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WHITEPAPER

OPTIMIZATION REPORT

Route planning with time-dependent travel times

EFFICIENT.
SUSTAINABLE.
SUPERIOR.

ROUTE PLANNING: SAVE ON TIME, MONEY, FUEL AND CARBON EMISSIONS

With route planning, effectiveness (time) and efficiency (total cost) are of the utmost importance to ensure that your drivers and technicians to reach their destination at the desired ETA while also keeping your drivers and clients happy and saving valuable money for your entire operations. However, there is one crucial time related aspect that is often overlooked when planning routes: **the actual traffic flow velocity at different locations and times of the day in a delivery area.**

The Research Institute for Discrete Mathematics at the University of Bonn recently published a research paper entitled “Vehicle Routing with Time-Dependent Travel Times: Theory, Practice, and Benchmarks” in which it explored this very topic. By analyzing freely available speed data from 10 cities across four sub continents that were obtained from Uber rides (with and without time slots), the researchers were able to gather enough data to fulfill the quality criteria of scientific work. The study demonstrates an existing issue of route planning, which is that you typically either have to plan according to the longest (worst-case) travel times in traffic or according to the average travel times.

By choosing either one of these options, the dispatcher has to decide between two inherent disadvantages: The worst-case scenario (assumption of slowest speeds) allows for the fulfillment of all time slots and, therefore, there are no late deliveries or arrivals. However, this is not cost-efficient and results in an 8%, decrease in efficiency, ensuring high quality but also generating high costs compared to when planning routes with **time-dependent travel times.** The latter accounts for the actual traffic flow velocity at each time of day in a certain area and is the key to optimizing your operations despite the trade-off with the disadvantages of route planning.

When planning routes with average travel times, these cost inefficiencies can be avoided, although they lead to a significant increase in missed time slots and, ultimately, late deliveries.

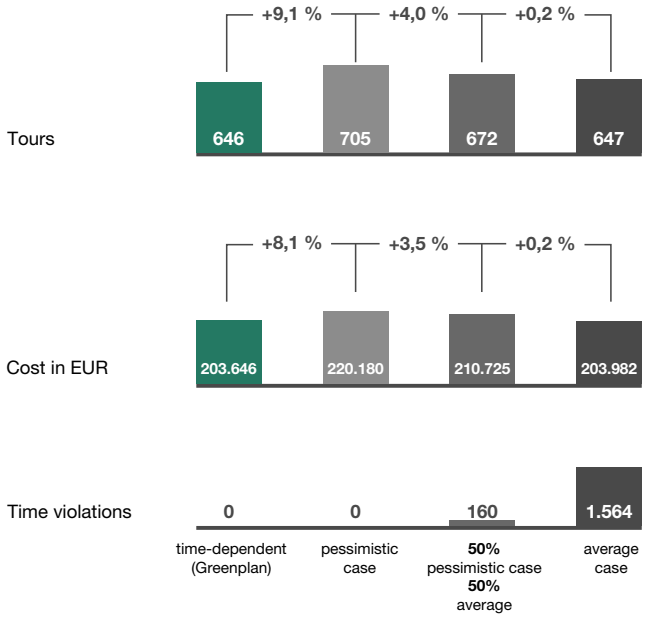
The traditional approach to route planning is such that you have to decide between either inefficiency or ineffectiveness, which results in missed time slots. However, the study shows that route planning with time-dependent travel times can fix both these issues.

HOW **TIME-DEPENDENT TRAVEL TIMES** WORK

The study calculated routes in cities such as New York and Nairobi with the following results: **The use of time-dependent travel times resulted in an 8.1% increase in cost efficiency compared to the use of worst-case travel times without any late deliveries.** Furthermore, time-dependent travel times also saved 0.2% in costs compared to average travel times, although the latter also involved a total of 1,564 late deliveries out of 3,500 deliveries compared to zero for time-dependent travel times. Even when using average travel times, the difference in cost-efficiencies stood at 3.5% and 160 late deliveries. All of this shows how the trade-off is handled better in both dimensions.

Traffic in all its different forms (e.g. traffic jams, empty motorways and rush hours) probably has the most significant impact on all of your operations in field services and logistics.

Poorly designed routes that lead your drivers into traffic jams cost you money, resulting in unhappy drivers and parcels either being delivered late or not at all. They are ultimately one of the main reasons why your operations might be too expensive. However, by taking into account the actual traffic flow velocity, you can benefit from reliable, cheap and even comfortable routes for your business.



Calculating with time-of-day dependent driving times leads to the best routes; calculating with fixed driving times leads to either greater costs (efficiency) or less punctuality (quality).

That is why a routing algorithm should be able to consider time-dependent travel times for all kinds of routes. To do so, the Greenplan algorithm relies on historical data from TOMTOM, a map provider covering global road networks to perform calculations that provide you with better and more reliable routes for your operations. In doing so, Greenplan knows how long it takes to drive each and every road at any time of the day or week.

While it would take 15 minutes to drive the full length of a certain road on Monday at 09:30, it might take only 5 minutes at 09:00. The distance of travel does not change but the travel time might differ due to the traffic situation on that road at certain times of the day. Taking these alternating traffic scenarios into account when planning a route seems natural and logical.

However, not all route planners have the historical data of all roads at their disposal. Greenplan has access to such data and can therefore optimize how routes are planned in logistics and field services.

