The logistics industry is no stranger to challenges. From natural disasters to complex tax laws and the recent port strikes, obstacles are overcome every day to keep business moving. North America is currently facing an overwhelming shortage of truck drivers that is threatening to dramatically slow the pace of commerce. Pay rates for drivers are being forced up and those costs will be passed to shippers in higher freight rates and then on to consumers for the products being shipped. Put simply, shippers are trying to find carriers to haul their loads. Carriers do not have enough drivers to haul them, and are even using 3PL freight brokers to help haul their loads. Service is suffering on all fronts.

So what can organizations do to traverse capacity and cost challenges to keep business moving?

**LLamasoft’s integrated transportation and network optimization technology enables businesses to model entire supply chain networks, incorporating alternate transportation options and key variables such as cost, time, capacity and delivery parameters.**
Establish a baseline model to visualize and assess your current end-to-end transportation network
Before selecting the right strategy to move forward, first assess what is working and what is not with your current transportation network. By utilizing data that has been gathered even down to the individual SKU level, companies can build and view a living model of their current transportation network. A baseline model of the existing network provides a credible and detailed foundation for analyzing the possibility of cost cutting through cross-docking, fleet sizing and sourcing reassignments.

Consider alternate modes of transportation
Regardless of the logistical issue a vendor is facing, consumers still need their products. To overcome the limitations of a finite number of drivers available to move goods by truck, organizations may have to seek alternate modes of transportation. This can range from air, ocean or rail to alleviate the capacity concerns of ground transport.

Assess inventory right-sizing and/or the use of private fleets
Another consideration is to evaluate right-sizing your inventory in order to meet desired service levels at the lowest possible cost. This can help address capacity concerns while posing the opportunity for millions in savings.

It is also worth considering utilizing private fleets as part of your transportation strategy. Fleet optimization allows businesses to maximize their resources by creating multi-stop routes, assessing direct shipment costs and determining the right fleet mix and size.

Use modeling technology to run what-if scenarios to test various strategies before implementation
From the risk-free confines of your model you can test the impact of using alternate transportation modes or using private fleets, validated with your actual data, and assess the right approach for your business. This “test before implementation” environment allows organizations to make the most innovative and intelligent business decisions without having to test the theory in the real world. Additionally, being able to accurately analyze potential network configurations and predict performance makes it easier to garner executive support for a new strategy.

Adopt transportation modeling as an ongoing business process
While using modeling on a project basis is helpful, to take the supply chain to the next level many leading organizations are adopting transportation optimization as an ongoing business process. This enables organizations to analyze the long-term view of their transportation network and historical trends. This also gives businesses access to living models for continuity planning and to mitigate risks for unplanned circumstances. A repeatable modeling process enables the team to have a strategy in place and be on the leading edge of adaptation to whichever circumstance does arise.

With new and more complex challenges impacting the industry every day, it is more important than ever for logistics professionals to utilize transportation optimization technology to design a smarter supply chain and gain the competitive advantage.

Source: LLamasoft

“Not only does LLamasoft integrate network optimization and vehicle route optimization, but it will also simplify our data input and output analysis, enabling us to quickly identify opportunities for freight savings in our supply chain.”
— David Raymond, Vice President of Operations Transformation, Wayfair

Source: LLamasoft
Why a Unified Transportation and Network Optimization Solution?

For large businesses evaluating numerous alternate network configurations that affect site locations, inventory levels, production capacities, and transportation strategy, toggling between multiple optimization applications extends project timelines, breaks data integrity and makes accurate, cohesive modeling results extremely difficult to achieve.

Only LLamasoft offers an integrated network design and transportation optimization solution. By designing with these integrated technologies, businesses can:

- Simulate near-term cost and service improvements to existing network operations
- Identify longer-term strategic improvements to the global transportation network
- Run continuous what-if analysis of new strategies, disruptions constraints and business challenges

LLamasoft includes a wide range of analysis techniques, enabling users to identify optimal DC-to-customer assignments, determine the ideal mode mix, create optimal multi-stop delivery or pick-up routes, determine the best utilization of assets, evaluate driver work schedules and identify hubbing and pooling opportunities.

