Becoming Location-Aware: State of Art and Science for End-to-End Supply Chain Visibility

Summary Report

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Executive Summary

On May 12, 2015, MIT's Center for Transportation & Logistics (MIT CTL) convened an invitation-only group of shippers, carriers, third-party logistics providers, and technology vendors to explore issues and approaches for achieving end-to-end supply chain visibility. Prior to the roundtable, MIT CTL conducted a survey of supply chain professionals, focusing on visibility issues. After a discussion of the survey results, the group delved into deeper discussions of data standards, examples of visibility projects, and business case issues.

Both the survey and the group reported many problems in data availability, timeliness, and quality. In particular, transshipment and ocean freight in South America were reported to be the most opaque. Shippers were especially upset when containers were "rolled" without any notice, i.e. the boxes did not make it onto the assigned vessel. Furthermore, propagation delays in data streams led to EDI messages taking days to reach the shipper. Supplementary data such as temperature, humidity, and shock were even harder to manage due to a lack of standards. Participants noted that GPS tracking tags hold some promise for improving visibility but are costly and don't provide the contextual data needed to understand why a shipment is where it is or what the local transportation service provider plans to do with the shipment.

The topic of detecting and managing exceptions, such as delayed shipments, arose throughout the day. Yet even the definition of "on-time" was context specific. Shippers may have multiple intermediate milestones that lead to the ultimate milestone of delivery to the customer or on-shelf availability. As much as everyone seeks more and more information, those additional data volumes don't add value unless the added information drives adaptive actions. That implies bringing together data on the shipment as well as knowledge of the operational options for adapting to an exception. The group debated who needs to know the thresholds for exceptions: should carriers simply stream the raw data to shippers for them to detect any problems, or should shippers tell carriers about each shipment's thresholds for acceptable and unacceptable ETAs? At issue was whether shippers wanted transportation as a black box service in which freight forwarders or carriers took full responsibility for door-to-door movement within a given timeframe.

The group identified three areas in which visibility contributes value. First, visibility helps companies rectify and avoid exceptions, thereby reducing expedited transportation costs and avoiding compliance issues, especially for goods requiring more careful handling. Second, accumulated visibility data provides value by enabling long-term improvements such as reducing inventories, using less-costly modes, and supporting new business models. Third, short-term visibility projects can uncover correctable flaws in the processes and operations of the company, suppliers, customers, carriers, and other service partners. Although visibility clearly has value, especially for high-value cargo, the specifics of whether shippers will pay enough for visibility to justify investments by shippers and service providers to collect the data remains unknown. Technology is getting cheaper, but will it get cheap enough to warrant installation of tracking devices on millions of ocean transportation assets?

Although the roundtable focused on issues within ocean freight, many participants noted the key role of upstream and downstream influences on variability and exceptions during ocean freight activities. Outside sources of variability included inaccurate forecasts, undelivered paperwork, or problems in trade finance that can delay freight. Getting the benefits of visibility requires systemic solutions, which is why both shippers and carriers advocated for collaboration to share value, such as by sharing forecasts that both decrease the chance that a shipper's load gets rolled and increase the utilization for the carrier.

The future will only bring more data and higher expectations for data-driven performance. Future systems might track the cargo -- rather than just the container -- to create a more business-relevant form of visibility. Predictive systems could help companies anticipate exceptions or disruptions rather than wait for an alert that something has happened. Better tools could help business users quickly and flexibly define how exceptions should be handled. Overall, companies can't manage what they can't see, which makes visibility a key element for improving supply chain performance. And once companies can see more, they can find even more opportunities to improve operations and add value.

1. Data, Data Everywhere, but We Don't Know What to Think

The growing volume of data in supply chains holds out the promise of improved visibility, but the desired level of visibility is not there yet. RFID was going to solve everything, but it hasn't. Seeing all the data is not the same as having a clear view of one's freight -- sometimes the data can actually obscure problems. Gaps, inaccuracies, and delays in getting data can mislead managers and delay necessary interventions.

1.1. Where's My Freight?

In an ideal world, real-time location data would be immediately translated into information for action, but that ideal has not yet happened. Track and trace functionality is evolving through stages of:

1. manual calling the carrier;
2. websites where shippers can check recent status;
3. real-time information pushed to shippers;
4. event management systems that automatically trigger actions based on real-time data.

The roundtable conversations and MIT survey results suggest that stage 4 has not been reached, and many systems still require manual checking or updating of freight status.