SAVE TIME AND MONEY WITH MORE RELIABLE AND PUNCTUAL DELIVERIES

Thanks to Greenplan's cooperation with the Research Institute for Discrete Mathematics at the University of Bonn, the routing algorithm is able to perform the necessary calculations for cost-efficient and punctual routes. Time-dependent travel times can be the key to your operations becoming more cost-efficient while also fully satisfying the quality requirements of your drivers and clients. Greenplan's routing algorithm is advantageous for your operations as it is intelligently able to process the historical data of roads and traffic. Having access to this data, does not mean that it can all be processed and included in mathematical calculations. By implementing all this, the Greenplan algorithm calculates the best starting time and the best routes for each shipment

or job that your drivers or technicians have to deliver or perform on any given day.
Instead of leading a driver through rush hour traffic only to deliver a small number of parcels, all tours are recalculated depending on the traffic flow velocity of each road to find the most efficient route. This helps to ensure that drivers do not get stuck in traffic. Drivers are therefore more likely to accept these routes. At present, a technician of a field service company often spends more time in the car and on the road than at the actual location of a job. This is because the dispatcher is unable to take the traffic flow velocity into account when deciding on a route for the day. This results in missed ETAs, unfulfilled jobs and enormous costs. This is why many dispatchers or route planning tools plan estimated times of arrival by applying several minutes of buffer.

They assume that a technician or driver will arrive at a certain location at 15:00, but since they are unaware of the current status of traffic, they promise their clients an ETA of 15:10.

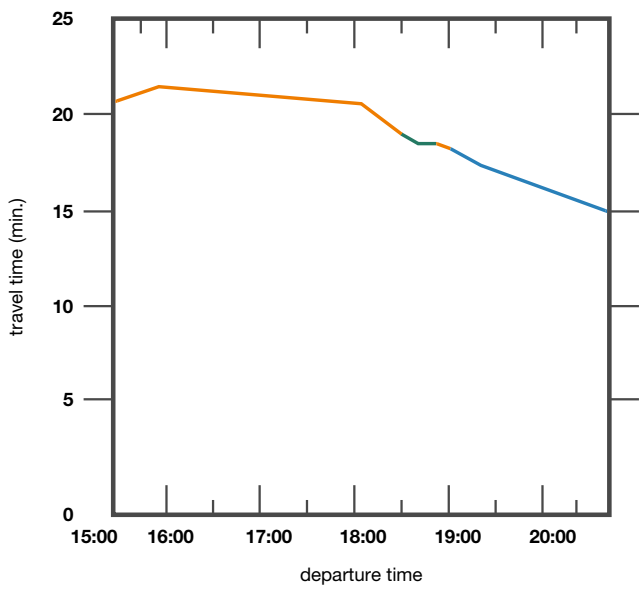
Obviously, this is a logical and simple solution for preventing the late arrivals of drivers or technicians and for allowing more flexibility to ensure that shipments arrive on time.

However, it is also a highly inefficient way of conducting all logistical or field service operations. This is, because a tour is not only planned with a single buffer time of, for example, 10 minutes, but with multiple buffer times. All these buffer times ad up, meaning unnecessarily longer tours and working hours for your drivers and technicians. What‘s more, your tours become more expensive, as drivers spend more time on the road and drive more kilometers, wasting unnecessary fuel. You should therefore stop planning with buffer times. Instead, you need to take into account traffic flow velocity at different times of the day and utilize time-dependent travel times.

Here‘ s why:

Taking the traffic flow velocity of all roads into account, allows you to better tweak the point in time at which your drivers or technicians start their route, arrive at certain addresses or use specific routes. Here you can see a map of New York City and three different routes a driver could take to reach point B starting from point A. As you can see all these routes take completely different directions and appear to differ in terms of distance covered. In the graphicy you can see the corresponding travel time, in which the colour shown represents the path that is fastest at that departure time.

In this example our algorithm calculates three different routes and decides which route is fastest depending on departure time. Assuming your driver would need to deliver a shipment at point B around 15:20, the algorithm would opt for the orange route.



At this time of day it takes the driver around 20 to 25 minutes when taking the red route. However, if your shipment is supposed to arrive between 18:30 and 19:00, the algorithm would send your driver on the green route.

At first glance, this might appear to be illogical as the route seems to be longer than the red route. However, thanks to the traffic flow velocity data, the Greenplan algorithm knows that this journey takes less than 20 minutes between 18:30 and 19:00.
Furthermore, the blue route is the best option to take in the evening hours. From around 20:00 until 22:00 it only takes 15 to 17 minutes to get from point A to point B. Different starting times or time-dependent travel times allow your drivers or technicians to take better routes to arrive at their destinations. You can therefore count on more reliable routes and stick true to your ETAs without having to factor in any buffer times.

This allows you to deliver more shipments or fulfill more field service jobs, benefit from cost efficiencies, avoid traffic jams, save fuel and reduce carbon emissions. Additionally, these routes help to ensure less congested roads in cities.

TEST TIME-DEPENDENT TRAVEL TIMES WITH GREENPLAN TODAY

Our route planning experts can help you to implement time-dependent travel times for all your operations. This will help you to improve your routes, increase client and driver satisfaction and to benefit from cost efficiencies and much more!

Reach out to the EPG and let us show you how intelligent route planning works with our award-winning algorithm by Greenplan.

The Greenplan algorithm was designed in cooperation with the Research Institute for Discrete Mathematics of the University of Bonn and logistics experts from DHL Group. It combines more than 50 years of mathematical and 75 years of logistics expertise to bring you the best results for your route planning in logistics and field services.

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