



Innovations in Transportation Roundtable: *Disrupting the Dominant Design of Procurement and Management*

Cambridge, MA | February 12-13, 2019

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Executive Summary

On February 12-13, 2019, representatives from 34 companies convened at the MIT Center for Transportation and Logistics (CTL) to participate in the 2019 *Innovations in Transportation Roundtable: Disrupting the Dominant Design of Procurement and Management*. Representatives from shippers (from food and beverage, retail, consumer packaged goods, healthcare, apparel, and pet food industries), truckload (TL) carriers, third party logistics providers (3PLs), and brokers discussed and debated challenges and opportunities in the current and future TL market.

There were 10 key takeaways from the event:

1. While TL markets were exceptionally tight from Fall 2017 to late Spring 2018 with much lower acceptance ratios and higher use and cost of spot rates, it does not appear to be a “new normal.” In fact, the TL market has already turned and softened for 2019.
2. Shippers still generally use, and prefer to continue to use, long-term contracts for a majority of their freight network. There are several reasons: budget stability, planning, consistency, etc.
3. Contract rates are generally found in an annual pricing event – typically a reverse (single to two round) auction with no pricing visibility between bidders.
4. While running annual auctions for contract rates is very common, they have many recognized flaws and tend to not even last the duration of the contract.
5. Shippers do use spot markets, but usually only when the routing guide fails. And there is not a huge churn in the carriers used each year – there does appear to be loyalty of some sort between shippers and carriers at a high level.
6. There is growing opportunity, capability, and appetite from both shippers & carriers for the development and use of more ‘flexible’ and responsive relationships.
7. While the current procurement methods have flaws, it does not seem likely to be completely replaced by a dramatically different approach, instead it will be modified at the edges.
8. Shippers and carriers both noted that while the quantity of data collected was no longer a pressing problem, the quality of the collected data remains an issue. It is seen as one of the limiting factors for the successful use of AI in transportation.
9. Availability to new data will enable more sophisticated analysis into drivers that increase costs and improve the overall efficiency – such as reducing dwell time.
10. Data analytics teams (staffed with MS and PhD level data scientists) are critical to long term success – but identifying, hiring, and retaining these skills is a challenge.

The Innovations in Transportation Roundtable is run annually by the MIT FreightLab.
If you are interested in joining or partnering with FreightLab, please contact Chris Caplice at caplice@mit.edu.

Introduction

The 2019 Innovations in Transportation Roundtable invited three dozen shippers, carriers, and third parties to discuss and debate the relevance of the traditional manner in which truckload freight transportation is procured and managed as well as opportunities and challenges associated with the availability of new data. This section describes some background on the current state of the TL market and the dominant design of transportation procurement and management.

State of the TL Market

The truckload (TL) market from fall of 2017 through most of 2018 was a roller coaster as capacity tightened and rates surged. Asked to describe their experience in one word, roundtable participants called 2018 “challenging,” and “volatile,” followed closely by “chaotic,” “expensive,” and “dynamic.” See Figure 1. Adding to the tightness was the phase-in of ELD (electronic logging device) mandates intended to help enforce truck driver HOS (Hours-Of-Service) regulations. This mandate effectively removed capacity from the market by reducing truck drivers’ flexibility — a euphemism for ability to cheat — on when and how much they drove each day. While shippers called it the worst of times, most carriers viewed it as the best of times.

While many pundits made claims that the challenging truckload market of 2018 was a fluke, calmer heads recognized it as just a repeat of a boom-and-bust cycle that ripples through the truckload market every three to four years. In fact, by the end of 2018 and into the early part of 2019, it appeared that the market was already turning. Spot rates had subsided and shippers were finding it easier to get the capacity they needed.

One participant presented a graph (See Figure 2) of spot rates and contract rates over the last decade that revealed this depressingly consistent boom and bust oscillation. During times of tight capacity, spot rates surge and acceptance rates plummet. This is exacerbated by storms, holidays, and other disruptions. Some carriers (or their CFOs) are enticed to refuse loads that have older low contract rates in favor of loads that pay higher rates. In a desperate attempt to lock-in capacity, shippers offer higher contract rates, so these rates start climbing, too.



Figure 1. Word cloud of the participants impressions of the 2018 TL market.

Carriers then buy more trucks and hire more drivers to reap the profits of the high spot rates and rising contract rates. But by the time the trucks and drivers appear, there is overcapacity. The shoe flips to the other foot as some shippers (or their CFOs) are enticed to tap low spot-rate capacity rather than tender their loads at higher contract rates. Carriers start lowering bids to help lock-in some revenue to cover their bloated fleets. The weakest carriers and drivers drop out of the market, which creates the bust and the start of the next cycle.

Some participants noted, ironically, that progress in transportation management might be worsening these cycles. Improvements in overall utilization means there is less slack in the system and thus rates surge more when volumes change.