Roundtable participants discussed the use of **GPS tags on freight**. These active RFID tags have the potential to provide independent, real-time updates on the location and motion of shipments, regardless of the maturity of the IT systems of local carriers, ports, and terminal operators. Yet the non-trivial costs of these devices mean their adoption depends on making a strong business case, which has not been achieved except in the case of very sensitive and high-value shipments.

In the first session and throughout the day, MIT CTL presented **preliminary results of its April 2015 survey** of supply chain professionals on the state of the practice of how shippers are obtaining end-to-end visibility of their ocean bound products. The survey asked questions on: regional variations in real-time visibility; visibility onto various events along the in-transit supply chain; the availability, accuracy, and timeliness of data; the providers and communications channels used; technologies being used; and the features and benefits of supply chain visibility. Overall, survey respondents marked an overall satisfaction score of only 2.66 out of 5, making them less than "moderately satisfied." A survey of the roundtable participants on the same questions found somewhat higher satisfaction scores, but most are still only moderately satisfied or worse. Many of the survey questions subdivided the answers among seven events or segments in a port-to-port ocean freight movement: gate in, loaded on board, vessel depart, status of assets in transit, vessel arrive, container discharge, and gate out. Discussions during the roundtable expanded this definition to include other related events, such as the truck or rail shipments to and from the port.

Both the survey and the participants alluded to **"black holes" in ocean freight**, which are stages or regions in which the shipper loses visibility into its shipments. South America, as a region, and the smaller ports of Asia offered poorer visibility than other regions. Smaller carriers as well as ports and terminals in these places were less sophisticated in terms of data availability and transmission. Customs and government-related processes in ports also posed a problem for visibility and variability. In addition, some shipper participants suspected that lingering congestion in the wake of the West Coast labor issues had worsened performance on those lanes.

The experiences of several shippers pointed to **transshipment as a major problem**, especially in Asia and South America. Companies lose visibility when smaller, regional ocean carriers handle the container for first-leg/last-leg movements. Moreover, the infrequency of feeder ship sailings might mean a three-week delay if the container misses its intended sailing. One shipper generally avoids transshipment, even if that means paying more for a direct route. The company's planners study trade-offs in savings versus carrier performance and transit time compliance.

1.2. Data Issues

The Holy Grail is a single version of the truth for everyone to work off from, but achieving that is difficult. Both the survey and the roundtable considered the issues of the **availability, accuracy, and timeliness of data**. On average, the survey found that shippers only get notifications of delays about half the time, and the status updates that they do get are often delayed by a day or more. Batching of EDI messages and the fragmented nature of the in-transit supply chain mean that messages can be further delayed or duplicated. Supplementary data, such as temperature data, are even more

problematic because EDI does not provide a standardized way of transmitting that type of information. The stories that roundtable participants shared helped to explain why data quality can be so low for ocean freight.

Message timeliness was a major issue for both survey respondents and roundtable participants. The survey respondents reported 12-hour or worse delays more than 50% of the time for all seven segments of ocean freight movement. One retailer holds ocean carriers accountable for timely data. The retailer evaluates carriers on the timeliness of messages in buckets of 0-4 hours, 4-12, 12-24, 24-48, or never received. The company directly ties payments to data delivery -- if the company doesn't get an EDI 214 (Motor Carrier Shipment Status Message) or EDI 312 (Ocean Carrier Arrival Notice), then it won't pay the carrier.

The group uncovered **several reasons why messages get delayed**. EDI is the lowest common denominator, and carriers typically don't submit EDI data in real time, a carrier said. A 3PL monitors EDI 315s (Ocean Carrier Status Detail), which it typically gets within six hours. An EDI 315 can convey details for one status event associated with one shipment or container, or it can provide details associated with many shipments or containers. Other participants noted that delays and duplications can occur as different parties in the transportation chain relay messages to the shipper. The shipper might get a message directly from the carrier but then gets a duplicate message from the freight forwarder some days later. The last ETA that a shipper gets may not be the most recent or most accurate if that message bounced around before going to the shipper. In addition, further delays occur in getting that data into the shipper's ERP system, or there are internal enterprise delays due to batch jobs in different parts of the organization. In some cases, a shipper may not get the EDI message until four days after the delay happens -- thus the notification of the delay is itself delayed, a representative of a carrier portal said. Even the use of shipment-level GPS trackers doesn't guarantee timely updates. If the tracking tag is surrounded by metal, it may be unable to provide an accurate fix or fail to connect to an uplink for sending its data. In such cases, the device buffers the data it gets and uploads it as soon as it can, but that might not be until the end of the journey, when the container is offloaded and a clear signal is available.

