Cost Optimisation Tool User Guide

Developed by OSCE Mission in Kosovo

OSCE Organization for Security and Co-operation in Europe Mission in Kosovo

Supported by: Fleet Forum and ETH Zurich
Version: February 2022

Introduction

About this Guide

The purpose of this guide is to support aid and development organisations to implement the Cost Optimisation Tool. The development of the tool was commissioned in 2021 by the Organization for Security and Co-operation in Europe, (OSCE) Mission in Kosovo (OMiK) to enable the Transport Unit to optimise the utilisation of its transport modes.

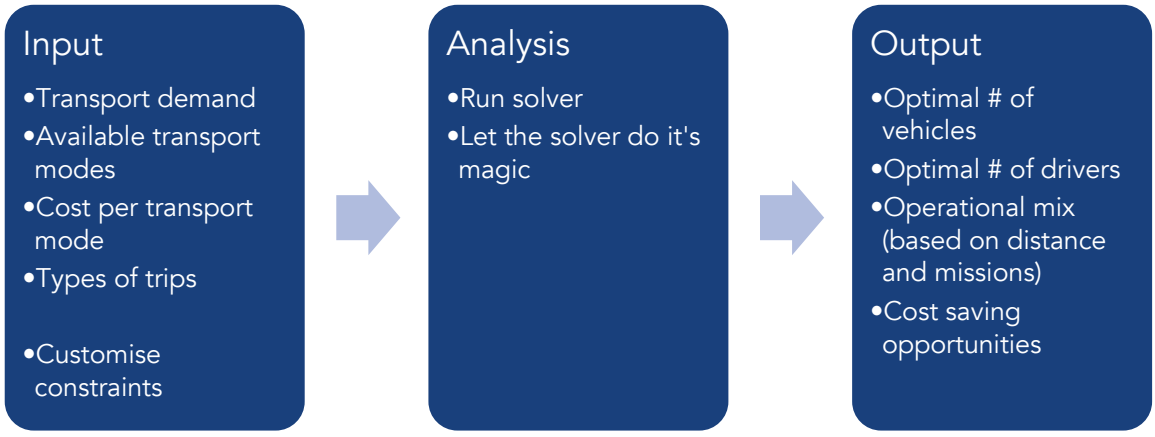
This guide and the Cost Optimisation Tool were developed with the support of Fleet Forum and ETH Zurich. Fleet Forum wishes to commend OSCE for making these knowledge resources available to other organisations wishing to optimise their transport.

For queries on the tool or the guide, please contact Fleet Forum (info@fleetforum.org)

About the Cost Optimisation Tool

Transport is a key enabler of aid and development activities. Transport managers are often tasked with determining:

- How many vehicles do I need to meet the transport demand of my organisation?
- Which transport modes should I use? Should I purchase vehicles and hire drivers to fulfil the transport demands? Or should I rent vehicles and outsource the transportation?
- What is the most optimal mix of transport modes from a cost efficiency perspective?
- Which transport mode should I use for a short trip (for example in the city)? And what about field missions?



The Cost Optimisaiton Tool enables users to get insight into the optimal mix of transport modes for passenger transport by inputting summary historical data for any period of time (one day, one week, one month etc.). The output of the tool allows users to compare their current state to the optimal one to gauge efficiencies and use the outputs of the tool to make recommendations and optimise.

The Cost Optimisation Tool is intended for **Transport Managers and Finance Managers**.

Unique features / opportunities of the tool

The tool is a transport optimisation tool, not a fleet tool. What we mean is the tool allows users to include different modes, not just purchasing vehicles. For example, in the case of OMiK, four transport modes were embedded:

1. Core drive: OMiK-owned vehicles operated by a professional driver that is hired by the organisation
2. Self-drive: OMiK-owned vehicles operated by staff members who require transport
3. Taxi rental: commercial company offers a vehicle and a driver. OMiK pays for the usage on a rate per kilometre
4. Outsourced transport: commercial company offers a vehicle and a driver at a daily rate.

The tool has a number of operational constraints that can be customised based on your organisational context. These include:

- Group trips into three categories based on duration and set the average duration per type of trip
- For how many hours is a vehicle blocked if a certain mission is performed by a certain transportation mode
- How often is a single leg between point A and pint B performed if a certain mission is performed by a certain transportation mode

The tool takes into consideration the concurrency of missions. In a world of perfect utilisation, we would the demand for transport would be constant, which would allow Transport Managers to make maximum use of the transport means. In practice, there are peaks in transport, for example, there might be more requests for transport at 9am in the morning then 2pm in the afternoon, or on Mondays and less so on Fridays. Through this tool, Transport Manager can indicate what the concurrency of the missions are.

Limitations of the tool

Historical data is inputted in the tool. It can be risky to optimise mix of transport modes based on historical data, especially if your future transport demand is significantly higher or lower.

The Cost Optimisation Tool has been designed for organisations to use per field or country office.

The tool is not designed to determine the optimal mix for a specific mission nor does it serve as a dispatching system.

Technical specifications of the tool

The Cost Optimisation Tool was designed in Microsoft Excel, using a Solver, for simplicity, ease of use and low costs.

Solver is a Microsoft Excel add-in program you can use for what-if analysis. Use Solver to find an optimal (maximum or minimum) value for a formula in one cell — called the objective cell — subject to constraints, or limits, on the values of other formula cells on a worksheet. Solver works with a group of cells, called decision variables or simply variable cells that are

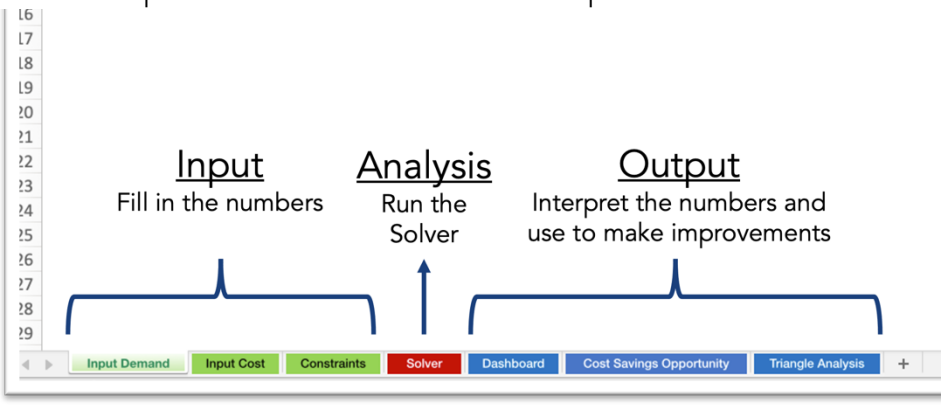
used in computing the formulas in the objective and constraint cells. Solver adjusts the values in the decision variable cells to satisfy the limits on constraint cells and produce the result you want for the objective cell.