Source: LLamasoft

Speed and Document Data Blending and Cleansing Required for Network Modeling

Now you have the right data, but how do you access it in all the places it resides, without spending half your day on the phone with IT? Automated access to ERP and other enterprise data through a data analytics tool can significantly reduce the time required to gather, cleanse and blend disparate data and ready it for modeling use. With established connections to enterprise data sources, you can essentially create a “library” of models for repeatable use, which will enable those analysts with non-SQL backgrounds to get into the data and get busy.

Source: LLamasoft

“With LLamasoft’s continuous moves technology, we are able to leverage backhaul optimization to gain exceptional insight into how to take advantage of route return trips to reduce overall distance, time and number of routes necessary. We can now demonstrate to clients how optimizing both outbound and inbound routes can result in significant overall route cost reduction.”

– Edward Sands, Global Practice Leader – Logistics, Procurian
Mapping Examples: Integrated Network Design and Transportation Optimization Solution

The LLamasoft output maps below illustrate a common supply chain design project combining both network and transportation optimization. Having both of these optimization engines in one unified solution enables business to move directly from network optimization to create corresponding multi-stop routes.

**FIGURE 1** Customer sites are shown in green and distribution centers (DCs) in red

Source: LLamasoft

**FIGURE 2** Lanes showing the allowable flows

Source: LLamasoft
FIGURE 3  Multi-stop delivery routes, with down arrows indicating deliveries

Source: LLamasoft

FIGURE 4  Close-up of turn-by-turn deliveries, which ensures accurate representation of transit time and distance

Source: LLamasoft
Leverage Transportation Modeling to Pursue Transportation Efficiencies and Solve for Capacity Challenges

Transportation modeling is an effective strategy for companies pursuing more efficiencies in transportation and wanting to solve for rising transportation costs and tightening carrier capacity. This research presents best practices for transportation leaders embarking on these modeling initiatives.

**Key Challenges**

- Faced with transportation dynamics, such as rising costs and tightening capacity, logistics organizations are revisiting their transportation strategies and tactics to minimize costs, guarantee capacity and meet higher customer service requirements.

- Transportation data might be spread across multiple systems, especially when companies do not have a transportation management system (TMS), and the collection of data is key to modeling transportation.

- Organizations need a more granular vision of their transportation network. They are looking to transportation modeling, just as supply chain organizations are increasingly using supply chain modeling.

**Recommendations**

- Define the overall goal and expected benefits of transportation modeling.

- Decide the use case you want to model: mode changes, private versus third-party fleet, asset positioning, lead times and other scenarios.

- Identify and quantify the benefits of modeling such as challenging legacy transportation networks and lowering overall transportation costs.

- Choose from among implementation approaches. Find the tool that offers usability and transparency, in addition to the required functional depth.

- Lay out the correct process to execute transportation modeling.

- Focus on data as this is an important aspect of the process. Understand the data and the sources to provide this data.

**Introduction**

Logistics service providers and the internal logistics teams of manufacturing and retail companies continuously search for ways to improve service while reducing costs. To achieve this, companies need planning tools that can help balance service and cost trade-offs, including the ability to validate new and existing business scenarios by incorporating detailed data into the decision-making process. As companies extend their supply chain capabilities, detailed transportation planning capabilities are increasingly crucial.

Transportation modeling allows companies to model multiple transportation configurations in order to determine the right balance between service level and cost, as well as to provide companies with the information they need to better use and manage their transportation networks.

Models take into account the effects of new business (acquisitions or new customers), historical performance, peak flows, trade-offs between private fleets and for-hire carriers, capacity, fuel costs and other variables.

Through what-if scenarios, modeling tools display the most efficient and lowest-cost transportation network that satisfies all user-defined requirements and customer-focused objectives. These tools can also help companies determine the optimal number of transportation assets and containers, and where these assets should be positioned.