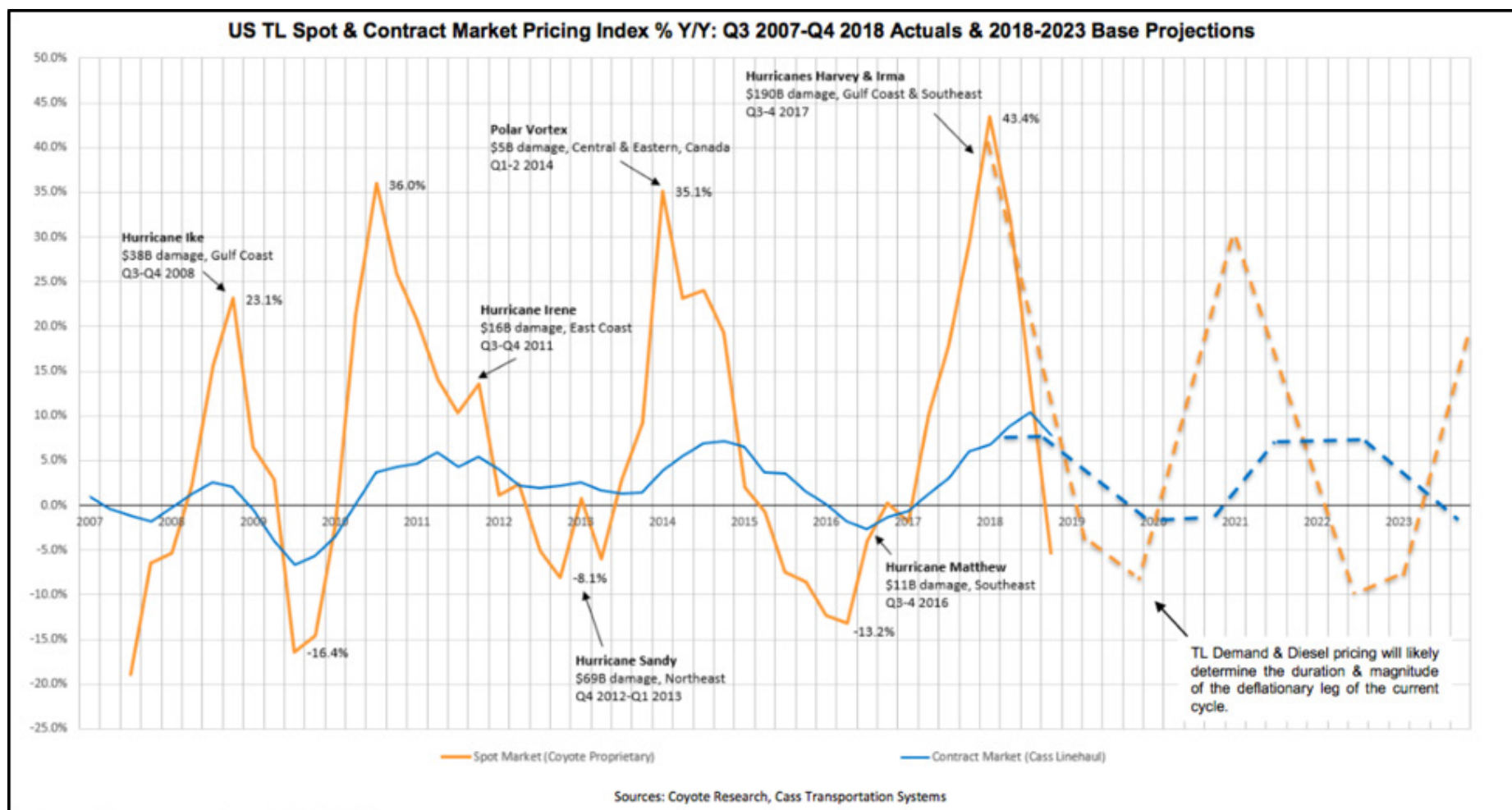


Figure 2. Spot and contract TL price changes over time. Source: Coyote Research.

One 3PL participant commented that when capacity exceeds a utilization limit the pricing goes haywire. The exact percentage is a matter of debate with some analysts targeting 95% and others even higher at 98%. Markets are also becoming more interconnected. For example, the heavy snows of 2014-2015 (referred to as Snowmageddon) in the Northeast affected TL pricing as far away as Phoenix, Arizona.

Based on the current phase of the cycle, one 3PL predicted that 2019 would be soft with a supply surplus, deflationary spot prices, record tender acceptance, and less vulnerability to short term events such as weather. This raised the questions of shipper-carrier relations – do relationships change with the turning of the market?



Image 1. Semi and trailer in blizzard. Source: Defense Imagery Management

The Dominant Design

While there are many different flavors of the truckload (TL) transportation procurement process used in practice, it seems to have the following common hallmarks:

- Shippers run an annual pricing event¹ for contract carriers with estimated weekly volumes on lanes (origin-destination pairs),
- Optimization based assignment of carriers to lanes based primarily on price, but also some level of service or other non-financial features (e.g., incumbency, available weekly capacity system-wide or by location/region, etc.),
- Winning carriers for each lane are fed into a routing guide within a Transportation Management System (TMS) with runner ups becoming alternates in the routing guide,
- Winning carriers are expected to honor the bid price for the entire term of the contract,
- Shippers are not strictly bound to supply the forecasted volume of loads and the winning carrier is not expected to handle all tendered loads – instead it is measured and managed, and
- Spot markets are only used for distressed lanes where the routing guide (primary and alternates) fails.

This is the dominant design for TL procurement and, as such, it sets the boundaries for most shipper-carrier relationships. This auction-based procurement methodology took hold in the 1990's to early 2000's when the primary concern for shippers was to find the “market” rate for a transportation lane. This was when the industry was absorbing a huge number of new TL carrier entrants and both shippers and carriers were adjusting to the new flexibility in pricing that deregulation brought.

¹ The exact term used for a pricing event is a hot-button topic for many shippers. I will use the term “auction” for the remainder of this report – but it includes all types of pricing events regardless of visibility of bids, number of rounds, number of participants, etc. The salient point is that carriers submit prices for the right to haul freight on a lane (or within a region) and the shipper somehow assigns lanes to carriers based on these prices and other factors.

Reverse auctions, as the most efficient method of searching for a clearing price in a competitive market, were a good fit here. Also, this time coincided with the rapid adoption of advanced computing power and optimization engines that enabled more sophisticated strategic modeling of freight assignments by companies of all sizes.

Optimization based reverse auctions served the market well for over a decade. As with any dominant design, while it was not perfect for every situation, it was “good enough” for the vast majority of shippers. The extreme tightening of the TL market in the latter part of 2017 through most of 2018 coupled with the rapid digitization of transportation management, however, has raised questions about this method’s continuing relevance today.

This roundtable was assembled to address the question, “Is the dominant design in TL transportation procurement and management still relevant, or is it ripe for disruption?” The two-day roundtable was divided into two themes. The first day dealt with shipper-carrier relationships as defined by procurement practices. The second day focused on the disruptive potential of the digitization of the transportation function – mainly through the availability of massive amounts of strategic and real time data. The remainder of this report is organized into two sections along the lines of the topics discussed each day.

“Is the dominant design in TL transportation procurement and management still relevant, or is it ripe for disruption?”

Day 1. The Evolving Shipper-Carrier Relationship

The procurement process defines the shape and boundaries of any buyer-seller relationship. Freight transportation procurement is no different. The first day of discussion focused on how shippers, carriers, owner-operators, and third parties form and maintain their working relationships and naturally started with a discussion of procurement methods.

Strategic Relationships or Managing “Ditch to Ditch”

Throughout the roundtable, there was a lot of discussion on whether shippers should (1) form long-term “strategic relationships” with some or all of their carriers or (2) pursue the lowest cost transportation options opportunistically (within reason) by managing carrier relations “ditch to ditch” as the market rises and falls. These are obviously two extreme options and most participants argued for a middle ground.