The Solver Add-in is a Microsoft Office Excel add-in program that is available when you install Microsoft Office or Excel. To use the Solver Add-in, however, you first need to load it in Excel. Visit the following link (https://support.microsoft.com/en-us/office/load-the-solver-add-in-in-excel-612926fc-d53b-46b4-872c-e24772f078ca) to learn how to activate the Solver Add-in.

The tool is designed for simplicity in Excel, consequently it is not so easy to add or remove transport modes. Therefore, we have created three versions of the tool: for 3 transport modes, 4 transport modes and 5 transport modes. Before you start using the tool, make sure you download the right version.

Structure of the tool

The Cost Optimisation Tool is structured in 3 parts



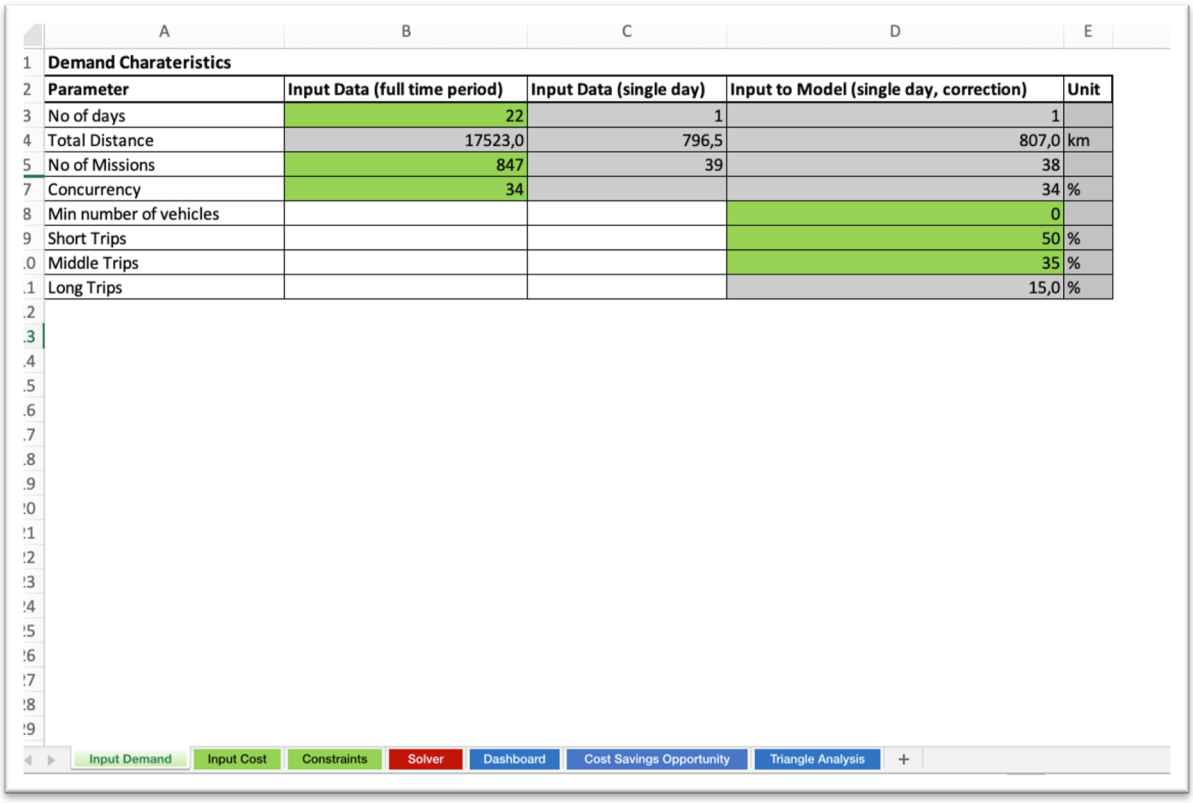
As you start to use the tool, you will note some cells are in green, others in orange and some in grey. The green cells are the ones you need to fill in everytime you insert new data into the tool. The orange ones need to be updated once, when you first start to use the tool, to take into consideration your operating context. The values in the grey cells are fixed and should not be adjusted.

Step 1: Inputting the Data

There are three tabs in which data needs to be inputted: Input Demand, Input Cost and Input Constraints.

Input Demand

This tab is related to the transport needs of the operation over a given period of time. The values in Input Demand need to be updated everytime you want to use the tool. The tool then takes the data you inputted and automatically makes an average (single day) which is used for analysis.



	A	B	C	D	E
1	**Demand Charateristics**				
2	**Parameter**	**Input Data (full time period)**	**Input Data (single day)**	**Input to Model (single day, correction)**	**Unit**
3	No of days	22	1	1	
4	Total Distance	17523,0	796,5	807,0	km
5	No of Missions	847	39	38	
7	Concurrency	34		34	%
8	Min number of vehicles			0	
9	Short Trips			50	%
10	Middle Trips			35	%
11	Long Trips			15,0	%

