

The rise and fall of lead times

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A look at recent trends across ocean, air, rail and truckload

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During the pandemic years of 2020-21, retailers were subjected to unprecedented volatility in transportation markets. After a spike in e-commerce activity, imports flooded the U.S. and led to persistent, widespread congestion at ports as containers took weeks to clear their terminals. This maritime congestion played havoc with rail networks, which were similarly inundated with shipment volumes and thus unable to supply empty containers for intermodal customers.

With travel restrictions and the grounding of passenger fleets, capacity for air cargo was severely limited at a time when low inventories and an eagerness for rapid restocking spurred shippers' demand for the mode. Domestic truckload capacity was constrained by a shortage of semiconductors that curbed production of new vehicles, inflated prices of used trucking equipment and a lack of entrants to reinforce the nation's carrier base.

Needless to say, lead times — or the period between when an order is received and when it is fulfilled, including times for transit and dwell — were grossly distended amid all of this chaos. Shippers placed orders with their overseas suppliers months in advance and still, at every link in their supply chains, ran into unforeseen delays. With more than 100 container ships waiting offshore of the ports of Los Angeles and Long Beach, it was not uncommon for dwell times to last five or six days by the end of 2021.

In 2021, as lead times continued to expand due to unrelenting congestion at the ports, retailers grew more vulnerable to the bullwhip effect. This effect occurs when temporary surges in demand — especially for durable goods such as furniture and consumer appliances, which are bulky and therefore devour warehousing capacity if not moved quickly — have a disproportionate effect on production forecasts of upstream suppliers. Much like the crack of a bullwhip, the damage caused by this effect is amplified by the length of one's supply chain.

One year later, new trucking capacity had flooded the market to meet this tsunami of freight. But retailers were dealing with the aftermath of their runaway spending on orders, struggling to move high levels of inventory amid declining consumer demand. This imbalance between newly added capacity and shippers' waning demand first became apparent in March 2022, when truckload spot rates began a precipitous decline as carriers forfeited their pricing power at an alarming rate. Ocean markets fell victim soon after: At the end of May, U.S. import demand unseasonably fell 30% over two weeks. Absent shippers' urgency to restock, air cargo traffic suffered as capacity ballooned during the summer. Intermodal volumes, which should have benefited from this lack of urgency, were inhibited as shippers avoided the rails due to deteriorating service levels and fears of an industrywide strike.

In this paper, we will survey recent trends in lead times across ocean, air, rail and truckload modes of transportation. In our careful study of the various causes behind these trends, we

will touch on consumer demand, geopolitical obstacles and mode-specific labor insecurities. We will then conclude each section by forecasting how these past trends will evolve or else become insignificant. Finally, we will address concerns about supply chain resilience against the backdrop of balancing transportation cost and service.

Waiting on the ports

One of the longest components of lead times overall stems from the maritime market as shipping across the globe via the ocean, while economical, comes with trade-offs. Those trade-offs were highlighted throughout the COVID-19 pandemic.

Transit times are just a minor component of the maritime market but make up an overwhelming majority of the time it takes for something manufactured overseas to reach the shores of its final destination. Prior to the pandemic, ocean transit times were relatively stable, hovering 27 days on average.

When the pandemic happened, manufacturing facilities faced various lockdown restrictions across the globe, consumers ramped up spending on goods and congestion ensued.

The result: Container ship lines extended transit times as a way to try and mitigate congestion but also attempt to keep on-time service metrics at acceptable levels.

The average global ocean transit time increased by nearly three days, jumping to 29.5 days in May 2020. Immediately following the initial emergence of COVID-19, global ocean transit times returned to more normal levels, but as congestion mounted at ports around the world, transit times increased.

Since early 2021, global ocean transit times have climbed to more than 29 days, an 8.2% increase from pre-pandemic levels.

Arguably the most important trade lane in the world, the trans-Pacific, is finally experiencing a normalization in transit times overall, falling back below the 30-day mark. Even though transit times along the trans-Pacific have been cut by roughly four days since the height of the supply chain congestion throughout the first half of 2022, transit times are roughly four days longer than they were prior to the pandemic.

The trans-Atlantic trade lane didn't experience quite the same phenomenon as the trans-Pacific, though transit times as a whole did increase since the beginning of the pandemic. While congestion allowed container ship lines to extend transit times, they have only increased by about three days.

The biggest difference overall between the trans-Pacific and trans-Atlantic transit times is that transit times along the trans-Atlantic trade route have been sticky at the higher levels.