One carrier described what they call “enlightened shippers.” Such shippers have reasonable contract terms; ask carriers for a balance of service, capacity and fair rates; and are willing to work through service problems. Beyond stability and budgeting, another reason for the popularity of contracts was for the sake of building relationships. This issue extended to independent owner-operators whose willingness to work for carriers or agree to accept loads depended strongly on how they were treated.

A shipper echoed these comments noting that each side has its own set of goals. Carriers want a return on their invested capital and happy drivers — they need good utilization, routes that get drivers back home at intervals they prefer, and shipper practices that don’t keep drivers idle or waiting. Shippers want a stable network with good tender acceptance and good service at a good price. Reaching all these goals, the shipper continued, requires a longer-term relationship and collaboration, not just a short-term transaction. Carriers need to be valuable to a shipper’s supply chain and understand the shipper’s business well enough to drive down inefficiencies. There has to be a relationship, they concluded.

Another shipper agreed on the importance of collaboration between shippers and carriers, but primarily for its top tier carriers. These relationships with carriers take investment. One participant cautioned that relationships need to be beyond just one individual -- because individuals can leave a company. Rather, executive buy-in and broader involvement is needed. For example, a 3PL encourages relationships throughout the organization, from executives all the way down to people who touch the freight. This level of investment means companies must be selective with whom they have deep relationships.

A large shipper agreed with this describing how they classify some carriers as “strategic.” With this select group, the shipper shares its 5-year objectives and asks how each strategic carrier saw its relationship with the shipper over the next five years. The goal was to have carriers who could grow with the company. In some cases, this shipper even talked to carriers that it did not currently use but thought might play a role in the shipper’s future. Investing time with these strategic carriers meant that the strategic carriers then tended to get most of the business. But carriers could not become strategic if the shipper did not choose them to be strategic -- the shipper was transparent about that.

Reciprocity: Reward or Wishful Thinking?

In theory, good relationships create reciprocity — a mutual tendency for the partner to forego a short-term gain for the sake of the long-term relationship. Shippers can measure carrier reciprocity through tender acceptance, average rates, and how the contract held up over time. Carriers can measure shipper reciprocity on the volume of business relative to contractual commitments and expectations. Anecdotally, several participants thought that enlightened shippers got better service during the challenging parts of the 2018 tight market.

Others were more cynical based on experiences with some unnamed shippers and carriers (often smaller ones). The cynic's view was that each side seeks relationships when spot rates are against them and changes their tune when spot rates favor them. Moreover, good shippers can go bad if there is a change in leadership. New leaders can undo the hard-fought advances in favor of some quick cost savings at the expense of long-time partners.

A poll asked for views on reciprocity in terms of whether shippers stick with carriers in soft markets, carriers stick with shippers during tight markets, both reciprocate, or neither. A large majority (65 percent) said it depends on the “depth” of the relationship between shipper and carrier while another 16 percent said both shippers and carriers reciprocate equally. A few thought reciprocating was one-sided with either carriers being more likely to reciprocate (8%) or shippers being more likely to reciprocate (5%). Only 3% took the cynical view of non-reciprocity and another 3% thought it was more complicated.

Public and private companies may differ in their willingness to stick to long-term relationships versus exploiting short-term cost advantages. The consensus was that public companies have more pressure to deliver quarterly savings. However, regardless of whether a company was public or private, everyone had budgets, and managers in private companies are still accountable for the financial sustainability of the company. Thus, extreme swings in the cost of transportation and large gaps between contract and spot rates could also affect private companies' willingness to stick to a long-term commitment.

Long Live the Dominant Design!

A polling of the attendees found that, despite the buzz about dynamic markets and digital freight matching, nearly two-thirds of shippers reported moving over 80% of their truckload (TL) shipments under contract rates while three quarters reported 70% or more. A majority of the shippers also reported to use the spot market only when contracts failed. When shippers were asked how they would like their TL shipments moved, the answers skewed toward even higher use of contracts over spot or dynamic markets. Nearly half (45%) wanted 90% or more of their freight under contract with another 45% wanting 80% to 90% of freight under contract. That is, the dominant design is alive and well in transportation procurement!

While most shippers reported using an annual bid cycle to award contracts covering the bulk of their truckload shipping needs, it was not universal. Some shippers reported using a longer bid cycle of two-to-four years with the advantage being that it muted the oscillations in freight rates. Discussions about the use of annual, or longer, contracts highlighted three strong rationales for them. First, shippers want a stable a budget (to not miss their quarterly profit expectations because of an unexpected surge in transportation costs.) Contracts let them lock in prices to some extent (barring network changes or other disruptions). Second, shippers noted that they want some certainty in the cost of transportation to estimate the cost-of-goods sold and set retail prices that have adequate margin. Third, several retailers said they use contracts to gain committed capacity, ensure sufficient trailers to be dropped in their pool, and increase carrier reliability. Essentially, contracts were seen as ways to gain better level of service from their carriers.

As one shipper put it, “contracts help managers know freight's contribution to the cost of goods. But the spot market is a roll of the dice.” Market conditions fluctuate and short-term factors affect it. Sometimes shippers pay a premium for price-security when they decide to use contracts. One good long-term solution to erratic truckload markets is to operate a better supply chain that reduces exposure to all these fluctuations.

Creating the lowest landed cost network means taking miles out of the network, tapping the broadest possible pool of trucks, and ensuring that drivers are moving every possible minute given their HOS limits.

Some of the carriers also seemed to prefer longer contract terms. One national carrier commented that they work with shippers with a variety of bidding cycles ranging from one to three years and that there are benefits to both short and long contracts. One-year contracts provide more flexibility as networks change while three-year contracts let the carrier plan a more efficient network. Another carrier echoed this sentiment stating that carriers benefit from longer-term contracts since this commitment gives the carrier confidence to invest in network changes such as maintenance depots, trailer yards, and where to hire drivers.

Other shippers had more dynamic networks that required more frequent bid processes due to the nature of their business. For example, a produce grower noted that due to seasonal variations in the growing locations from which it ships it has to run two RFPs per year. This makes deep, long-term relationships difficult. While the company values incumbency, it has to consistently add new carriers. The twice-yearly transitions in its network are costly and the transition is not always smooth in which case they have to default some business to the spot market.

TL Auctions – Are they worth the effort?