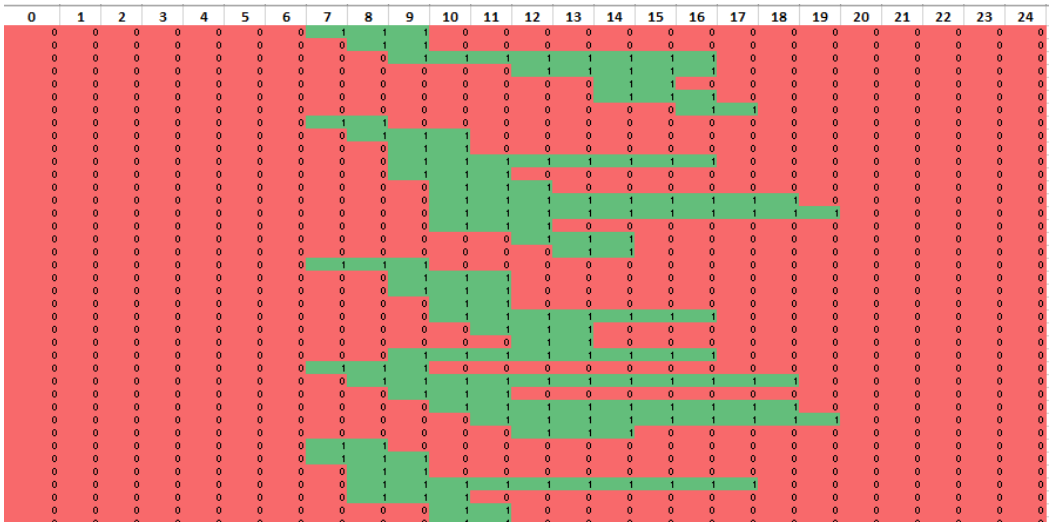
Input Demand | Input Cost | Constraints | Solver | Dashboard | Cost Savings Opportunity | Triangle Analysis | +

Input variable	What does it mean?
No days	The number of days for which the data is being inputted. It can be 1 day – 365 days
No of missions	The total number of missions completed in this period of time
Concurrency	The % of missions taking place in parallel
Minimum number of vehicles	The minimum number of owned vehicles required. This variable is only necessary if the security level in your context is high and the organisation must own a number of vehicles for evacuation purposes.
Short trips	The % of trips that are within the previously identified parameter of short trips
Middle trips	The % of trips that are within the previously identified parameter of middle trips

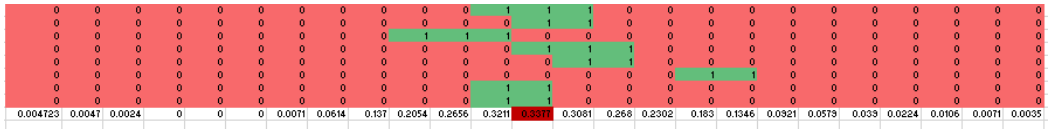
Concurrency is a critical variable in this tool, and you will need to use your data to calculate this. To facilitate the calculation, we have provided you with a calculation table (attached to this guide) as well as instructions below to use the calculation table.

How to calculate concurrency:

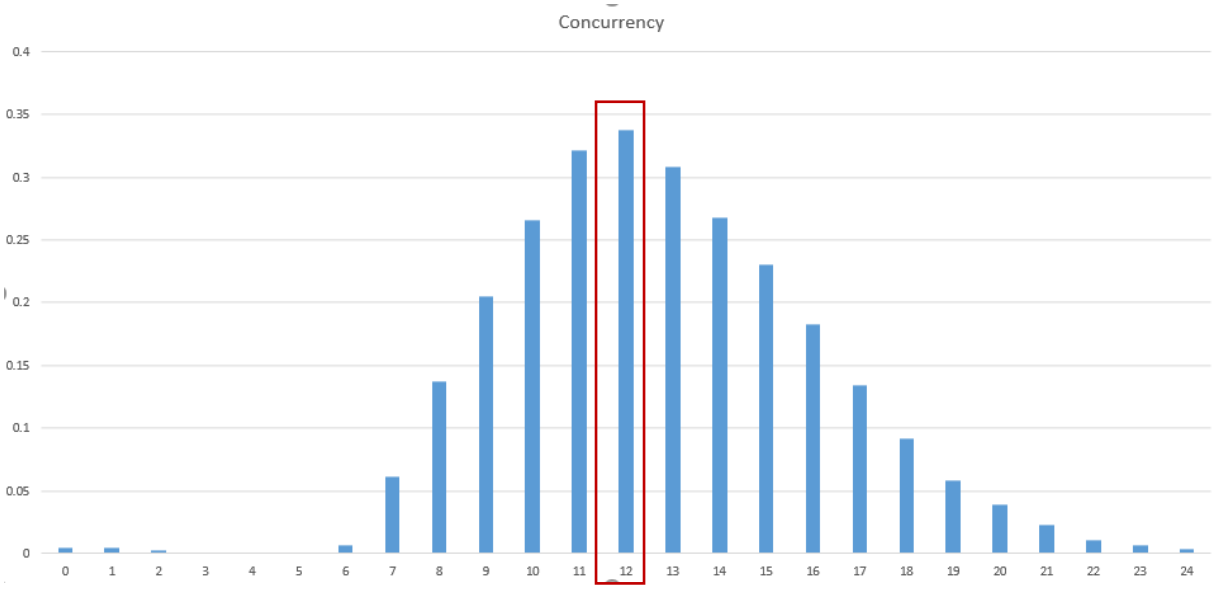
1) Track start and end of each trip (round-down start time and round up end-time -> conservative calculation)



2) For each hour of the day, sum up all trips performed during that hour and divide sum by total number of trips in that time period.

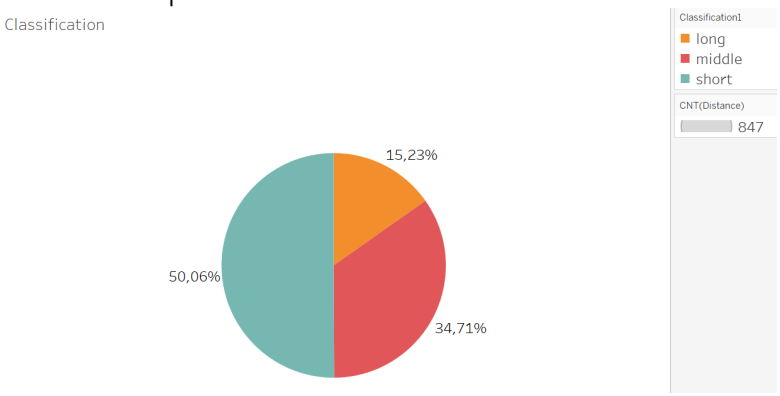


3) Determine hour of the day with the most trips and report percentage of trips performed simultaneously during that hour as (max.) concurrency in the time period.



