The Power and Deficiencies of Modern Fleet Routing & Scheduling Solutions

Fleet Routing & Secondary Network Dynamic Routing

WHITEPAPER

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FLEET ROUTING

Over the past 35 years, technological advances have made fleet routing and scheduling solutions widely available and quite powerful. Legacy providers such as **Omnitracs/Roadnet**, **Descartes**, **Ortec** and **Aptean/Paragon** are now competing with up-and-coming solutions from providers like **Bringg**, **LogiNext** and **Opsi systems**.

Both legacy and the new breed of providers have put a great deal of time and treasure into developing algorithms that can increase the productivity of their customers' fleets. Some notable advancements include:

- Increased CPU power, which enables more scenarios to be evaluated during the routing process
- Cloud-based solutions that make higher-performing IT platforms and tools more readily accessible during routing
- More accurate mapping data that is used in both location geocoding and travel time/distance calculations
- More sophisticated heuristics that enable the creation of higher-quality solutions

Additionally, most routing solutions on the market today consume data from the fleet electronic logging devices and/or electronic proof of delivery (ePoD) solutions. These data can be used to identify discrepancies between what was planned versus what occurred in the field. They are then used to train the system so future planning runs "learn" from historical data, thereby increasing the accuracy of the models used during routing.

SECONDARY NETWORK ROUTING

One of the most common uses of private fleets is to support final mile delivery of a company's products. We call this the "secondary distribution network."

The secondary network is defined as the movement of product from a distribution center to the end customer location and can be further broken down in subgroups categorized by stop densities. The focus of this paper is on High Density networks.

> *While the advancements in fleet routing technology have been impressive,drivers continue to complain about the solution quality generated by today's routing packages.*

SECONDARY NETWORK HIGH DENSITY

VERTICALS
- Wholesale, Foodservice

EXAMPLE
- Sysco, US Foodservice

DESCRIPTION
- Regional with > 10 stops / truck
- Wholesale Distribution outbound from DC to customers

OBJECTIVE
- Minimize cost through the formation of highly utilized trailers
- Delivery inconsistencies make dynamic routing difficult. Static routes common

COMPLEXITY
- Need to balance optimality with customer service
- Large number of stops makes this problem impossible to solve to optimality
- Fleet Territory planning is important
- Rich UI required to support planner modification

PRIMARY VENDORS
- Descartes
- Omnitracs/Roadnet
- Aptean/Paragon
- Ortec
- PTV
- LogiNext
- Bringg

This type of network is commonly seen in food service, paper and beverage distribution businesses. It is characterized by routes with high stop counts (10-20 stops), dense delivery networks, vehicles that typically return to the domicile each day and the need to support a variety of delivery constraints, including customer time windows and vehicle size restrictions.

To service this network, these distribution businesses rely on a fleet of vehicles and drivers to deliver to their customers small yet frequent orders.

While the advancements in fleet routing technology have been impressive, drivers continue to complain about the solution quality generated by today's routing packages.

STATIC ROUTING

Drivers question the routing sequence, day to day imbalances in route duration and other fundamental aspects of their routes. This has led to the widespread use of "static routing" by many secondary network fleet operators.

Static routing uses route templates to perform the initial build. Route planners then review and manipulate the solution to their needs before submitting the finalized route plan to the distribution center for picking and loading.

Static routing is the opposite of dynamic routing, which, in its purest form, builds loads based on a mathematical objective function (e.g. cost minimization, profit maximization) constrained by operational factors such as vehicle capacity, hours of service limitations and customer delivery preferences.

Routing and scheduling software providers sell their solutions to shippers based on the sophistication of their heuristics and the ability to save 10% or more on fleet costs by using dynamic routing.

However, in high-density secondary networks (versus low-density, which are epitomized by grocery and big box retailers), we continue to see dynamic routing be more the exception than the rule.

Even when dynamic routing is used, it is common for the routers to re-build the routes to their liking after planning, leaving little semblance of the original route solution in place.