Most shippers admitted that the time and effort required to conduct an auction was not trivial. Participants were polled and transportation auctions generally took from 2-4 months from rate submission by carrier to carrier selection and assignment. Some shippers reported taking up to 5 or 6 months! And these are mostly for one-year contracts! Surprisingly, while computer and information technology has improved dramatically since auctions became prevalent in the 1990's, it has only served to allow shippers to spend more time to better analyze more and more facets and factors. It has not sped up the bid process. While shippers spend a significant amount of time preparing and analyzing the auction, they still tend to expect carriers to take no more than two weeks to respond.

Carriers noted shortening the length of time from creation of the RFP to actual implementation would significantly improve level of service since the forecast accuracy of the weekly volumes would be much better.

Discussions of the bidding process then led naturally to questions of how well it works. In particular, do the contracted rates actually hold for the full the duration of the contract? When asked what percentage of the business contracted in an annual bid is still moving under those contracted rates at end of year, over half of the participants believed this was over 80% while 10% admitting to having no idea. Analyses by several 3PL and consultant participants seemed to contradict this 80% number by reporting results that most shippers demonstrate a pattern of relatively rapid contract degradation. One 3PL found that contracts began to underperform after about six months and that the average rate age in the route guides was also six months. Another analysis of over 100 shippers found that the half-life of spend on contracts was about three months, with the longest being nine months. Multiple shippers admitted that they needed to do better post-mortems on their contracts and auction results to learn how to improve the contracting process for the next cycle.

Forecast errors about network flows for both shipper and carriers seemed at the root of these degradation problems. Shippers write RFPs based on demand forecasts, strategic plans, and what they believe to be true about their networks. But after signing the contract, demand might change, they might need to add lanes, or a shipper's customer might reorganize its DCs. Similarly, carriers bid based on forecasts of their known network patterns that define where they have cost-efficient capacity to offer a given shipper. But after signing the contract, the carrier's network might shift as their other shipper customers experience changes in their network, the carrier wins additional business, or it loses some lanes in subsequent contract renewals. Neither shippers nor carriers have good visibility onto the shifting patterns of shipments in other players' networks, and that fact causes the assumptions behind the contract rates and capacity commitments to break down over time.

Dynamic Spot Markets as an Alternative?

With all of the flaws with annual contract rates, there is some movement to shift to more dynamic procurement. New entrants to the TL space especially are trying to change the primary way of procuring TL transportation to lean less heavily on annual contracts. Instead, shippers would more closely ride the market's rises and falls in the spot market.

A poll on participants' rationale for using spot markets asked, "Which statement best describes how you use dynamic markets (spot) currently?" Nearly half (47%) said they used spot "only when the routing guide fails." As one logistic provider commented, everyone in this room has used spot rates to accommodate failures from the annual bid.

However, 39% of the shippers reported that spot was intentionally built into their procurement plan with 20% reporting that a "portion of volume is carved out of annual bid for spot," 13% "mainly planning to use spot for 'tail' or 'dog' lanes," and even 6% claiming "it is the main part of my plan." The remaining 16% said "something else." Several shippers noted that they segment their network and relegate less important freight, such as fixtures or unpredictable, infrequent volumes, to the spot market. One retailer said that 90% of its lanes had less than one load a week, so the strategy was to give that to a broker to get everyday pricing and ensure they would get capacity.

Several participants noted that technology can help in a volatile market. Transactions on the spot market are getting much easier. Logistics providers especially saw the rising use of technology and APIs as supporting greater use of spot markets. APIs can handle dynamic pricing, automated exchange of information, and volumes of bids too large for people to handle. Although such systems need human-defined and human-monitored guardrails, the systems can shorten the turnaround time for processing large numbers of spot bids.

Online platforms have revolutionized the spot market for personal transportation (i.e., taxicabs). A free and easy-to-use smartphone app quickly matches ride-seeking passengers with a pool of passenger-seeking drivers, handles timely payments, and enables feedback that incentivizes

reputable behavior by both sides. In general, these kinds of platforms, as well as brokers and 3PLs, have more visibility into patterns of loads and assets that can help pool supply, demand, and mitigate risk. Such platforms may be one way that shippers might gain more efficient access to hidden capacity – more on this when we discuss owner-operators.

Still, it did not seem likely from the discussion that any shipper would be willing to go 100% spot market anytime soon – except, perhaps, for some very small shippers.

Hybrid Procurement Practices

Threaded throughout the day's discussion was the open question of whether the dominant design of transportation procurement should be replaced. And if so, with what? One participant, however, said that there is a reason for the dominant design of annual transportation contracts: any replacement would have to deal with the big hurdles of changing mindsets and fitting in with budgeting imperatives.

So, rather than a complete abandonment of the dominant design, it appears that many shippers are chipping away at the edges through the use of hybrid procurement methods. The participants discussed a wide variety of variants to the dominant design of annual auctions. Each is discussed in turn.

Bundled or Combinatorial Bidding

Bundled or combinatorial bidding was initially developed in the late 1990's as a way for shippers and carriers to better communicate their underlying economics. Package bids allow the carrier to leverage their economies of scope when bidding instead of relying on standalone lane by lane bids. Truck lanes aren't independent of each other. For example, a carrier can service a Boston-Miami lane better if the carrier also has a Miami-Boston lane. Pricing each lane in isolation is more expensive, but by combining selected lanes, the carrier can gain better asset utilization (lower empty miles) and pass the cost savings on to the shipper, but only if the shipper gives them the entire bundle.

While interesting theoretically, it hasn't worked out that well in practice. One shipper did use package bids for several years within an optimization-based auction along with considering performance, payment terms, and weighting prices. The shipper bundled some lanes and had others as loops, but they found it difficult to operationalize these. Another shipper tried bundled bids in Asia but realized that bundling 85% of its lanes resulted in a 40% increase in cost. The bundle might get a low bid on one lane but a very high one on another, so the bundle actually cost a premium. An informal poll of the participants found that the group agreed that combinatorial bidding was less effective for long-term contracts – mainly because while the bidding is in packages or sets of lanes, the routing guide and actual tendering occurs lane by lane.

Zone Bidding

Zone-pricing, widely used in LTL and parcel markets but less so in TL, may be a way to lock in capacity but retain flexibility for changes in the network or demand. Zones enable shippers to aggregate volume from multiple lanes that share a cluster of origins, destinations, or both. Shippers may be able to more accurately forecast zone-level flows and commit to them in advance while preserving flexibility to use different origin facilities (that share a zone) or handle fluctuations in destination or retail demand (that share a zone). But carriers may pad their zone bids to cover the worst-case distances between the furthest corners of the zones. The system might work for small, dense zones or for long-haul routes where the variance of distances across the zone is small relative to the average distance. This is often used by shippers for sets of low volume or tail lanes to ensure that a wide region is covered by some rate in the routing guide.