How to calculate the spread of short-middle-long trips:

1) Define distance intervals for short, middle and long trips (e.g. [0-10), [10-40), [40,…]
2) Classify each trip in the time period as short, middle or long (e.g. =IF(distance<=10;"short";IF(distance<=40;"middle";"long")))
3) Calculate percentage of short and middle trips in the time period based on the total number of trips.



In the Input Demand, you are also to indicate the percentage of short and middle trips. Long trips is automatically taken by calculating the difference between 100% and the percentages you have indicated for short and middle trips.

As the tool is makes an average (single day), the number of trips may end up being fractions, due to dividing the total number of missions by the number of days. The single day correction makes sure that we are only passing full missions (no fractions) to the tool.

	A	B	C	D	E
1	**Demand Charateristics**				
2	**Parameter**	**Input Data (full time period)**	**Input Data (single day)**	**Input to Model (single day, correction)**	**Unit**
3	No of days	22	1	1	
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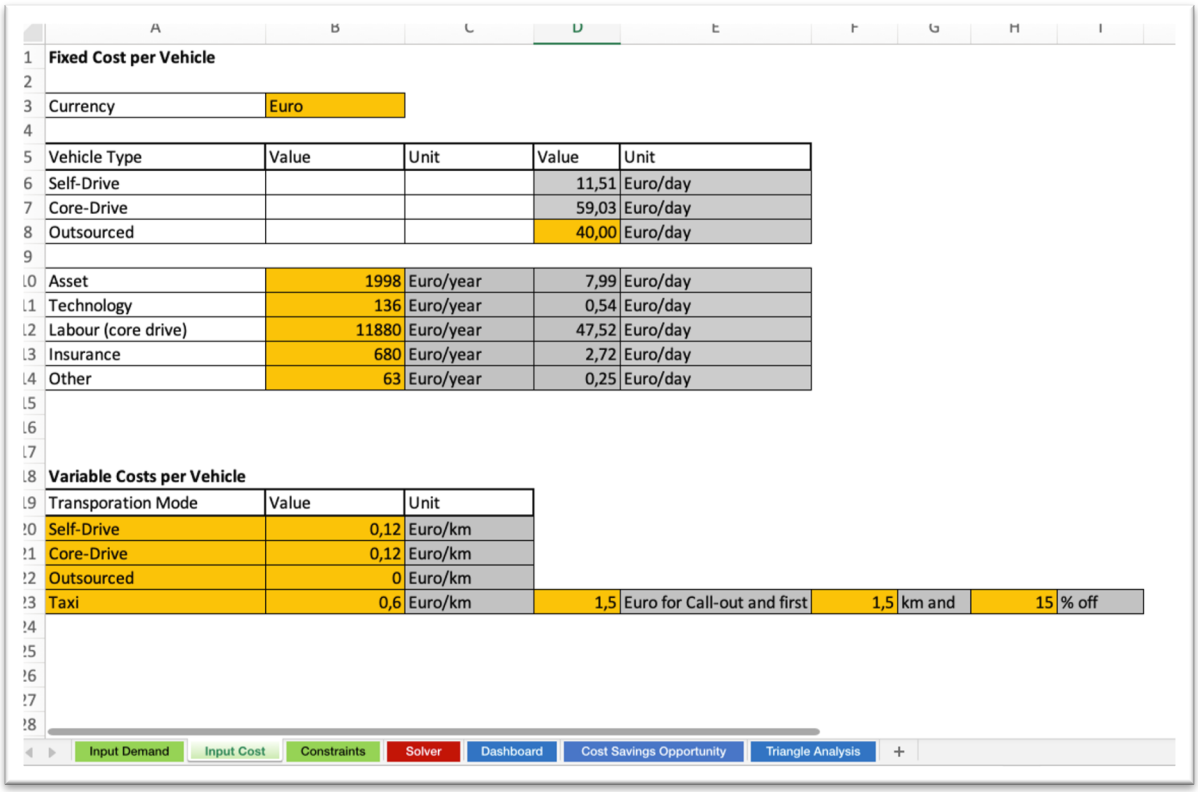
7	Concurrency	34		34	%
8	Min number of vehicles			0	
9	Short Trips			50	%
.0	Middle Trips			35	%
.1	Long Trips			15,0	%

Input Cost

This tab is related to the costs for each of the transport demands. We have made a distinction between fixed costs and variable costs: the more kilometres driven, the lower the fixed cost per kilometre.

Type Cost	Input cost	What does it mean?
Fixed	Asset	Cost of putting vehicle into service. Also include costs for transportation from the supplier to the location of operation, import costs, registration costs etc.

		Deduct, if any, the amount of money you'd get for selling / auctioning off this vehicle after its depreciation period. Divide the amount based on the depreciation policy of your organisation.
Fixed	Technology	Costs associated with the vehicle tracking and fleet management system
Fixed	Salary	Labour costs for the vehicle. e.g. driver's salary and per diem
Fixed	Insurance	Cost of the insurance premiums per year
Fixed	Other	Any other fleet costs (breakdowns, repair, road tax etc.)
Variable	(per transport mode)	The fuel costs + the costs for the preventative, scheduled maintenance + repair In the case of taxi, you can incorporate the rate per km in this cell.



Fixed Cost per Vehicle

Currency	Euro

Vehicle Type	Value	Unit	Value	Unit
Self-Drive			11,51	Euro/day
Core-Drive			59,03	Euro/day
Outsourced			40,00	Euro/day
Asset	1998	Euro/year	7,99	Euro/day
Technology	136	Euro/year	0,54	Euro/day
Labour (core drive)	11880	Euro/year	47,52	Euro/day
Insurance	680	Euro/year	2,72	Euro/day
Other	63	Euro/year	0,25	Euro/day