WHY DOES DYNAMIC ROUTING NOT WORK IN HIGH-DENSITY SECONDARY NETWORK ROUTING

A variety of reasons have been proposed for the failure of shippers to use mathematically based dynamic routing models in their operations. They include:

- Drivers prefer the consistency that static routing provides
- Drivers are more efficient when they service the same locations day after day and week after week
- Customers like the consistency of having the same driver arrive at close to the same time for each delivery
- Dynamic routing is highly reliant on accurate data, which can be an immense job to maintain. If these data are inaccurate, the heuristics will make bad decisions (GIGO)
- Shippers do not know how to tune the algorithm's optimization parameters to meet the business needs
- The complexity of a typical routing problem cannot be solved to optimality by today's planning engines. Given there is no known formula to solve even a moderately sized problem, heuristics are used, which provide good, but not optimal solutions. (Note: A twenty-stop route has 2,432,902,008,176,640,000 potential sequences, of which only a very small fraction are evaluated during optimization)

While these reasons are certainly valid, there may be other factors that are contributing to the low adoption of dynamic routing solutions. Perhaps, for example, the solvers are ignorant of key factors that need to be considered when forming routes that make their models inaccurate.

TWO AREAS OF CONSIDERATION

Below are two areas that we feel need to be addressed by the software providers to increase the validity and acceptability of dynamic routing in high-density secondary networks.

Area 1

Transit Time Variability by Time of Day (aka Rush Hour Modeling)

When building and sequencing routes, a solver must know the distance and transit time between any two points in the network. These values, along with the work duration for each stop, are two of the core inputs used in building routes.

To ensure that travel distance and transit time data are quickly accessible to the solver, routing solution providers create a transit matrix. The matrix is a simple, but in most instances, extremely large table that has all locations along with the times and distances specified to every other location. For a distributor that has 1000 customers, the matrix would be made up of (1000 * (1000-1)) or 999,000 values.

This matrix is loaded into memory to minimize the fetch times that are used when sequencing stops. However, for any origin/destination pair, there is just one value. In other words, the time and distance are fixed and not aware of variability by time of day or day of week. Therefore, the algorithms build routes ignorant of predictable traffic patterns.

	ORIGIN 1	ORIGIN 2	ORIGIN 3	ORIGIN 4	ORIGIN 5	ORIGIN 6
DESTINATION 1	24 MIN	37 MIN	19 MIN	28 MIN	54 MIN	18 MIN
DESTINATION 2	41 MIN	13 MIN	45 MIN	95 MIN	28 MIN	65 MIN
DESTINATION 3	12 MIN	63 MIN	56 MIN	13 MIN	64 MIN	44 MIN
DESTINATION 4	22 MIN	14 MIN	22 MIN	37 MIN	48 MIN	17 MIN
DESTINATION 5	54 MIN	5 MIN	37 MIN	82 MIN	59 MIN	38 MIN
DESTINATION 6	36 MIN	56 MIN	26 MIN	37 MIN	58 MIN	17 MIN

Solvers could make API calls to mapping providers such as **HERE Technologies**, who do have predictive traffic information, but the time required to do so would be excessive.

For any given optimization run, a solver may make 1,000,000 or more route adjustments. API return times at 1 second, would require years to return a solution, which is obviously not feasible.

Developing an elegant means to solve transit time variability during dynamic routing will lead to better constructed and sequenced routes and ostensibly, less driver push-back.