Transit times represent just one part of the overall ocean transportation. Lead times are another component that factors into the overall lead time needed to get goods stateside. Lead times for transportation, across all modes, traditionally lengthen when supply chain pressure intensifies and are cut when supply chain constraints ease.

When capacity constraints on the ocean became prevalent, the need for extending lead times became increasingly important and the market reacted accordingly. From January 2020 through August 2021, global ocean lead times extended from nine days to nearly 13 days.

Extending lead times for ocean transportation was a necessity during that time period as demand surged, backlogs at manufacturing facilities were extended and capacity on container ships was remarkably tight.

In the period since, despite rampant congestion through the first nine months of 2022, ocean lead times globally have been cut by more than four days, returning to more normal levels as capacity constraints ease.

The lead times, specifically during the times when demand picks up, extend, which factor into longer lead times for overall orders of goods coming from overseas.

The factors many don't plan for, until it becomes a problem, are delays at the various ports, both internationally and domestically. In a "normal" freight market, delays are nearly nonexistent across the globe.

As the pandemic raged on and demand levels remained sticky at record levels, delays at ports across the globe mounted. At the peak, the average global delay at the ports was nine days. For context, as the global ocean market has softened since June 2022, delays at global ports have fallen to just three days, a 66% decline from the peak.

The U.S. ports came under heavy scrutiny for the inability to clear backlogs in an effective manner at the height of the demand surge. The result was U.S. port delays averaging nearly 13 days from the time a vessel reached the port until the time the vessel was able to be unloaded, not factoring in the time it takes to unload a vessel, clear U.S. Customs and be cleared for transportation, either via truck or rail.

Since the congestion has eased, delays have diminished, falling below three days on average, better than the global average.

The increased delays were largely a nonfactor in planning as capacity was incredibly tight and securing space on a vessel was arguably more important than the vessel waiting at times more than two weeks at a port in the U.S.

But when you add in the lead times, transit times and delays at the port, at the height of the demand cycle, total ocean transit times came in at 53 days, on average. Factor in the time for orders to be placed and then manufactured, which can vary, the minimum time for an order to arrive at a port in the U.S. was over two months and at times even longer.

Even as the container ship lines have kept transit times longer, in an effort to likely improve service metrics, the total lead time associated with ocean shipping has dramatically declined. The combination of lead times, transit times and delays are now under 40 days, erasing nearly two weeks of additional time.

Less air cargo demand plus more capacity equals shorter lead times

While air cargo accounts for less than 1% of global trade by weight, it represents 35% of global trade by value. Given their exposure to high-value freight, timeliness is the key offering of airlines. Although transit time along major trade lanes did not change significantly since the pandemic, flight cancellations and delays on the ground have been a constant thorn in the side of air shippers for the past three years.

Trans-Pacific demand for air cargo is normally sustained by importers of consumer electronics, machinery and electrical equipment. The timing of yearly product launches, the pace of obsolescence and the need to manage future orders ahead of high-volume purchase periods all dictate the time sensitivity of traditional air cargo. But historic congestion at container ports led other retailers — especially those benefiting from the stimulus-driven e-commerce boom — to switch modes in order to restock rapidly. Thanks to the influx of these retailers, global air cargo traffic growth outpaced global goods trade growth throughout 2021.

Unfortunately, this demand growth came at a time when airfreight capacity was decimated. International travel restrictions and domestic quarantine policies caused an industrywide grounding of passenger fleets. In 2019, passenger flights accounted for more than 55% of total air cargo capacity headed to the U.S. In 2021, less than 36% of total air cargo capacity bound for the U.S. was supplied by passenger flights. Part of this difference can be attributed to the 19% decline of total inbound tonnage capacity from 2019 to 2021, though inbound tonnage capacity on freighters rose by almost equal measure over the same period, jumping 17%.

That so much concentrated volume arrived on these giant freighters (rather than in more manageable amounts spread across multiple passenger flights) caused major delays among ground handling companies. Many of these companies terminated workers in the early days of the pandemic and then struggled to attract labor when the market was more competitive. Accordingly, wait times for trucks unloading and loading at airport cargo facilities shot up in 2021 and, in some regions, still remain higher than their pre-pandemic averages.

Peak wait times at airport terminals have likely passed: Not only is trucking capacity far more abundant, but demand for air cargo has largely evaporated. As mentioned above, air cargo is typically a mode of last resort for shippers, limited to perishables and high-value goods with margins sufficient to cover the expense. But in 2021, airfreight was a bargain relative to highly inflated ocean shipping rates. This relative bargain has long since vanished.