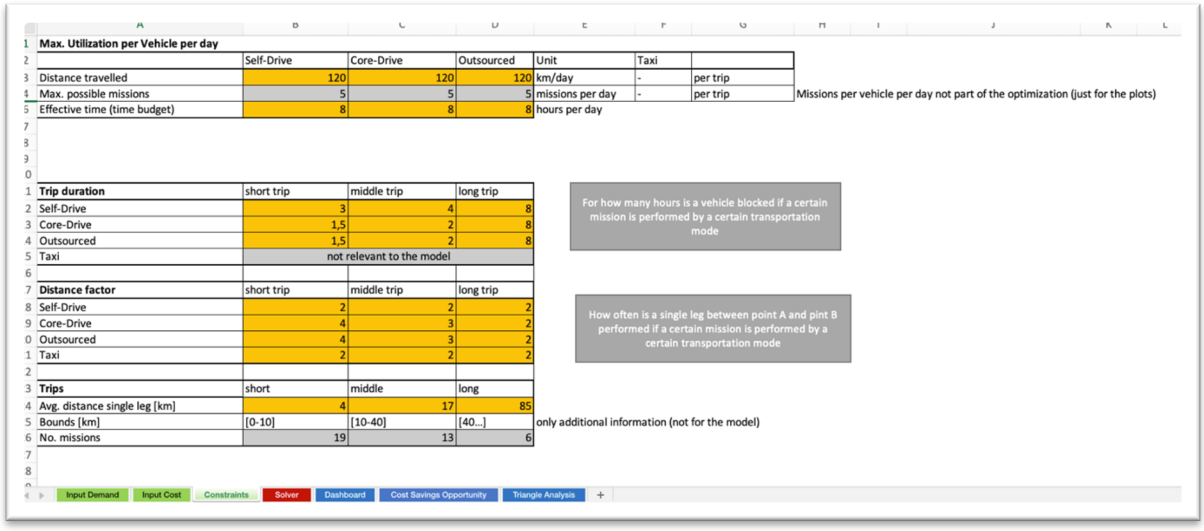
Variable Costs per Vehicle

Transporation Mode	Value	Unit						
Self-Drive	0,12	Euro/km						
Core-Drive	0,12	Euro/km						
Outsourced	0	Euro/km						
Taxi	0,6	Euro/km	1,5	Euro for Call-out and first	1,5	km and	15	% off

Input Demand | Input Cost | Constraints | Solver | Dashboard | Cost Savings Opportunity | Triangle Analysis

Input Constraints

The tool has several operational constraints that must be customised based on your organisational context the first time you use the tool. Once you do so, the tool will factor in these constraints when calculating the optimal mix of transport modes. For example, if taxi rental is a transport mode available in your operation and it can drive about 100 kilometres per day and your long trips are 150 kilometres on average, then the tool will not consider taxi rental as a transport mode for long trips.



Max. Utilization per Vehicle per day

	Self-Drive	Core-Drive	Outsourced	Unit	Taxi	
Distance travelled	120	120	120	km/day	-	per trip
Max. possible missions	5	5	5	missions per day	-	per trip
Effective time (time budget)	8	8	8	hours per day		

Missions per vehicle per day not part of the optimization (just for the plots)

Trip duration	short trip	middle trip	long trip
Self-Drive	3	4	8
Core-Drive	1,5	2	8
Outsourced	1,5	2	8
Taxi	not relevant to the model		

For how many hours is a vehicle blocked if a certain mission is performed by a certain transportation mode

Distance factor	short trip	middle trip	long trip
Self-Drive	2	2	2
Core-Drive	4	3	2
Outsourced	4	3	2
Taxi	2	2	2

How often is a single leg between point A and pint B performed if a certain mission is performed by a certain transportation mode

Trips	short	middle	long
Avg. distance single leg [km]	4	17	85
Bounds [km]	[0-10]	[10-40]	[40...]
No. missions	19	13	6

only additional information (not for the model)

Input Demand | Input Cost | Constraints | Solver | Dashboard | Cost Savings Opportunity | Triangle Analysis | +

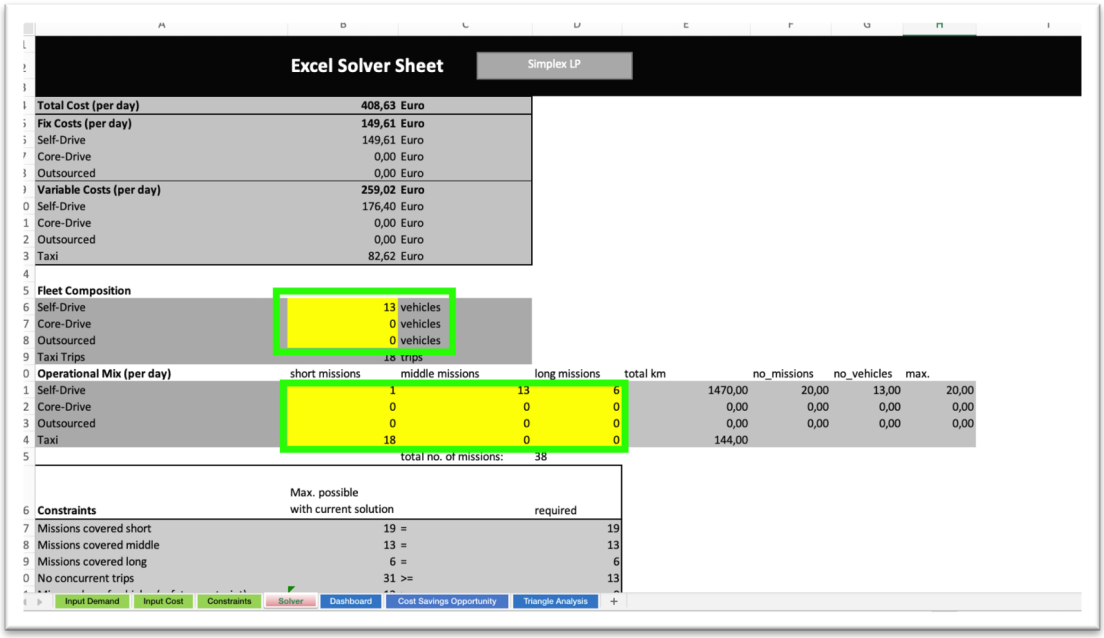
Input constraint	What does it mean?
Distance travelled	The total number of kilometres per day this transport mode can complete
Effective time	The number of working hours per day for which you can use this transport mode
Trip duration (per transport mode)	For how many hours is a vehicle blocked if a certain mission is performed by a certain transportation mode
Distance factor (per transport mode)	How often is a single leg between point A and point B performed if a certain mission is performed by a certain transportation mode. In an optimised scenario, for owned transport, the value will be 2.
Average distance single leg (km)	The average distance in kilometres of a single leg per type of trip.