Index-based Contracts

Indexing was another method that some participants mentioned as a way to lock-in long-term (multi-year) capacity commitments but also pay a “fair” price that ensures tender acceptance by carriers. This method attempts to split the difference between a fixed-price long-term contract approach and a volatile spot-rate approach while keeping transportation costs in line with some benchmark. One participant noted that indexing

worked until recently, when the index failed to rise as fast as carriers thought it should have. The carriers stopped accepting loads linked to the indexed price, and the shippers were forced to abandon indexing.

While not discussed explicitly at the roundtable, Index Based contracts are being examined as part of a Supply Chain Management (SDM) Capstone Project to be completed and published in June 2019.

Many, Many, Mini-Bids

Multiple shippers mentioned that they complement the annual bid cycle with frequent mini-bids – mostly handled through APIs. One shipper reported that setting up a carrier on the API takes only two weeks — programmers determine how the feeds work and how often they want to refresh their pricing. Another shipper noted that it did annual bids for 6,000 to 8,000 lanes and then mini-bids throughout the year for 200-400 lanes at a time due to changing networks. But 50-60 percent of its business stayed the same. Another shipper commented that they did not just look for lowest-cost bids but to ensure that the whole system can work. They estimate the cost of problems and delays on top of the bid rates for specific lanes (based on history) to get the true ‘long-term’ cost of assigning a lane to a particular carrier. That shipper evaluated carriers’ bids but modulated the bids by estimating and reviewing a carrier’s historical performance. Similarly, a third shipper factored in service, not just price, when choosing carriers.

Another shipper described a project underway to develop a proposal tool that would allow for shorter contract terms, i.e., 30, 60, or 90 days. The tool would allow traditional carriers to post on that board for those intervals and not have procurement involved as a gatekeeper -- the tool would remove subjectivity. If the manager could save his team 4-5 hours evaluating bids, that would be more cost-efficient. Essentially, this might solve (or mitigate) one of the biggest problems associated with large scale annual bids – the cost and effort required to run them.

Another large shipper goes to the spot market 37% of the time (for about a 1000 shipments per day). The shipper allows certain carriers to dynamically price every single load in its network. The shipper then awards loads to meet its contract obligations first and then goes to the spot market where capacity might be more available or prices might be better.

Futures Market

In many commodities markets, both suppliers and buyers use futures markets to hedge price risks. That is, they buy or sell a futures contract to lock in the price, often without pre-committing to a specific transaction with any specific partner. In theory, futures could give shippers known costs (and carriers known revenues) that are currently offered by long-term contracts while letting them arrange specific loads on the spot market. Costs created by changes in the spot price would be offset or hedged by profits on changes in the price of the futures contract.

A poll asked for participants' opinions of using a futures market for TL transportation, on a range of 1= "It'll never happen" to 7= "It's going to be huge!" Slightly more than half the group (53%) rated the chances as a 4 or 5, with only 3% seeing it as huge and 12% seeing it as never happening. The average was a middle-of-the road score of 3.6.

Futures are used in ocean shipping, but the truckload market may be too fragmented for futures to work. Furthermore, futures markets require a reliably-measured market rate that futures contract holders can use to settle the contract at expiration. But spot market prices vary wildly from load to load, with no consensus price. The viability of a true futures market in the North America TL market is an open research question – although some nascent markets have launched in spring 2019.

Accessing Untapped Capacity: Independent Truck Drivers

Independent truck owner-operators represent a very deep pool of trucking capacity that many large shippers have not tapped. The challenge is in accessing them efficiently — it's easier to establish a deep relationship with one large carrier that has tens of thousands of trucks than to establish individual relationships with tens of thousands of drivers.

As mentioned previously, online platforms could help match shippers' loads to independent truckers. Traditionally, brokers have provided access to smaller carriers, but there is discussion amongst some participants that technology could replace most of the activities currently performed by a broker. Such platforms could also help carriers select only the most reputable drivers to reduce the "nuclear risks" to a shipper's brand if the driver behaves in an unsafe manner. Three challenges with working with independent owner/operators were identified: lack of trailers, resistance to monitoring, and treatment at shipper facilities. Each is discussed in turn.

Access to Trailers

Although carriers and drivers would love the speedy convenience of drop-and-hook, this isn't always possible within the operational constraints and distribution strategies of shippers. Many large shippers use dropped trailers as flexible/mobile inventory storage for handling surges, while others simply need time to unload inbound trailers and load outbound ones. For independent owner-operators, trailers are an even bigger challenge. The typical owner-operator only has one, maybe two trailers (usually flatbed or reefer) which they can't afford to leave behind.

Trailers are another essential transportation asset that need to be purchased by someone, maintained by someone, and then positioned in the right place at the right time for loading, hooking, dropping, and unloading. Overall, there is an 8-1 ratio of trailers to trucks in the US, but most of these trailers are in the wrong place. Unfortunately, many shippers all need to hold onto trailers at the same time. Although some providers are working in the issue, no one has invested the estimated \$300-\$500 million needed to create a national trailer pool.