Broad inflation has also weighed heavily on consumer spending habits, prompting them to reserve once-discretionary income for household necessities such as groceries and gasoline. What little remains in discretionary budgets is, if not saved, instead directed toward services such as lodging and passenger airline travel. Case in point: Per data from the Department of Transportation, the number of passengers on U.S. flights nearly rebounded to pre-pandemic levels in 2022. Nor is this trend likely to slow down this year since, according to card spending data from Bank of America, airline travel was among the few categories that saw monthly spending growth in March.

Retailers that have mostly corrected their stock levels are cautious about purchasing activity due to ongoing concerns about inflation sapping consumer confidence and purchasing

power. This pincer movement of high inventory levels and low consumer activity implies that air cargo demand will not gain from mode-switching shippers as it recently had.

Nevertheless, there are lingering obstacles that could keep lead times for airfreight elevated in the near term. Routes between Europe and Asia have often had to be redirected due to the restriction of Russian airspace; aircraft along these longer routes have to carry more jet fuel and thus have less space for cargo. Airlines and air cargo terminals alike have also continued to struggle with labor shortages and union actions, the most recent of which is a threatened strike by FedEx pilots after a two-year negotiating process has failed to secure a new contract.

China is sure to be an interesting piece of the puzzle surrounding the future of air cargo. On the one hand, the country is desperate to recoup time lost in 2022, when manufacturers and export facilities were frequently shut down from regional COVID lockdowns. The urgency of manufacturers in China could translate into higher demand for airfreight out of the nation as a way to make up for previous downtime.

On the other hand, geopolitical tensions in the region are escalating. In late 2022, China surrounded the central island of Taiwan in a naval blockade, flying drones over its offshore islands and firing missiles over its capital city of Taipei. This show of military force threatened the leading global supplier of semiconductors, a key engine of air cargo demand.

After the effects that the Russo-Ukrainian War has wrought on global trade, manufacturers are wary of housing operations in countries that could be exposed to international sanctions. In fact, the univocal response from the West to Russia has stoked fears among international firms that other countries like China could be vulnerable to similar sanctions in the future. Should such sanctions be enacted, airspace would be heavily restricted and exporters would likely be left in the lurch. Trans-Pacific air cargo routes, even those that do not directly involve Chinese terminals, are sure to be subject to the same limitations that Europe-Asia ones are observing: namely, longer routes that require more jet fuel onboard and thus allow for less cargo uptake.

Once bitten, twice shy

The importance of the trucking industry to the U.S. goods economy can hardly be overstated. By weight, roughly 75% of U.S. freight is moved on a truck — whether the trailer is a standard dry van, refrigerated (or reefer), flatbed or any other niche type to haul heavy and oversized equipment. Despite its significance, the operational health of the trucking industry was not part of the average consumer's consciousness until recently, when supply chains broke down while struggling to satisfy monstrous demand amid a pandemic.

Compared to other modes of transportation (and certainly to other industries), the trucking industry is both highly fragmented and highly cyclical. According to the FMCSA, more than 91% of fleets operate with six or fewer trucks, while less than 3% of fleets have 20 or more vehicles.

Relative to the unionized labor force of railroads, container ports and airlines, this degree of fragmentation can hinder driver-initiated service disruptions, though it cannot prevent them altogether. Case in point: In December 2021, truckers boycotted the state of Colorado when a young and inexperienced driver, convicted for the deaths of four individuals after a highway

accident, was sentenced to 110 years in prison. Or take the response to Canada's vaccination mandate for cross-border drivers, which resulted in the protests of the Freedom Convoy.

The story of trucking in 2020 begins with a carrier base that was just thinned by an industry recession in 2018-19 and further diminished in the early days of the pandemic. As stated before, the marriage of consumers' deep pockets filled by government stimulus funds and of national quarantine measures that both destroyed spending on services and amplified consumers' boredom (and thus desire to spend) birthed an unprecedented wave of demand for goods. Of particular note was the run on consumer packaged goods, particularly of hand sanitizer and toilet paper, during the early stage of lockdowns in 2020.

Given both this heavy demand and lack of carrier capacity, new drivers should have flooded the market in pursuit of high truckload rates. But there was a limiting factor: Semiconductor shortages limited the number of new trucks manufactured and, without these new trucks, large enterprise carriers could not update their aging fleets and sell off their used equipment. Prices of used trucks shot up but, despite this constraint, new drivers were seduced by exorbitant rates and continued to enter the industry.