Shippers use the tools to do tactical planning of their transportation networks. Carriers and third-party logistics (3PL) providers use them as a sales tool to show potential customers how the service can benefits customers’ networks. Additionally, 3PL providers offer transportation modeling as a consulting service for their customers.
There are three different kinds of modeling in logistics: optimization modeling, simulation modeling and heuristic modeling. Simulation modeling, the most common and effective way to model transportation scenarios, is defined as creating a model that is based on the real world. When the model has been created, you can perform experiments on it to see how changes made to the model can affect the overall cost of the logistics network (also called scenario analysis). For example, by changing the constraints on the transportation network, it is possible — using a simulation model — to see how this affects the cost-effectiveness of the overall network.

For a simulation model to be effective, you need to collect significant amounts of data on transportation, warehousing, labor costs, material handling and inventory levels, so that when you make changes to the constraints, the model accurately reflects the changes. This type of model is very useful when companies have made general decisions on the transportation network and want to verify what the overall effect of any changes will be.

**Analysis**

**Define the Objective of Transportation Modeling**

Transportation modeling is used by shippers and 3PL providers, as well as by carriers. Modeling can be used on a strategic, tactical or executional level. Additionally 3PL providers use transportation modeling during their sales process and as a consulting service.

The following are some use cases for transportation modeling:

- Analyzing and preparing for freight network changes
- Responding to shipper RFP/RFQ with accurate bids (carrier-specific)
- Comparing multiple transportation plans
- Evaluating cost benefits with outside carriers and company fleets
- Exploring transportation mode shifts (LTL to TL) for cost savings
- Exploring business expansion and investment options
- Planning for seasonality

Companies are using transportation modeling for different ways of looking at their transportation networks and the different scenarios for multiple modes. Depending on the scenario, different outcomes and benefits will be obtained. Companies can:

- Challenge legacy transportation networks.
- Determine lowest overall landed cost.
- Identify optimal mode mix.
- Measure all constraints for most efficient routings.
- Identify efficient multistop vehicle routes, while optimizing fleet size. Include pickups and deliveries interleaved throughout a route, or use backhaul optimization to minimize cost.
- Identify efficient schedules, while balancing shipments across time periods.
- Reduce overall transportation costs.
- Identify a reliable distribution network, driven by an operationally feasible plan.
- Increase profitability, and improve pricing and scoping of new business opportunities for logistics providers.
- Create simultaneous profitability analysis of the holistic impact of new business opportunities.

Specifically, when it comes to tackling the challenges of tight carrier capacity transportation, modeling can: (1) optimize the fleet by determining optimal private fleet size; (2) identify how many assets are needed to run optimal routes; (3) minimize private fleet and 3PL carrier assets; (4) determine which carriers to use in addition to private fleet; and (5) identify optimal asset mix within fleet.

A distribution company reduced annual logistics costs by using a transportation modeling tool. The company’s transportation network serves more than 900 cities, as well as 700,000 last-mile distribution locations, with 1,250 vehicles traveling more than 62,000 miles each day. Some of the results obtained after using the tool included savings of $1.2 million in annual transportation costs, a 20% reduction in overall travel distances, and a 24% decrease in fuel consumption.
Choose From Among Implementation Approaches

Once the company has determined the objective of its modeling initiative, it must choose a deployment model. These include:

- **Using a commercial technology tool:**
  The market for transportation modeling is not as mature as the supply chain modeling market. Some of the vendors focus purely on transportation, while others focus on transportation modeling as a part of overall network modeling. Traditionally, these tools were deployed in an on-premises environment; however, they are increasingly being offered as SaaS solutions or in a subscription-pricing model.

  - The advantages of using the COTS tools are availability, ease of use, experience of the vendor, predefined data models and integration. Disadvantages might include that the solutions are not customized to the company’s specific needs and price.