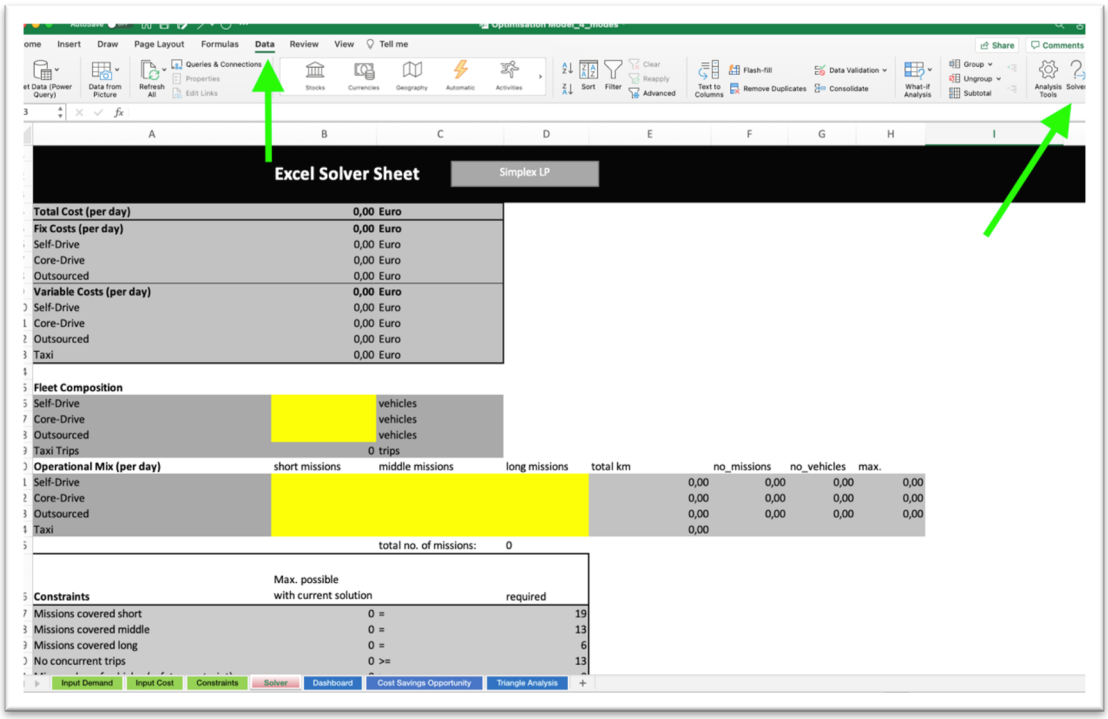
Step 2: Running the Solver

Once you have filled in all the data, it's time to run the solver.

Remember, right before you run the Solver, press 'Save' in Excel. The Solver is sensitive to changes in the values and in order to receive an accurate response, you must always Save before running the Solver.

Once you have saved, click on the Solver tab (in red) and delete all the numbers in the yellow, as indicated in the figures below. Next, in the Menu bar, click on Data. Once you click on data, look for the Solver option and click on it.





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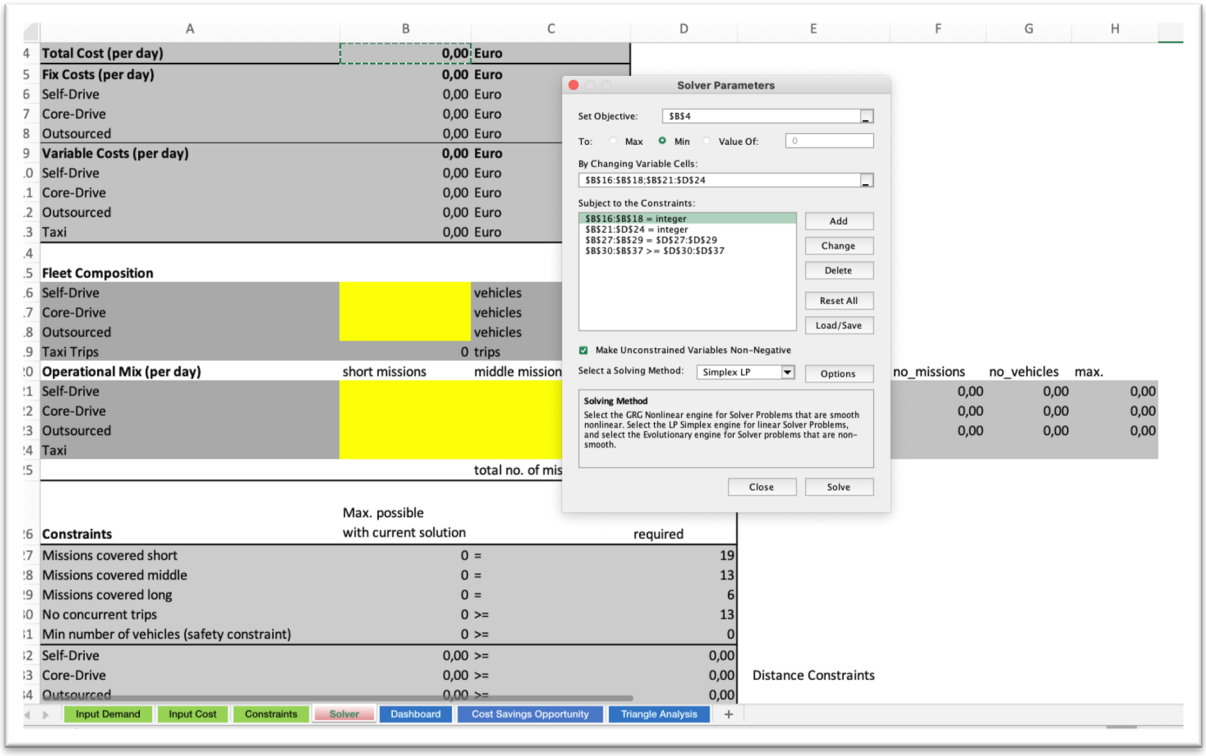
Once you click on the Solver, a box will appear. Click on the Solve button.



Once you have done so, the what-if scenario will automatically run, using the inputs you provided, and the yellow boxes will be populated with numbers.