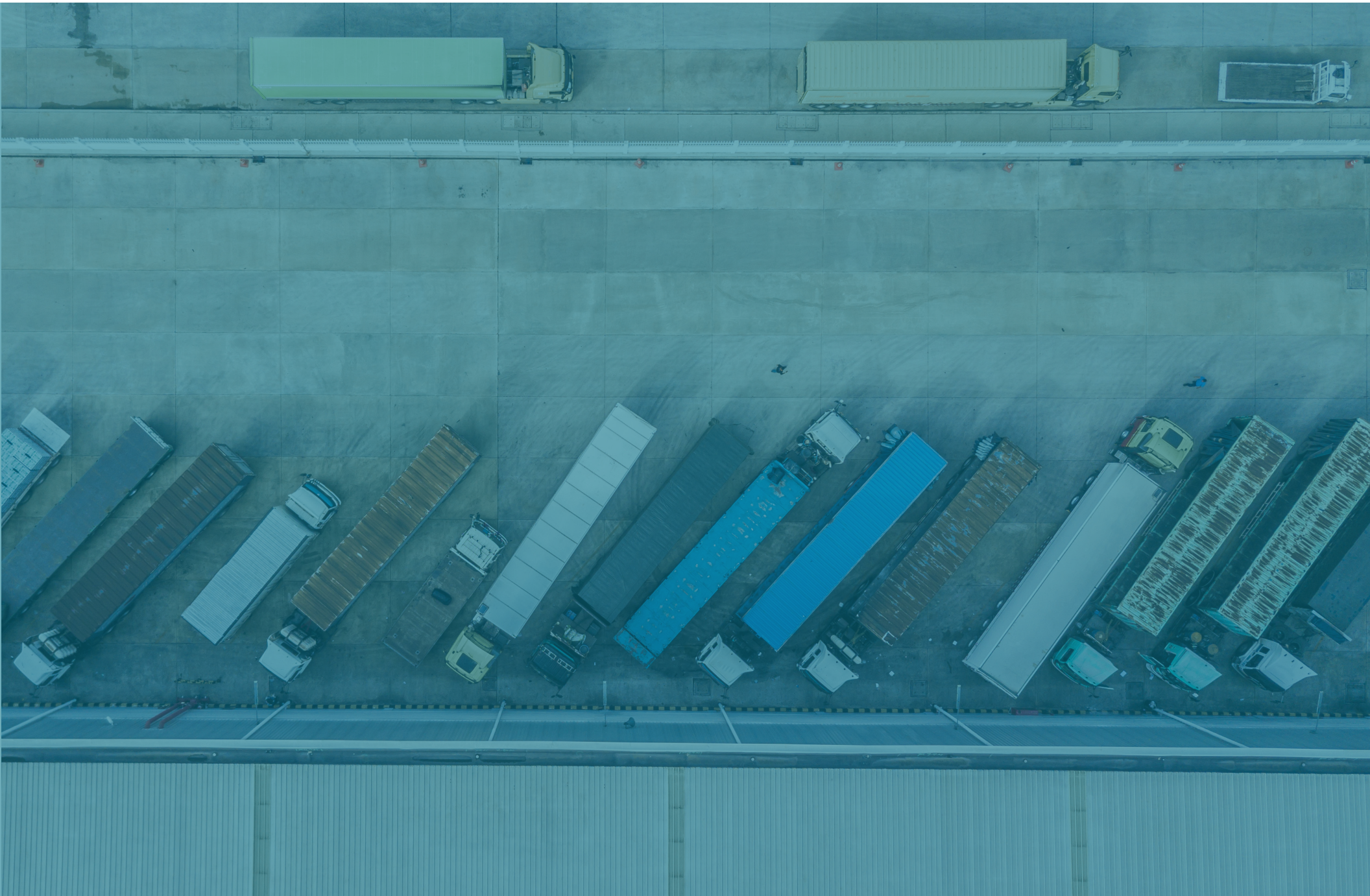


Image 2. Parked trucks and trailers. Source: Adobe Stock.

Driver Resistance to Data Collection

While many larger players are using real-time tracking to more accurately manage transportation and shipments, this can be a challenge with Owner-Operators. Data and apps can be used in place of blind trust that the truck or shipment is on time. For example, if a shipment is expected to arrive by 10 a.m., tracking now enables shippers to see if it will be late and react. While it might be too late to modify the shipment delivery, it can provide time for the shipper/receiver to make alternative plans given the late arrival, i.e. redeploy warehouse labor, shift the unloading/loading schedule, pull inventory from another location, etc. In such cases, data is a replacement for trust. Tracking can validate that the driver delivered the load and can use geofencing to objectively record dwell time.

One challenge with working with independent truck owner-operators is that many are independent by name and nature. Many are very private individuals who object to tracking or oversight. Their view is “if you trust me, then you don’t need to track me, and if you need to track me because you don’t trust me, then don’t use me.” Many prefer working with smaller shippers who don’t require the tracking. Drivers don’t mind if the trailer is tracked but they don’t want themselves tracked, such as if they go to a casino.

In the realm of consumer data collection, technology companies typically “bribe” consumers to reveal otherwise private data by offering some sort of “free” service that the consumer wants, such as social communication, streaming music, restaurant reviews, file hosting, and so on. Similarly, shippers might be able entice privacy-minded truckers to accept some level of tracking with features that truckers value, such as faster pay, reduced dwell time, good payment for detention, or visibility onto lucrative hauling opportunities.

Driver Voice and Social Media

The combination of high driver churn at carriers, along with interest by shippers in accessing independent drivers, has companies looking at driver relations. A number of participants on both the shippers’ and carriers’ sides are starting to collect feedback from drivers. This entails surveying drivers on the facility’s restrooms, food, parking, dwell time, how drivers are treated, and other factors. In the case of at least one transportation provider, drivers get to see these ratings and amenities before they accept the shipper’s load. Social media plays a growing role both as a way for drivers to share information with other drivers (e.g., crowd shaming bad shippers) and as a tool that shippers and carriers can use to build relationships with drivers.

Many companies were looking to improve the lives of drivers, giving them the right load at the right price and taking waste out of the network. For example, one shipper was upgrading driver amenities based on feedback they received. This included letting drivers park and sleep on the shipper’s premises because finding parking is a serious challenge for drivers. Onsite parking means that drivers don’t use up their HOS looking for a parking place. They can arrive early, take a break at the shipper’s facility, get the load when it is ready, and drive out with a maximum of remaining HOS. These techniques helped the shipper ensure that only 1 in 25 carriers failed them in 2018. A carrier correlated on-time performance with shipper facility parking and found that parking pays for itself through better performance.

Day 2. Digitization of Transportation – Rise of Big Data

The second day of the roundtable focused on how companies are digitizing their transportation functions through the use of big data. Participants described their analytic efforts around modeling key transportation issues such as markets, partner performance, and dwell time. The group also discussed the kinds of personnel needed for these projects. Overall, participants rated their ability to gather data higher than their ability to analyze data, and they rated their own big data abilities above those of their partners.

In a poll that kicked off the session, participants were asked, “How would you rate your company’s ability to collect large amounts of relevant data on a 1 to 10 scale?” Nearly half (42%) gave themselves high scores ranging 8 to 10 out of 10. None believed they were a low 1 or 2, only 12% rated themselves below a 5, and the average score was 6.7. There was consensus in the room that data collection wasn’t the problem it once was. Companies were also actively collecting more data. For example, a carrier had a TMS but noted that they still needed to populate it with more detailed data. A 3PL, in turn, learned that in its old systems, it collected data on price, but never collected data on the bids that were not accepted.