  - Some of the leading vendors providing this capability are JDA Software, LLamasoft, 4flow, Manhattan Associates, TMW Systems and inet-logistics.

- **Developing an in-house modeling tool:**
  This approach is typically chosen by more analytically mature companies that have the modeling resources. This model is also appropriate for companies with very specialized functional requirements that are currently not being met by the commercial tools.

  - The advantage of using a customized tool is that it is tailored to the company’s specific needs. Disadvantages might include custom development needs (cost, time and expertise), lack of predefined data models and lack of predefined integration.

  - Companies can use available optimization and simulation solvers — like AIMMS, Gurobi Optimization, IBM Ilog Optimization Decision Manager (ODM) Enterprise (recently acquired by LLamasoft) or Rockwell Automation’s Arena simulation software — to build the model.

- **Using a solution provider:**
  Other companies are looking for a modeling tool — either developed by the service provider or licensed from a software vendor — and professional services that can help build the model and possibly implement the recommended solutions. In this situation, the companies can engage one of the large service providers (like Accenture or IBM), or choose a smaller, more specialized solution (like Chainanalytics or St. Onge). Lack of internal expertise is often the reason why companies choose these solution providers.

Lay Out the Correct Process to Execute Transportation Modeling

Start with setting the project requirements and scope. This includes setting the business objectives and problem definition. Agree on the project scope, the modeling strategy and the data requirements.

Next in the process comes data collection and analysis, followed by baseline modeling and documentation of validation criteria.

Now we are ready to do the scenario analysis: Here we compare costs, service levels and utilized capacity. Comparisons of cost and service can be made between the different scenarios.

As a last step, the data and the findings can be transferred to the execution team and the executional systems to integrate in the daily transportation planning.

Companies are starting to perform this modeling more frequently and incorporating it as a step in the overall transportation planning process, rather than as a once-a-year project. Given that transportation supply chains are becoming more dynamic, this allows companies to better react to changing circumstances and new challenges in transportation (see Figure 1).

Focus on Data — An Important Aspect of the Process

Data is an important aspect of this process and can take up 60% to 70% of the overall project effort. Master data and shipment data for the modeling can be input through different methods. The tool will output data that can feed visualization, reporting and transportation management systems.
From an input data perspective, the tool needs the following:

- Locations (such as, origins, destinations, and consolidation or deconsolidation centers)
- Transportation data (rates, carriers, asset availability)
- Transactional data (origins, destinations, weight, cube or quantities, early/late pickup and delivery options)

Depending on the modeling solutions, the data can be imported from an Excel spreadsheet, an Access database or through direct integration with the TMS tool. Users can upload it to a template or map fields from an external Excel or Access file to the fields within the modeling tool. It is vital to ensure mandatory keys are not missing and that data is in the right format (for example, number versus date). While most data is uploaded in bulk, users can still add or change a single record within the tool through the user interface. If data is incorrect or missing, the tool will give an error.

Once the data is imported, it needs to be cleansed, consolidated, aggregated and validated.

The tool provides as output:

- Route summary
- Stop details
- Unrouted shipments
- Asset utilization
- Cost
- Service level

The data can be displayed in the tool or can be easily exported to be manipulated in Excel or in an Access database.

**Case Study**

In 2013, Land O’Lakes established a supply chain center of excellence (COE) in order to support long-term strategic planning and provide advanced analytics around network optimization and realignment. At the end of 2013, the company was facing questions that required transportation modeling as part of the solution and resulted in the investment in transportation modeling:
In 2012, Land O’Lakes executed a large acquisition in one of its business units. The acquired company had its own distribution footprint, colocated with its manufacturing footprint. Over 80% of the customer base was shared between the existing business and the acquired brand. Land O’Lakes wanted to conduct a network analysis to review the potential benefit of merging the two distribution networks.