This influx of capacity was not, however, immediately apparent to many shippers. The highest degrees of chaos (and therefore the highest rates) were centered around Los Angeles and its tsunami of containerized imports. Warehouses in the region were stuffed to the brim with goods, especially those related to the e-commerce boom, that had to move farther inland. Since new drivers, desperate to justify their expensive purchases of used equipment, were chasing after the highest rates, they flocked to Los Angeles in search of a freight gold rush.

Even established carriers with existing freight contracts were drawn to Los Angeles, causing them to abandon their previously contracted loads. As a result, carrier compliance tanked, while the leftover shipments fell to spot markets. Spot markets across the country benefited from this surplus, with the bulk of shipments from retailers and CPG firms moving in the spot market during 2021. But this reliance on spot markets was far from ideal because shipments would have tight windows to move and were often delayed and rescheduled. This confusion overwhelmed shipping and receiving facilities, prolonging detention times.

A curious trend has taken shape and looks to hold for the foreseeable future. Even though the aforementioned mayhem is now largely absent from truckload markets, lead times — not as defined throughout the article but defined strictly as the period between a shipper's request for capacity and when the load is scheduled to move — are continuing to rise. Nowhere is this trend more pronounced than in the heavyweight market of Ontario, California, which is fed truckload volumes by freight from the neighboring ports of Los Angeles and Long Beach. Maritime imports, as has been mentioned, are suffering from unseasonal depression. Given this lack of activity, truckload lead times cannot be driven higher by congestion alone.

The only plausible explanation is that shippers, having been burned by supply chain mayhem in 2020-21, are acting with an abundance of caution. This theory has additional support by the fact that contract rates have not fallen as far or as fast as spot rates. Furthermore, truckload activity was unusually high in Q1 2022, indicating proactive measures to front-load freight in a traditionally quiet season rather than noisily competing for capacity in the busy spring.

Yet capacity is already starting to thin: Q1 was marred by news of bankruptcies among small, large and midsize carriers alike. As capacity continues to exit the marketplace, the balance between carriers' supply and shippers' demand will increasingly be restored. Tighter capacity will eventually justify the heightened caution seen in today's market. Even still, spot markets are unlikely to match their growth of 2020-21 in the coming years; truckload lead times will therefore not be thrown into complete disarray anytime soon.

Are you being serviced?

According to data from the Department of Transportation, railroads move only 4.5% of U.S. freight by value but account for 27.5% of domestic freight ton-miles. Historically, rail has been the mode of transportation that offers the greatest cost-effectiveness and efficiency. Yet rail's cost-effectiveness and efficiency have both been compromised in recent years: For example, excessive dwell times at the origin doubled lead times between the Midwest and West Coast for grain shippers, costing the grain industry revenue losses and additional freight expenses of an estimated \$100 million in the first quarter of 2022 alone.

Many fingers have been pointed at the rail industry's adoption of precision scheduled railroading. PSR, which was pioneered at Canadian National in the early 2000s, quickly became the default playbook for most Class I railroads. At its fundamental level, PSR implies longer and heavier trains, fewer locomotives and lower head counts — all of which translate to lower operating ratios for the rail carriers. When it was introduced, PSR was advertised for its improvements to customer service. In actuality, PSR changed the nature of train scheduling: Rather than have rail cars wait at customer facilities to be loaded at their convenience, trains arrive and depart on fixed schedules by which customers must now abide.

Just as railroads were poised for rapid, pandemic-fueled growth in volumes, congestion at container ports spilled onto the rails and wrought havoc on the industry. Containers, used by intermodal shippers and agricultural exporters alike, were tied up in key intermodal markets like Chicago and Los Angeles. Dwell times at rail terminals, which were declining prior to the pandemic, grew 5% in 2021 against 2019, averaging more than 21 hours. Wait times for truck drivers at intermodal ramps also rose 6% over the same period, averaging two hours in 2021.

Not only were these containers trapped in congested terminals and intermodal ramps, but ocean carriers were desperate to get them back to Asia as soon as possible. Stimulus checks endowed consumers with an abundance of money for discretionary purchases and, as most services like restaurants had been shuttered by pandemic-induced lockdowns, e-commerce activity surged. Moving containerized imports was thus highly incentivized (and profitable). Ocean carriers wanted immediate turnarounds of containers once they reached their inland destinations, canceling backhaul agricultural shipments of grain, soybeans and almonds, to name but a few affected crops. In fairness, ocean carriers' cancellation of these shipments was not the fault of railroads, but it did add to shippers' growing discontent with deteriorating rail service.

