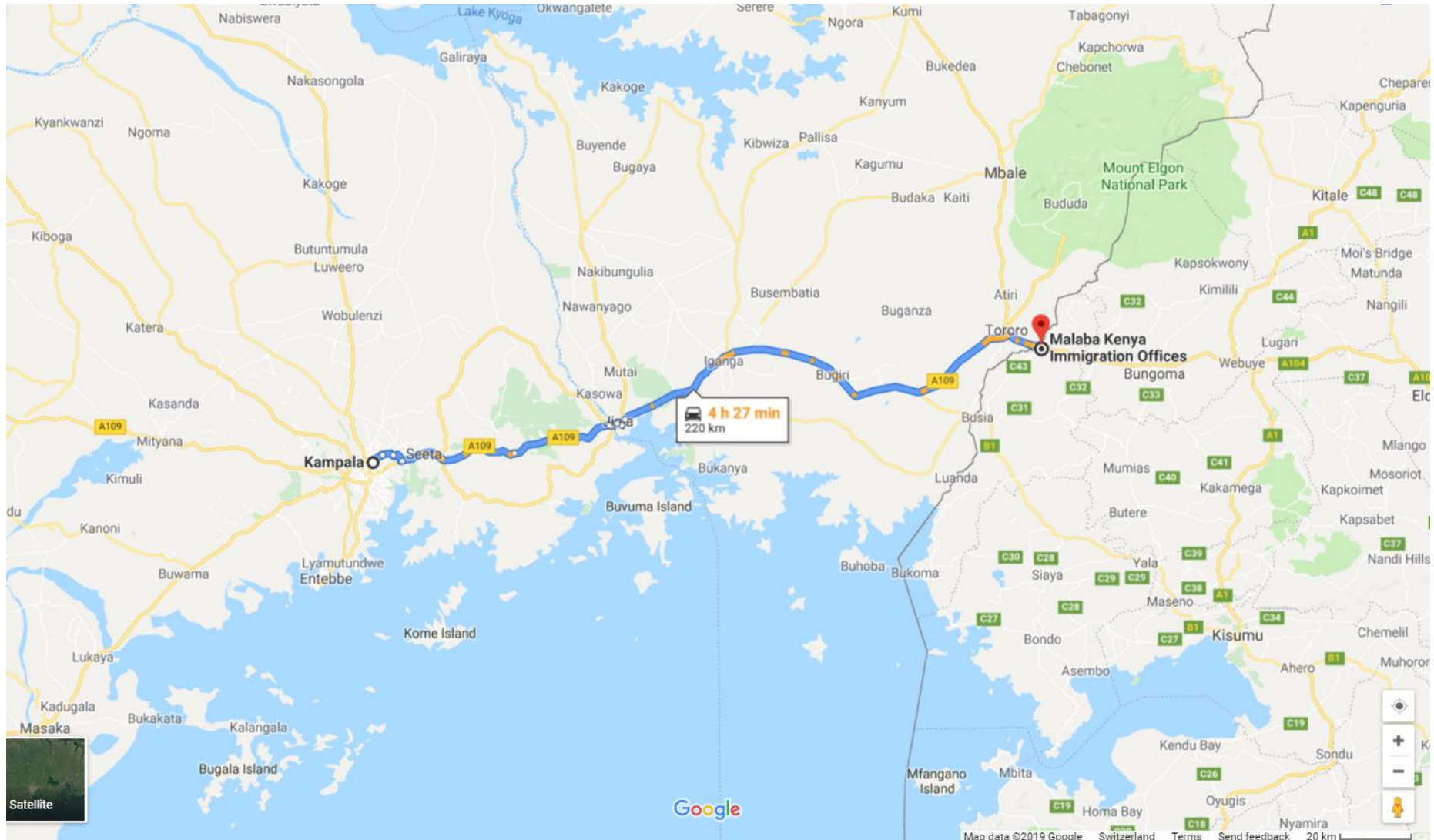# How to fill out Part II of the questionnaire? – II/IV

- Please fill out row 1 (highlighted cells only):

Step:

1. Enter the name and the country that indicate the place of departure. For example: Kampala, Uganda

2. Enter the total amount of time spent at the place of departure by providing the hours and the minutes. Please enter the total amount of time (For example: 20 minutes for fueling, 15 minutes for customs and 5 minutes at the restroom, then please enter 40 minutes).