Traditional network optimization work could prove out where the combined organization would have additional or reduced transfer shipments or touchpoints, but there was no way to capture how combining these two order sets would impact the consolidated outbound transportation moves. Land O’Lakes realized there was likely to be a benefit to their consolidated shipment cost by merging the two networks, but the company needed a solution that could provide granular analysis of executional cost-benefit at the order and shipment level that could then be used to support the network modeling process (see Figure 2).

In another Land O’Lakes division, 80% of the products are made and distributed locally, and approximately 20% are made and transferred to other facilities, then distributed to customers. Instead of maintaining and distributing the “nonlocal” 20% at all shipping points, the company wanted to capture the cost to service these products and model scenarios for using regional distribution centers (DCs) to service these items. Forecasting accurately in larger piles and improving fill rates would be some of the resulting benefits. This strategy, however, would require two separate shipments to service customers, resulting in less consolidated outbound opportunities. Land O’Lakes needed to understand the implications of splitting the volume and understand the impact to their remaining consolidated outbound (see Figure 3).

Land O’Lakes started using LLamasoft’s Transportation Guru, a supply chain transportation optimization tool. The transportation simulation modeling for the scenarios outlined above was done in conjunction with network optimization studies.

**Scenario 1**: Land O’Lakes baselined its entire network, as well as the current state network for the acquired facilities, replicating the current KPIs for such factors as cost, load and average stop count/distance. Then analysts ran scenarios where they integrated the product at the acquired facilities into the pre-existing DC footprint. The routed output provided detailed information that included: cost; the number of routes that would be added or eliminated by scenario; changes to load factor; and average route distances. These results were then entered into the network optimization tool to solve for modeled scenarios where there would be large changes to the consolidated outbound shipments. This ensured that relevant cost decreases or increases would be accurately captured in the scenario modeling, and Land O’Lakes could support its assumptions with a detailed, consolidated, routed solution.

**FIGURE 2**  What Land O’Lakes Needed to Solve — Supply Chain Consolidation

Source: Land O’Lakes
Scenario 2: Land O’Lakes conducted transportation modeling analysis regionally, and completed six separate models where analysts baselined local facilities. They flagged what volume was made locally and what was not, then ran scenarios where only locally made product was distributed to understand the impact to the transportation spend. In certain cases, multiple scenarios were run per region to help understand where the optimal place to colocate a potential DC location would be. This process helped support the network modeling effort in terms of site selection, validating costing strategies for the network optimization solve, and validating outbound service assumptions at facilities where annual volumes would potentially increase or decrease by a large percentage.

Both efforts are still ongoing and continue to evolve. The optimal state that was modeled for Scenario 1 reduced the outbound cost per pound by around 20%. The simulation effort for Scenario 2 played an invaluable part in helping to steer the network modeling efforts in terms of site selection for potential DCs, and in helping to identify where Land O’Lakes incurred the highest penalty for upsetting local volume.

More recently, Land O’Lakes has started using LLamasoft’s Transportation Guru to do localized studies around volume scheduling and balancing at an operational level. These efforts yield a potential savings of 6% to 10% by simply adjusting order patterns. Future plans include similar work around fleet sizing and asset utilization.

Evidence
Data was collected via Gartner’s Secondary Research Services team in March 2015. Interviews were held with the leading modeling vendors in April and May 2015 and with several reference customers (from December 2014 to May 2015), who have been using transportation modeling extensively.

Gartner worked extensively with Land O’Lakes on the use case from March to May 2015.

Gartner Research Note G00274665, Bart De Muynck, 08 May 2015
About LLamasoft

LLamasoft, Inc. provides software and expertise to help large organizations design and improve their supply chain network operations. LLamasoft Supply Chain Guru is the leading supply chain design and analysis application available in the market today. It enables companies to model, optimize and simulate their supply chain operations, leading to major improvements in cost, service, sustainability and risk mitigation.

LLamasoft is dedicated to advancing technology focused on the continuous improvement of enterprise supply chains. Our customers include many of the world’s largest organizations across a wide range of industries.

Contact LLamasoft
866-598-9831
sales@LLamasoft.com

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