Over the past few years, the STB has begun to take a more active role in addressing shippers' complaints with regulatory policies. Perhaps the sharpest criticism that the STB had of the industry concerned the PSR-driven reduction in headcount, which shippers, labor unions and the STB alike claim has caused a collapse in rail service. Per STB data, Class I railroads cut their

workforces by 29,000 positions between January 2016 and February 2020. Thus, as STB Chair Martin Oberman argued, “When railroads try to excuse their failures by pointing to labor shortages at other businesses, those other businesses did not enter the pandemic having stripped themselves of nearly 20% of the workforce in recent years.”

What have been the greatest repercussions of this reduced headcount? Trains have slowed noticeably: Against an average of 31.6 mph in 2020, intermodal train speeds fell 3% in 2021 and 6% in '22, dipping to 27.8 mph at the height of the rail service meltdown in May of the latter year. Another consequence has been the frequent issuance of embargoes, which are temporary restrictions of rail traffic due to weather or congestion. In 2017, prior to its adoption of PSR initiatives, Union Pacific issued a total of 27 embargoes, 19% of which were caused by congestion. In the first three quarters of 2022 alone, the number of embargoes skyrocketed to 886, an overwhelming 98% of which were caused by congestion.

To summarize, this combination of PSR initiatives — including reduction in employees, fewer locomotives, longer trains, closures of classification yards and of unprofitable lanes — coupled with pandemic-induced disruptions, like intermodal container unavailability, brought about not only ballooning lead times but also a persistent uncertainty of whether a shipment would even make it onto the rails.

That uncertainty only intensified when labor disputes came to a head in late 2022. Two years prior, rail workers' unions and railroads began to renegotiate labor contracts. Unfortunately, these negotiations stalled and so the unions filed requests for a federal mediation board to arbitrate in early 2022. As neither side reached an agreeable compromise, the board ceased its efforts in June 2022. The workers were then poised to begin a strike in September, which would have cost the U.S. roughly \$2 billion in lost economic output per day, per analyst estimates.

While any strike was ultimately forestalled by executive fiat, shippers were understandably anxious about potential service disruptions being added to those that had become a matter of course. But while rail shippers were relieved to see that the strike was averted, some were discontent with the resolution. Sweeping hiring initiatives, they argued, are still necessary to improve rail service and lead times.

Looking to the future, it is probable that carriers will be forced to improve service by dialing back some of their PSR initiatives. Two of the likeliest candidates for reform are train lengths and train crew sizes — both of which were fingered for the derailment of a Norfolk Southern freight train in East Palatine, Ohio, this past February.

Fragile labor relations bode ill for industry's future

After their transportation spend spiraled out of control over the past few years, it would be easy to assume that shippers want to seek retribution. Regardless of mode, shippers are well primed to take advantage of their current pricing power and to recoup some of their previous losses. Although the cost of transportation has broadly fallen, shippers do not appear to be twisting the knife by wrenching rates any lower than they were before the pandemic.

This reluctance betrays lingering — yet justified — anxieties about supply chain resilience. Geopolitical instability has reignited a desire for manufacturers to either reshore or nearshore

their base of operations, wary of output disruptions from international sanctions and the fickle policies of foreign governments. The volatile cost of crude oil and distillate fuels is a casualty of this instability, sapping consumers' demand for discretionary purchases while keeping upward pressure on transportation costs.

Labor insecurity in the transportation sector is also a concern, particularly as the labor market continues to be the sole bright spot in a weakening economy. Though the most recent threat of a rail strike was narrowly avoided late last year, rail unions are set to begin another round of nationwide collective bargaining in January 2024.

A DOT proposal, set to take effect this summer, could reclassify owner-operators under lease agreements with established carriers as employees rather than independent contractors. This distinction, because of the requisite provisions that must be allotted to employees such as health care benefits and sick leave, has important implications for truckload transportation costs and the availability of capacity: Since employees are more expensive than contractors, the hiring process of drivers will become subject to more scrupulous decision-making.

With the above hazards and the turbulence of the past three years both in mind, it makes sense for shippers to brace for higher lead times and unforeseen delays. Yet there is little to suggest that — in the coming 18 months — ocean and air transit times will skyrocket, that congestion will rear its head at ports and cargo terminals, that rail service will deteriorate any further from its recent lows or that nationwide demand for truckload capacity will drastically exceed its current abundance.

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