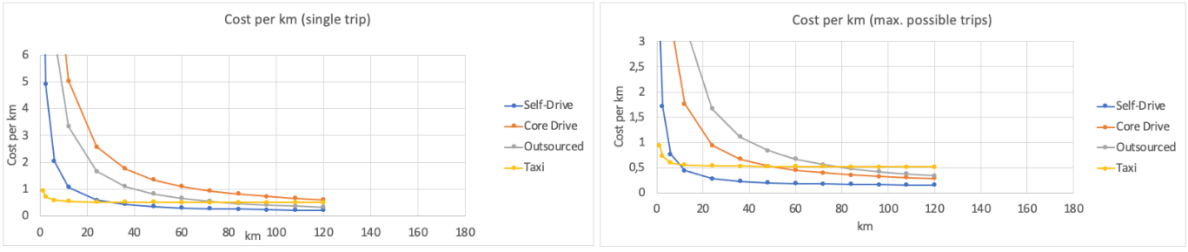
You have completed the analysis step, now it's time to interpret the results.

Step 3: Interpreting the Results

There are three tabs in which data needs to be inputted: Dashboard, Triangle Analysis and Cost Savings Opportunity.

Dashboard

In this tab, you will get insight into the optimal transport mix. The two plots are not part of the optimisation tool itself. Instead, they only serve the purpose of giving the Transport Manager a better understanding of the solution chosen by the solver. The plots show at what distance a specific transport mode becomes more cost-efficient than others. In the example above, we see that taxi and self-driven are the most cost-efficient modes and there is a point in which one is more favourable than the other. This means that taxis are most cost-efficient for short trips, whereas self-driving are more cost efficient for long trips.



The plots compare the cost-per-km for all different transportation modes. The cost associated with each transportation mode is divided into fixed and variable costs.

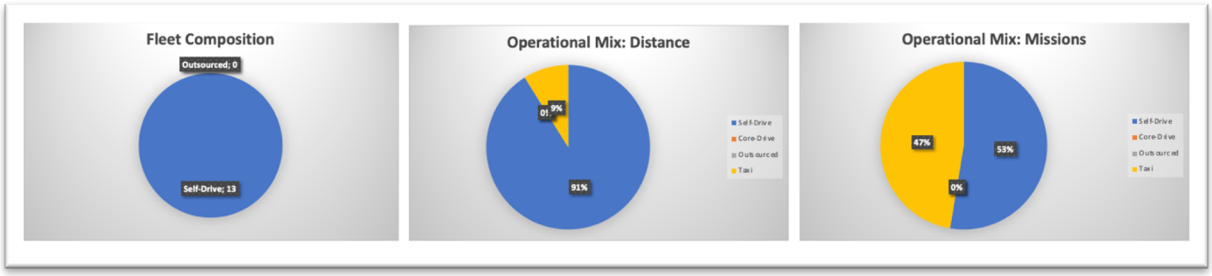
The left plot assumes that each vehicle can perform only one trip per day. Hence, the total fixed cost per day are assigned to that one trip. The cost-per-km can be calculated by:

$$\frac{C_{fix} + c_{var}\text{distance}}{\text{distance}}.$$

However, the maximum number of trips per vehicle depends on the type of missions, and one vehicle will probably perform more than one trip per day. The right plot calculates the cost-per-km assuming more than one trip per day e.g. five trips (see "Constraints"-Sheet row 4 – those numbers can be changed). The number of trips are however pre-defined. The cost-per-km for vehicles with more than one trip per day can be calculated by:

$$\frac{\frac{C_{fix}}{\text{no. of trips per day}} + c_{var}\text{distance}}{\text{distance}}.$$

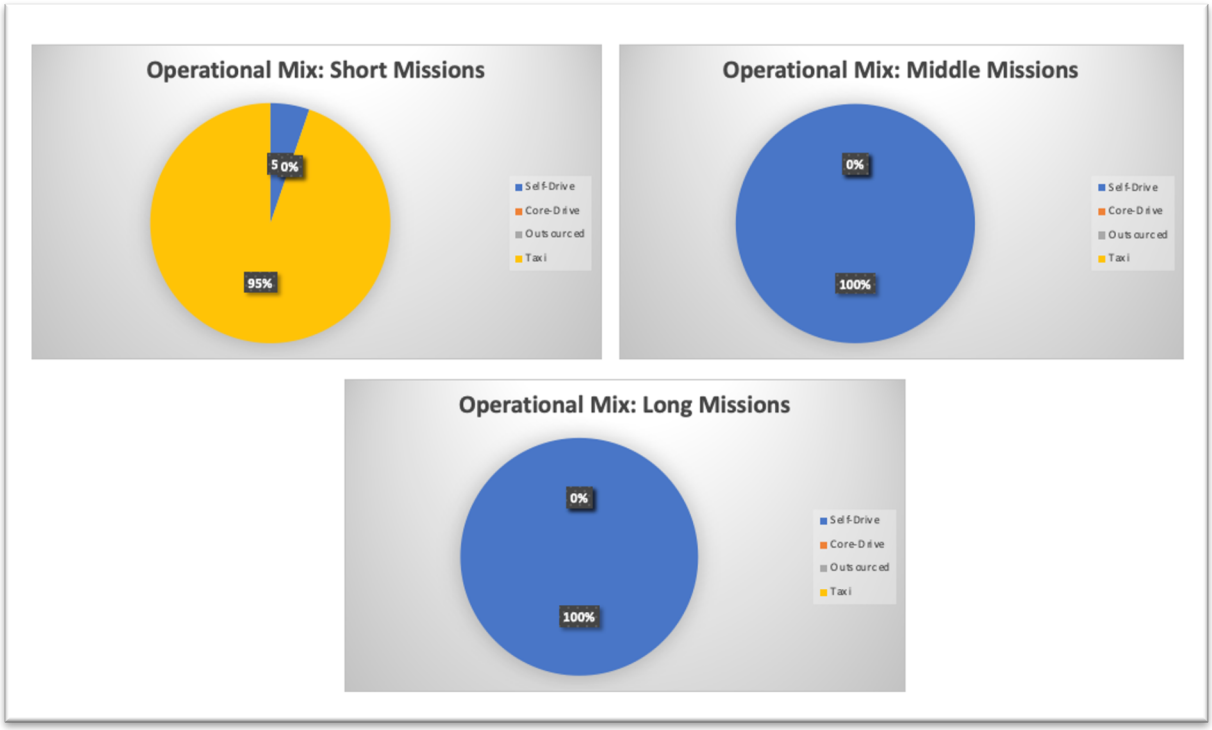
Both plots provide general insights into the cost structure of the transportation modes. But both plots are only an approximation. They assume fixed number of trips independent of the type of trip. The plots represent the two extremes – only one trip per day vs. many trips per day. The plots don't show the "actual" cost-per-km for each transportation mode, because this depends on how each vehicle of that mode is actually used for missions.