The caveat was that while quantity of data collected was no longer a pressing problem, the quality of the collected data remained an issue. For example, two companies found that while they had a lot of data, it wasn’t clean. For example, one company found that even its own company name was spelled five different ways in their own data! Thus, they had to spend a lot of time cleaning it before they could apply it in machine learning or AI.

A second poll asked, “How would you rate your company’s ability to analyze and make decisions on large amounts of relevant data?” In this poll, the self-assessment regarding usage was lower than for collection, with only 20 percent of participants rating themselves an 8 or better out of a possible 10, none being 1-2, 28% scored below a 5, and the average was 6. The spread of ratings was larger for the ability to use the data

than to collect. Interestingly, when polled as to their partners’ abilities the scores tended to be even lower, with only 14 percent of participants rating their partners as an 8 or better. Although, no one rated their partners to be a 1 or 2, fully 40% said they were worse than a 5, with the average score being only 5.5. It is surprising that each participant thought they had better capabilities than their partners – regardless of whether that firm was a carrier, a shipper, or a 3PL.

Data Scientists and Retention

So, while data collection is not the pressing issue it once was, the ability of a company to translate this data into insights and actions has become a priority. The first step to achieve this capability is, of course, to find and hire the right people. Several companies noted that there are multiple challenges here. The first is that creating a data analysis team requires an upfront investment and therefore a leap of faith by senior management.

Second, personnel on a data analytics team need to have knowledge not only in data science, but also domain knowledge in transportation. One participant noted that this is often overlooked in hiring and recounted an example of a smart, yet naïve, data scientist who came to management with results of an analysis that showed that “cost is directly related to fuel” without realizing this is common knowledge in practice.

This led to a discussion to whether it is better to teach transportation concepts to data scientists or to teach data science to transportation professionals. Across the board, participants thought that it is better (and easier) to teach transportation to data scientists rather than the reverse.

Retention of data scientists was also discussed, with participants saying that pay levels were important. However, it wasn’t only a matter of money, but also giving them interesting projects to work on and be engaged. Sometimes the location of the office plays a factor as well.

Interestingly, most firms have already started on this road to having a dedicated analytics team in transportation. In fact, about half of the participants in the room had Master's or PhD degree holders in their organizations, compared to zero a decade ago! MIT has found that whereas in previous times masters students wanted to be corporate strategists, now the market is driving them to learn data science, artificial intelligence, machine learning and Python. This leads to the conclusion that the market demand is starting to be met by changes in university programs.

While hiring data scientists might be important, one shipper cautioned that a company must have a strategy first and then create data processes to support that strategy. The strategy could be continuous improvement or something else. This company went back to basics during its initial use of big data, with an emphasis on strong governance, data cleanliness and data timeliness so that it could be usable. Another company focused its efforts by looking at all the reports being produced and discontinuing reports that no one was using.

The productivity of data users also matters. Another perspective that had to change was to provide a data-based answer to a question in minutes, not hours. Companies need solutions that let users quickly get the story in four or five clicks. They need systems and technology that integrate the data. New tools like Tableau are much more user-friendly, enabling people to create their own reports.

Using Data to Model and Predict Market Trends

One type of analysis being enabled by the presence of large amounts of digital data is market trend analysis. For example, an information provider works with shippers and 3PLs to help them understand the transport market. The market is different for carriers of different sizes, such as the Tier1 and Tier2 carriers of \$100 million - \$500 million in size compared to the long tail of independent owner-operators.

Overall, across the total volume, their analysis found that the price information was very efficient. There were hundreds of thousands of actual lane rates, but the market was very efficient in setting prices. The volume percentage of the spot market typically maxed out at 10 percent, the information provider said.

The information provider also built a supervised machine-learning model to predict TL prices, using both historical TL transactional data and exogenous factors, such as econometric metrics from the Federal Reserve. Run in Spring 2018, the model predicted that capacity would loosen in the fall of 2018 and continue to loosen into 2019. This was surprising because most analysts were claiming the tight market from 2017 would continue through 2018 and 2019 – as a new normal.

Several participants noted that it took a major wakeup call in the tightening of the TL market to gain credibility from upper management to make any changes. Once they had shown that their models were accurate management started listening to them. Similarly, one carrier noted that they had a hard time convincing management to invest in the company's first analytics team because the ROI was unknown until they demonstrated some results.

An analytics company discussed some of the other kinds of answers that big data analysis could shed light on. For example: "how have past bids unfolded? Who is giving us the best value? Who are our best providers and how do they affect outcomes?" The market is the backdrop of the activity, and data must be represented in objective ways.

A shipper has an analytics team using tools for analyzing internal data. The team reviews the metrics and KPIs and discusses them weekly with finance and the commercial team, so that both the commercial team and the finance team see projections on a quarterly basis. The company's analysis also led the company to have a discussion with its 4PL to find efficiencies.

A shipper said that prior to doing various analyses, the company had assumed that product wasn't getting to its DCs because the carriers weren't doing their part, but further analysis of the data showed that it

was actually the shipper's own fault! Similarly, another shipper previously pressured their carriers for things that the shipper itself had not forecasted well or had different load weights than predicted, which cost the carrier extra. They found that in most cases, it was not the fault of the carrier.

Using Analysis to Identify and Minimize Dwell Time

Another hot area ripe for analysis with new sources of data is dwell time. Dwell time -- also known as detention -- refers to the time between when the truck driver arrives at the shipper's site and the loaded truck can leave. Long dwell time is a serious problem in transportation that affects costs, service, and relationships among shippers, carriers, and drivers. For example, independent owner-operators may refuse a load from shippers whom they know to have a long dwell time, because the driver does not get paid if the truck is not moving. Hours spent waiting are lost hours not only for pay, but they also reduce the hours of service which the driver can spend on the road.

A 3PL that had studied dwell time found that it caused twice the financial penalty implicitly than the explicit accessorial charge. Furthermore, unpredictable dwell times affected not only the driver who was waiting but could also adversely impact the next load, thereby causing a domino effect of delays on multiple shipments. It was also noted that the FMSCA (Federal Motor Carrier Safety Administration) monitors dwell time because long dwell time has a direct relationship to crashes when drivers try to make up for lost time.

Dwell time also had effects on rates and contract outcomes. A shipper learned that dwell time had a direct correlation with the highest rates which carriers bid. That is, the carriers were charging the shipper more because the dwell time was keeping their drivers from driving. The shipper discovered that the rate variance on good dwell time versus bad dwell time was huge, so making an investment to shorten dwell time was worthwhile and easy to sell to upper management.