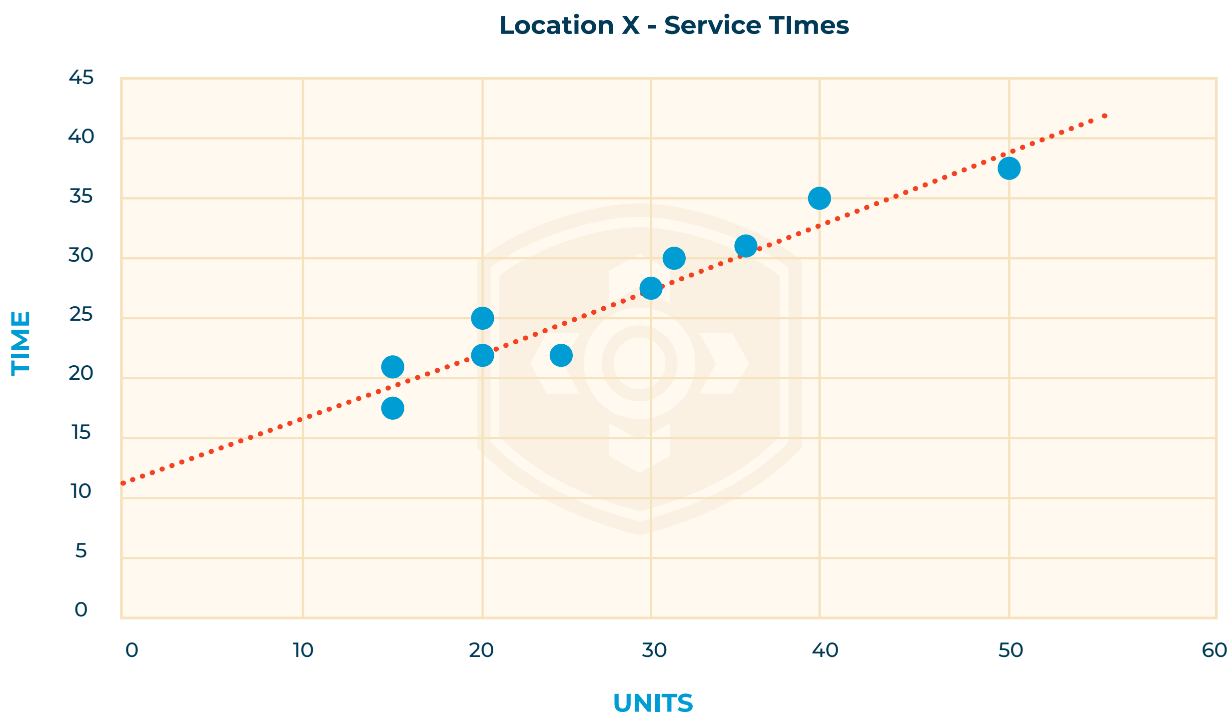
Area 2

Stop Time Variability by Time of Day

Recently, JBF provided consulting services for a small but innovative transportation management software provider out of South Africa. The company, **Opsi Systems**, develops and deploys transportation management technology that assists shippers and 3PLs in managing their freight operations. Aside from solvers, Opsi also offers an electronic PoD system that captures actual information from the field.

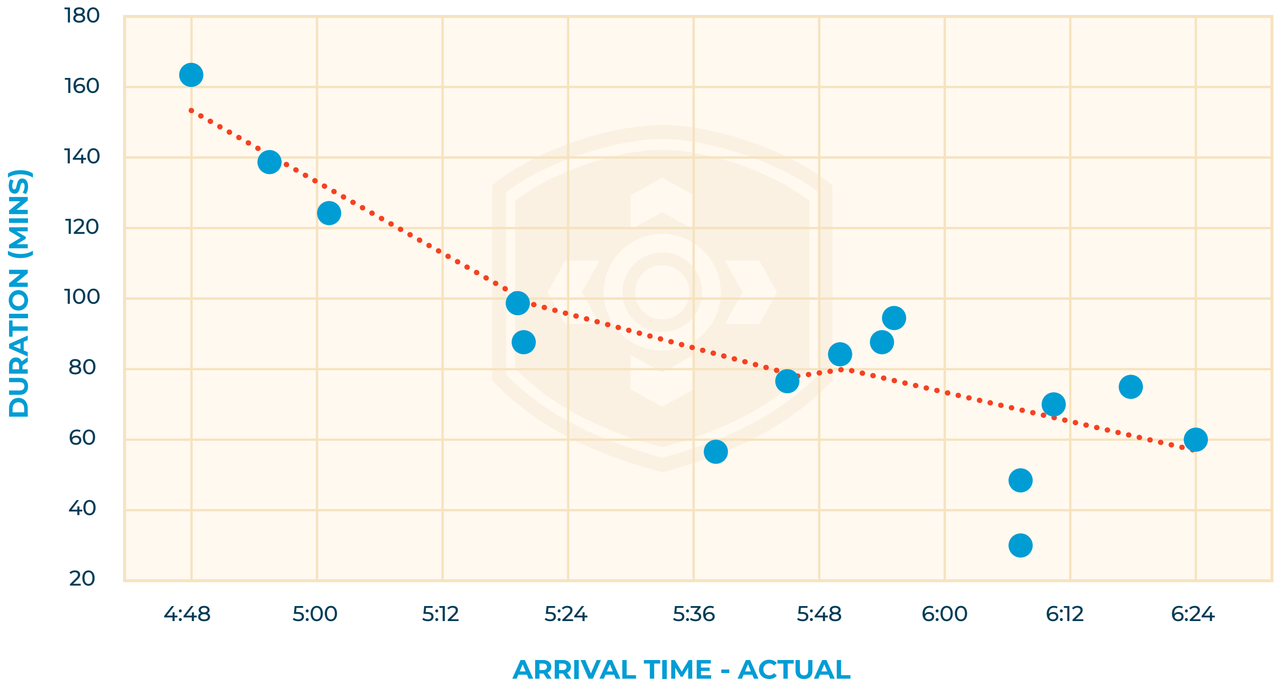
During the engagement, they shared with us an interesting insight.