3. Fill in the amount of costs incurred at the place of departure. If you have several payments, please insert the total amount only (For example: "$28.17" or if you paid 50 USD for fuel and 10 USD at customs, then please enter "$60").

4. Describe any actions (e.g. fueling, rest period) undertaken at the stop and provide details, if applicable, regarding the break-down of the time spent (see step 2) and of the different costs (see step 3).

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Kampala - border

How to fill out Part II of the questionnaire? – III/IV

Step:
5. Choose from the drop-down menu the mode of transport used to get from departure to next stop.
6. Enter the distance in kilometer from departure to next stop.
7. Enter the duration of the journey from departure to next stop by providing the hours and the minutes.
8. Enter the costs of the journey from departure to next stop in USD.
9. Enter name of place and country of next stop.
10. Choose from the drop-down menu the best description of the nature of the stop.
11. Enter the total amount of time spent at the stop (in hours and minutes).
12. Fill in the total amount of costs incurred at the stop.
13. Describe any actions (e.g. fueling, rest period) undertaken at the stop and provide details, if applicable, regarding a break-down of the time spent (see step 7 and 11) and of the different costs (see step 8 and 12).

25

Border - Nairobi

# How to fill out Part II of the questionnaire? – IV/IV

Please repeat the steps of row 2 for as many rows as you have stops before reaching the final destination. (In the example there are rows 3 to 6, see slide **XII**.)

When reaching the final destination, please fill out the last row (highlighted cells only):

Step 14:

14. Please choose from the drop-down menu the mode of transport used to get from departure to next stop (same as step 5).

Step 15:

15. Please enter the distance in kilometer from departure to next stop, which will be the final destination (similar to step 6).

Steps 16 and 17:

• Please enter the duration and the costs of the journey from departure to next stop in hours.

Steps 18 and 19:

• Please enter name and country of the final destination. Choose from the drop- down menu "Final destination".

Steps 20, 21 and 22:

• Please enter the total amount of time and costs spent at the final destination for individual activities. Add a detailed description of activities.
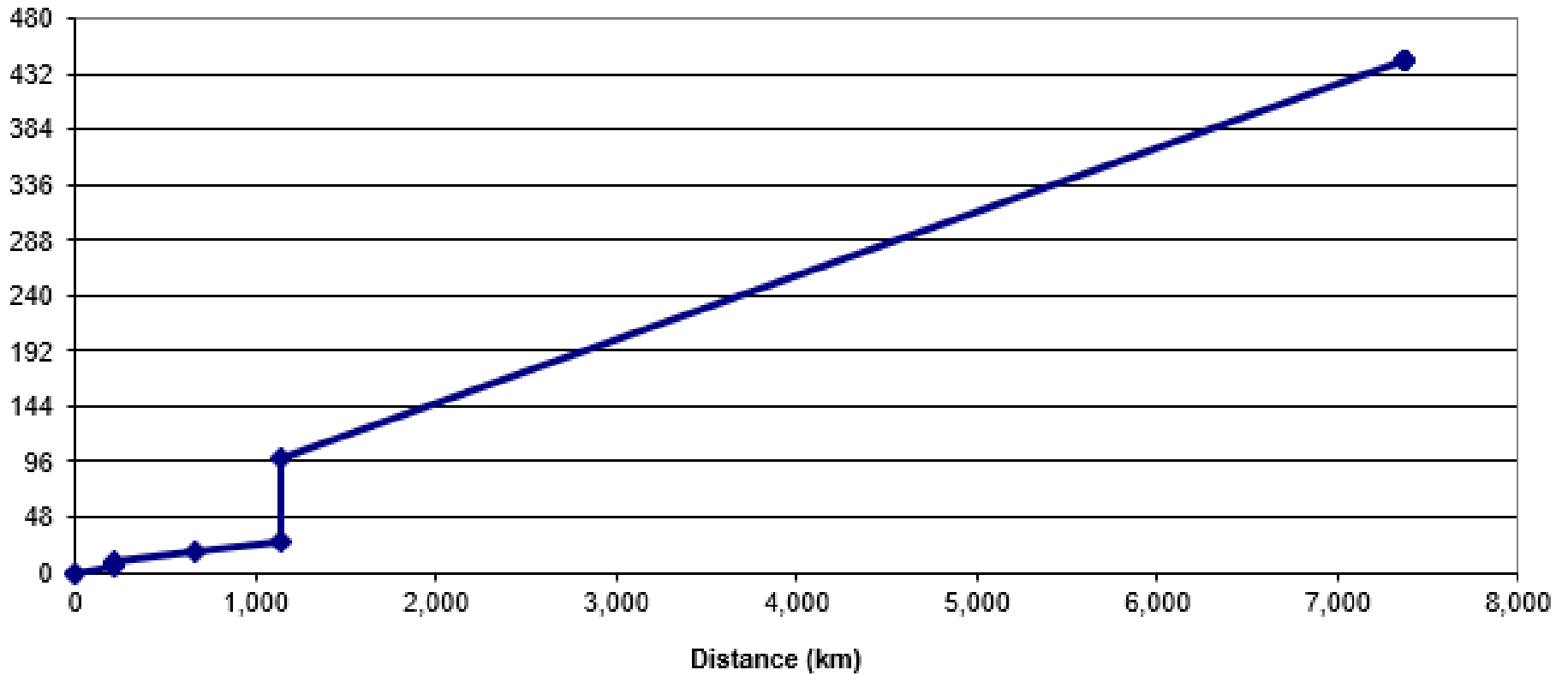
Nairobi - Mombasa
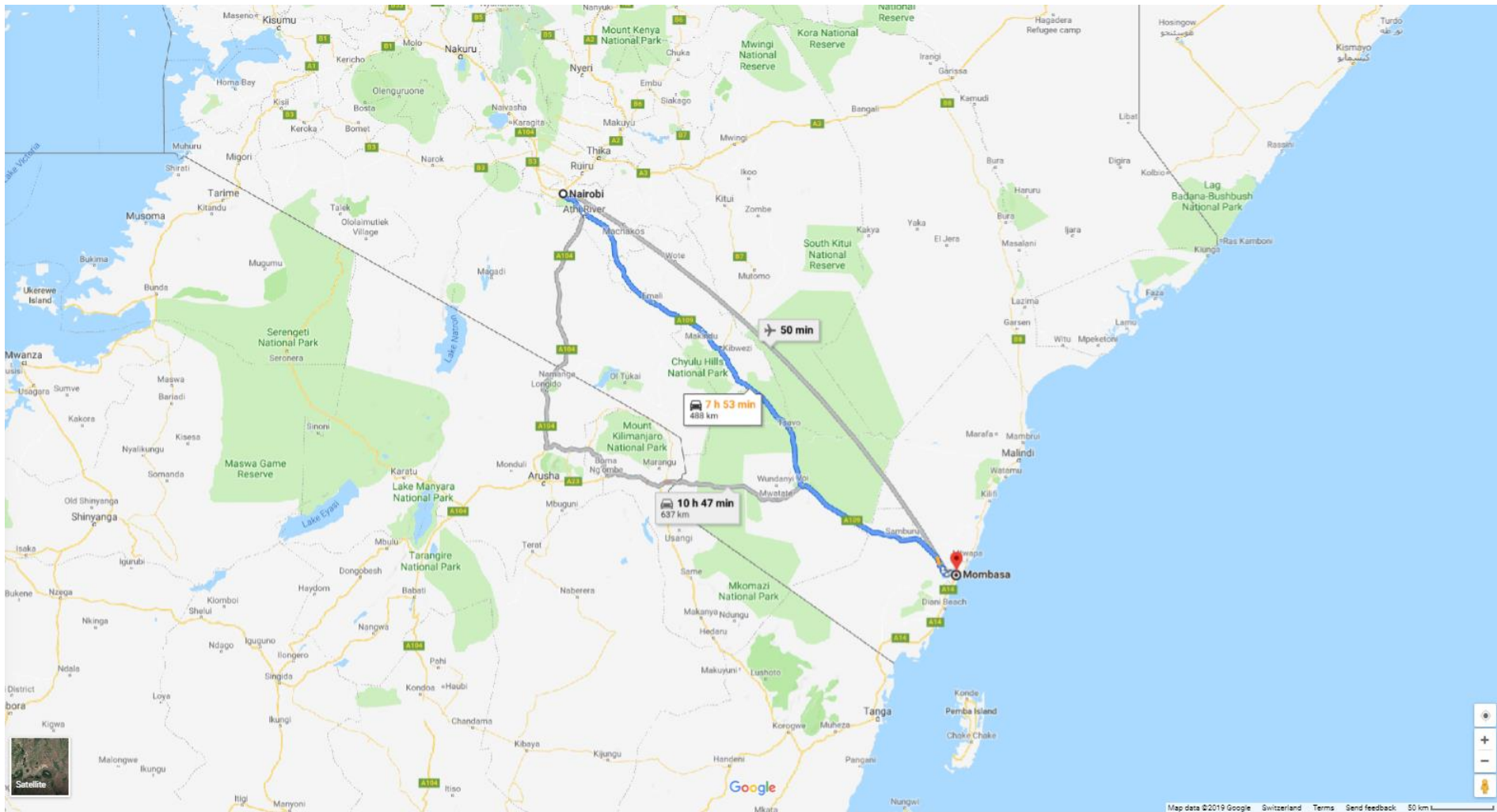