Excessive dwell time even caused problems in the bid cycle. Specifically, an incumbent would know the real average dwell time on a lane and

thus bid that lane higher to take it into account. A new carrier, unaware of the dwell time, might offer a lower rate. Unfortunately, awarding the contract to the new carrier could lead to a "winner's curse" when the new carrier learns of the dwell time, and this could lead to service failures if the new carrier who underbid the lane decides to stop taking loads at a money-losing price due to dwell.

Given the negative impacts of dwell time, numerous shippers are looking for ways to reduce it. One shipper is offering drivers a place to park and sleep at their own facility, so that drivers can have a break and don't have to use hours looking for a place to sleep. They are also asking drivers to arrive with zero hours. Another shipper faced a challenge when tackling dwell time, namely the siloed nature of the organization. For example, one part of the company wanted drivers to deliver at 4pm or later, but that change would adversely impact warehouse staffing.

Looking Beyond a Single Number

A logistics firm cautioned that there could be false comfort or false expectations that come from giving an answer as a single number, as opposed to a range. Belief in a single-perfect-number could lead to disastrous outcomes. For example, is a predicted estimated arrival time really a perfectly exact number or is it a range with a high likelihood that the true ETA might be some minutes earlier or later than the single number? ETA predictions have to be constructed such that reasonable decisions can be made about them, such as how to handle outcomes within the early-to-late range.

Similarly, any given key performance indicator such as "rate per mile" often has contextual factors that strongly modulate the business impacts associated with that metric. For example, the business impact of a given "rate mile" varies significantly if it is covering a 2000-mile route versus only a 200-mile route. And that impact also varies if it applies to a frequent daily shipment versus a rare once-a-year load. Thus, a high rate per mile from some carrier might be fine if it only applies to short lanes or low-frequency lanes.

Overall, determining how to present the data that has range or context issues depends on who will be working with it and how the results will be presented. The goal is to help people make better decisions.

Challenges and Opportunities of Real Time Data

The discussion turned from big data as a general topic to more specifically the use of real time data in transportation. Much of this conversation centered on the topic of tracking the locations of trucks and shipments, with an obvious interest in ETA (estimated time of arrival) and delays. Participants in the food industry also monitored shipment temperatures. Overall, real time data was used to provide visibility to customers and to detect exceptions for proactive mitigation. Real time data was seen as a way to both reduce the cost of service (reducing the number of customer inquiry calls) and improve service outcomes (i.e., intervene early when a problem occurs).

A poll asked participants what kind of real time data they wanted about in-transit loads. The two most frequently cited were “location” and “estimated time of arrival.” A second tier of sought-after information included data on delays, time, predictive data, and temperature data. Finally, companies were also interested in “load at risk” “availability” “status” “geospatial” “arrival” “OTIF predictive” and “security.”

A second poll asked what real-time information a company could act upon. The two types of data most frequently cited were “estimated time of arrival” and “delays.” Secondly, a few companies indicated that they could act upon location, dwell time and temperature data. Other data named included “compliance” “loaded trailers” “inventory at risk” “inventory in motion” “assignment” and deviations that could affect labor scheduling.

A 3PL described how they built a predictive model for estimated time of arrival on all loads based on lane, distance, estimated break time (not HOS). They provide this information to customers in real time so that they can view it. The model also predicts loads that might be a risk, so that the 3PL can manage them as exceptions.

Companies in the fresh food, beverage and pharma industries were also very interested in real-time temperature data so that they could manage the freshness and quality of their products. For one shipper, temperature needed to be within a 2-degree range, and this was particularly important to monitor in the summer. The shipper shared data the real-time data with its network, across DCs, and knew where every truck was, along with its temperature and airflow. The company updated customers if necessary and solved problems if something adverse arose.

Another shipper mentioned that it wasn’t just temperature but also the amount of time that the product spent at that temperature. Loads that had longer transit times in higher temperature were more at risk. By detecting in real-time that the ideal temperature range had been exceeded for a certain period of time, the company could contact the driver to see if the product could be off-loaded.

Many of the preceding examples given by the companies point to the strong use case of real time data in catching and managing exceptions. A 3PL built a tool called “Loads at Risk.” The tool helps the 3PL’s operations team focus on the loads that are important because something is going wrong with them. The company asks for EDI X6 data on an hourly basis -- 15-minute updates would be too much and would slow down the whole system. With the tool, the number of loads to manage by the team decreased from 1500 to a couple of hundred potentially at-risk loads, making it much more manageable. The operations team then communicates with receivers ahead of time, to proactively communicate to close the gap with carriers to mitigate risk. For example, it might do a product transfer or expedite a product or load or alter the labor.

If one particular item in a load might stock out, that one item could be pulled from the load and expedited. Also, proactive communication with receivers puts them at ease knowing that the 3PL is actively watching the load and taking action as needed. Building the tool took 1.5-2 years, but it is paying dividends because now instead of getting calls from receivers every day about the status of their loads, they only get calls on the one load in 50 that might be delayed.



Image 3. Container yard. Source: Wikimedia Commons, public domain.

Conclusions and a Call to Action

The North American TL transportation market is exceptionally large and highly complex. Traditional methods for procurement, while very beneficial for many decades, are starting to fray at the edges. Higher demand (due to raised economic activity and other factors) and tighter supply have stressed an already tense market. Advances in communication and computational technology coupled with promising new methodologies in Machine Learning and Artificial Intelligence, offer some new approaches to shaping and enforcing shipper-carrier relationships.

The MIT FreightLab believes that this is an opportune time to investigate and explore these new and emerging practices in order to improve the way in which transportation is procured and managed. We are actively seeking companies (shippers, carriers, brokers, 3PLs, and others) to join us in this research. Active questions we are looking to answer include:

1. Should the dominant design of transportation procurement be replaced or simply modified? And if so, how and with what?
2. How can shippers and carriers work together to reduce the rate submission to assignment time in auctions?
3. How can some level of flexibility or responsiveness be introduced into the traditional procurement process?
4. How much do routing guides degrade over the length of a bid cycle and why?
5. How should a shipper determine the “optimal mix” of contract types (dedicated, contract, spot, etc.) to use and where across their network?
6. How can we better predict future demand/rates in the short and long term?
7. Can futures markets be introduced into TL markets, and if so, how?

If you are interested in joining any or all of these research efforts, please contact Chris Caplice at caplice@mit.edu.



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