For today's solvers, the duration of a site visit is typically either a fixed value (e.g. 15 minutes per stop) or a combination of fixed and variable times that calculate the service duration based on delivery quantities. The use of historical data enables routing solutions to calculate location-specific fixed and variable times based on past deliveries, whereby the Y Intercept is the fixed time and the slope represents the number of units delivered per minute.



However, Opsi, who has accumulated large amounts of data from their customers, proves that stop service durations, like travel times, are not static but can vary considerably based, not only on the delivery quantities but also on the time of day.

The chart below shows how service times can be dramatically impacted by stop arrival time. In this example, the stop has a time window that enables deliveries as early as 4:45; however, history shows us that when arriving that early, the stop service duration is significantly longer.



As with transit times, routing providers calculate stop duration as an up-front, one-time process during a routing pass and then use that time regardless of when a delivery is made. Opsi is showing that solvers should be cognizant of stop time duration variability during route sequences to maximize the productivity of a route and driver.

The quintessential example of this is in food service. Every driver knows that you should avoid delivering to an on-premise eating establishment at lunchtime because it will take longer. The data provided by ePoD solutions confirms this, but we still don't have heuristics that can vary service durations by time of day.

SUMMARY

Fleet routing solutions are very powerful, but shippers, especially those that operate in high-density secondary networks, should not assume that these solutions are infallible. There are a variety of factors that come into play that reduce the efficacy of a solver.

It is incumbent upon the shipper to have clean and accurate data. However, it is incumbent upon the routing solution providers to ensure that their solutions can effectively model all relevant criteria that significantly impact model accuracy.

We look forward to seeing what innovative routing providers like Opsi Systems, among others, come up with to address these and other challenges that inhibit the adoption of mathematically based solvers.

ADDITIONAL RESOURCES

- Why Excessive Dwell Time is Pervasive in TL Shipping And What Shippers Can Do About It
- The Impact of Dwell Time on Truckload Carriers
- How Improving Appointment Scheduling Can Reduce Driver Detention
- Detention in Trucking Guide

About Mike Mulqueen

Mike Mulqueen is a leading expert in logistics solutions with over 30 years managing, designing and implementing freight transport technology. His functional expertise is in Multi-modal Transportation Management, Supply Chain Visibility, and Transportation Modeling. Mike earned his master's degree in engineering and logistics from MIT and BS in business and marketing from University of Maryland.

ABOUT JBF CONSULTING

Since 2003, **JBF Consulting** has been helping shippers of all sizes and across many industries select, implement and squeeze as much value as possible out of their logistics systems. We speak your language — not consultant-speak – and we get to know you. Our leadership team has over 70 years of logistics and TMS implementation experience. Because we operate in a niche — we're not all things to all people — our team members have a very specialized skill set: logistics operations experience + transportation technology + communication and problem-solving skills + a bunch of other cool stuff.

LOGISTICS GEEKS WITH PERSONALITY

WE LOOK FORWARD TO HELPING YOU WITH YOUR CHALLENGES WHEN IT COMES TO IMPROVING VITAL PROCESSES.

IT'S WHAT WE DO BEST!

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