Part III: How to plot the graphs?
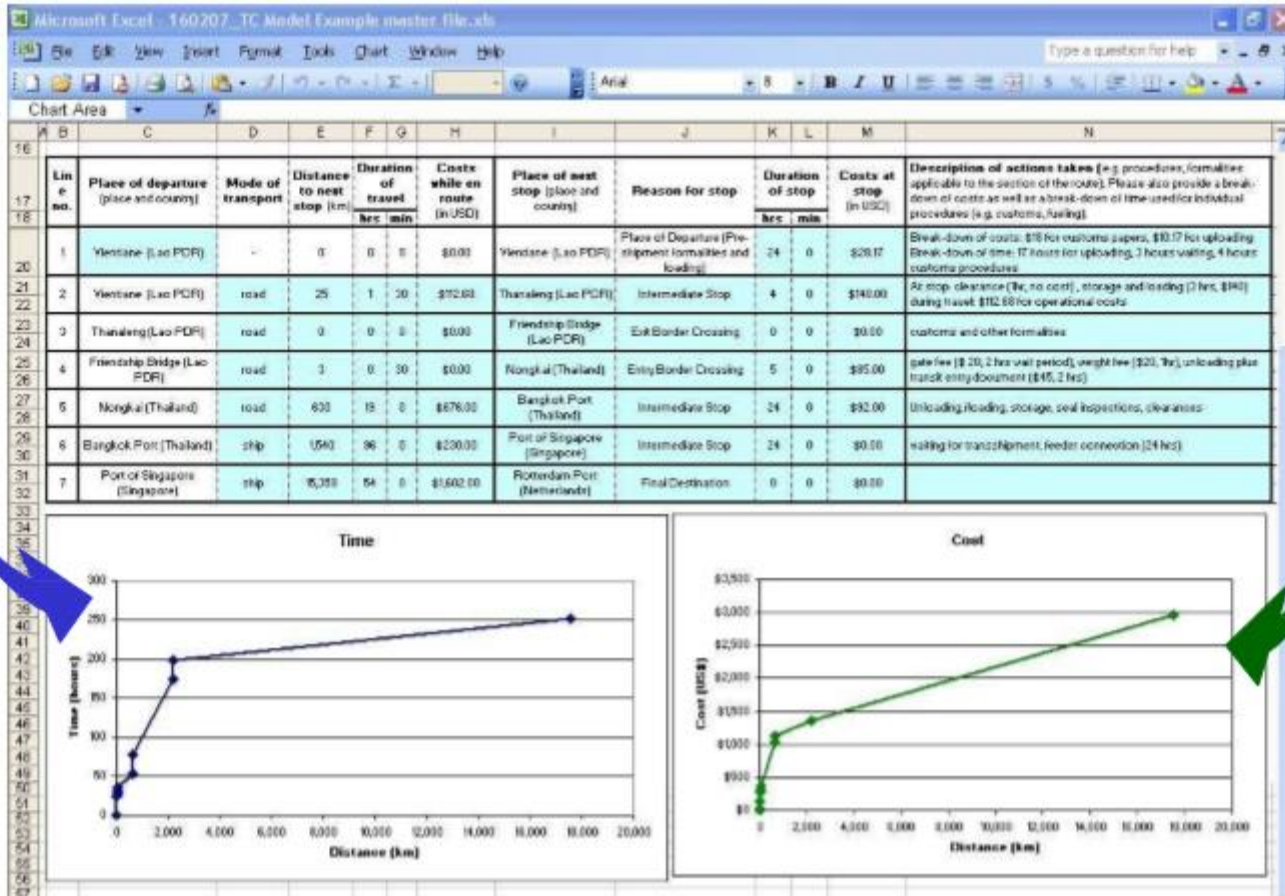
- The individual charts "Time over Distance" (left) and "Cost over Distance" (right) are plotted automatically as a function of the information you entered into the highlighted cells.

Time

Cost