In the next set of graphs, we get insight into the optimal fleet composition and the optimal operational mix based on distance and missions.

In addition, we have created three more piecharts visualising the optimal operational mix based on the type of trips. This helps give a better understanding of which transport mode is more suitable per trip type. In some cases, the tool might recommend multiple transport modes per trip type

The tool "fills up" the capacity of the vehicles it buys. It intends to use self-drive vehicles for long and middle trips. Short trips are mostly performed by taxi. The vehicles performing middle trips have some capacity to also perform an additional short trip. If you buy vehicles for the middle and long trips you better fully utilize them.



<u>Cost Savings Opportunity,</u>

In this tab, there is a possibility to understand the savings opportunities of adopting the optimal operational mix. To do so, you are first asked to fill in the costs associated with your current operational mix.

Once filled in, the Cost Optimisation Tool will then show you the savings opportunities, in terms of vehicles, drivers and costs

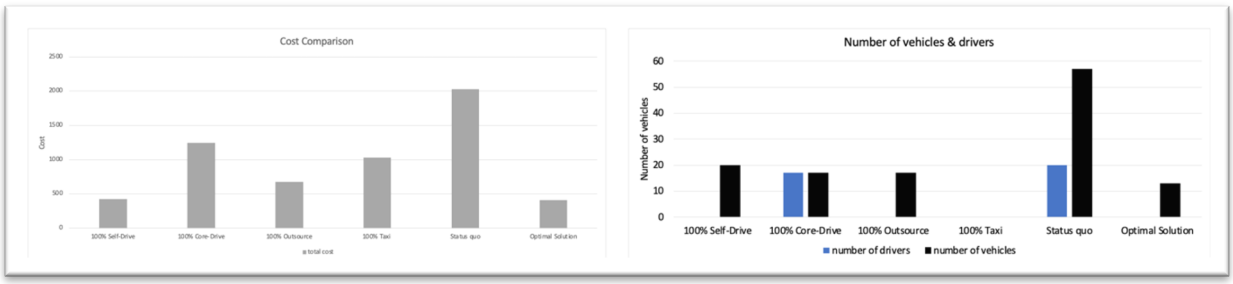
Time period for savings plots	250	days
Time period	25	days
Type	**Status quo**	
Vehicles (Buy - Resale Value)	12869,33	Euro/period
Technology	4549,14	Euro/period
Salary (core drive)	15695,00	Euro/period
Insurance	3358,68	Euro/period
Other	331,69	Euro/period
Cost for Outsourcing	0,00	Euro/period
Cost for Taxi Services	11108,15	Euro/period
Cost for Fuel + M&R	2737,99	Euro/period
No drivers	20	
No vehicles	57	

Please note, the cost savings opportunities are indicative, and they do not consider the costs of transitioning to the optimal operational mix.

For example, if the optimal solution is to primarily outsource transportation, whereas your current situation is primarily core-drive, the tool does not include the costs of disposing the vehicles and terminating employment contracts.

Triangle Analysis

In the final tab, we examine the total number of drivers and vehicles as well as the corresponding transport costs if the organisation were to fully use any of the transport modes and we compare this to the status quo and the optimal solution.



Frequently Asked Questions (FAQ)

In my country programme, there is 1 capital office and multiple field offices. Shall I combine the data for all offices and input it? Or separate it?
There is no one right answer to this question. This is a cost optimisation tool and in order to achieve maximum efficiencies, it is wise to treat the fleet as one. On the other hand, if the field offices are very far from each other and the transport modes and associated costs vary, we would recommend treating these as different fleets and fill in the Cost Optimisation Tool separately.

How can I add or remove transport modes in the tool?
The tool is designed for simplicity in Excel, consequently it is not so easy to add or remove transport modes. Therefore, we have created three versions of the tool: for 3 transport modes, 4 transport modes and 5 transport modes. Before you start using the tool, make sure you download the right version.

Transportation Mode	Fix Costs	Variable Costs
Self-Drive	Yes (no driver salary)	Yes
Core Drive	Yes (driver salary)	Yes
Outsourced	Yes (fixed price per day)	Yes
"Fix Cost Vehicle + Variable Costs"	Yes (fixed price per day)	Yes
Taxi	No	Yes (fixed price to call out first x km free discount)

For the Input Demand, can I use forecast data instead of using historical data?
Yes, actually it is even better to use forecast data. It can be risky to optimise mix of transport modes based on historical data, especially if your future transport demand is significantly higher or lower. When designing the tool for the first time, OSCE opted to use historical data as they wanted to see the result without factoring the reduced demand due to Covid-19.

Certain input variables do require you to have detailed data (for example concurrency) which might be difficult to forecast. In such cases, we recommend you use historical data specifically for these variables.

Can I use the data for one day in the tool?
Yes, this is possible. The number of days for which the data is being inputted. It can be 1 day – 365 days, it's up to you. The tool takes the data you inputted and automatically makes an average (single day) which is used for analysis. To ensure the results are reliable and can be used for decision-making, we recommend that you input data for a longer period of a time (3 months or more).

If this is the first time you are optimising and you think there are a lot of efficiencies to be gained, you can also use the data for 1 day, a peak day in your operation. The result of the tool would show you the efficiencies you could make with minimal adjustments to your fleet operations.

Why is my actual mileage higher or lower than the total distance in the input demand?
The tool uses the number of missions and the percentage of short, middle and long trips to calculate the total distance, therefore it is normal to have some differences. If the difference is significant (for example 15% or more), this can be an indication to adjust the average distance single leg (km) in the Input Constraint tab.

My question has not been answered in this guide. What can I do?
For queries, please contact Fleet Forum (info@fleetforum.org)