Participants also worried about **data quality issues**. For example, a manufacturer has experienced a situation in which two different containers booked by the same shipping line were given different ETAs. Similarly, a beverage manufacturer wondered which data format supply chains were using, whether it was still EDI or some other format. They were particularly concerned about reliability, and weren't sure they were getting the right data. Finally, a retailer suggested that financial data could be used to track the process backwards, particularly if there were data integrity problems. Another retailer reported using invoice payment data if data integrity was poor.

Sometimes shippers don't receive any data, because **carriers and service providers have decided not to share real-time data**. For example, when Qualcomm tracking systems came to the trucking industry, some carriers refused to share the data because they did not want shippers to worry about late trucks that were still able to make up the lost time in transit. Some carriers see real-time data as a bit like Big Brother. Legal concerns can also affect cooperation on visibility efforts. A pharmaceutical company has its own temperature sensors on its cargo, but if one fails, the company asks the ocean carrier to validate the reading. But ocean carriers are hesitant to provide these data because doing so would expose them to liability issues.

In addition to location data, some shippers -- particularly in the life sciences and food industries -- want **to monitor the temperature and other environmental variables for their shipments**. Supplementary data could include humidity, shock, and the opening of the container. A pharmaceutical company, for example, uses live real-time GPS to track the temperature and humidity of its shipments. These are vital readings due to spoilage issues.

Managing these dimensions of visibility was problematic. EDI can transmit supplementary data, but the **limitation is one of standards, not technology**, a representative from an ocean carrier portal said. For example, transponder data that is typically used to communicate that a shipment is running slower to the next location could be blended with temperature streaming data. But, shippers consider EDI to be too slow. Moreover, although EDI allows the addition of supplementary data, it's not standardized.

A retailer said that its merchandize group (the buyers) were primarily interested in knowing where their goods were and whether those goods would be late. Currently, the retailer relies heavily on manual work processes using Excel spreadsheets, not dashboards. Streamlining the process of data reporting across divisions was a goal. The sophistication of data and reporting from 3PLs was of especial interest. The survey confirmed that **manual methods were the most prevalent channel for getting visibility data**.

1.3. Visibility Data Design: Inundation vs. Elucidation

"The trend of having more visibility isn't going away," a manufacturer said. Yet the biggest challenge is to find the right types and volumes of data that enable action, a 3PL added. Participants debated the right amount of transparency and the **delicate balance between too much and too little information**. Excessive volumes of data come with excessive costs in the areas of: IT implementation of systems to present all that data, operational costs of collecting all that extra data, and labor overhead costs in the distractions of superfluous data. At the roundtable, both shippers and service providers seemed to be fighting the natural human tendency for business users or customers to always ask for more data and more kinds of data, even if this resulted in data overload and consequently less effective outcomes.

Ocean ships commonly ping the satellite with their location every 10 to 15 minutes, but that **the shipper does not necessarily get value from seeing every real-time update**. The value depends on the time-criticality of actions that might be triggered by the data. Some business users like to see updates every four hours, while others only need a daily report. Granularity varies by shipment type: for crucial cold-chain shipments, 15-minute temperature data might be warranted. For critical, climate-controlled shipments, EDI is too slow, a pharmaceutical maker said. Part of the design process involves finding the right frequency of data collection and reporting processes for different shipment types and for different business users. Companies face a tradeoff between the cost of an occasional delay in responding to an issue versus tracking everything in real-time which is resource intensive.. An ocean carrier wondered if anyone might be interested in a pull-based system that companies could interrogate when they want, instead of the current practice of pushing streams of updates to users. Only two participants indicated an interest, which seems to indicate that companies want to receive the data as it comes in.

The growing volumes of raw sensor data lead some companies to want **more selective and meaningful subsets of that data**. For example, an electronics manufacturer said it manages 40,000 shipments a month but would prefer not to have to track every vessel that's carrying one of the shipments somewhere in the world. Another manufacturer noted that it wasn't even using all the data it already receives. A beverage maker said that his company may be getting information from the carrier about exceptions, but is the company aware of the information? Is the company able to see that one exception data point among the full stream of data? Yet a retailer had the opposite opinion in wanting the full data stream as part of living in the era of big data. "I often have questions I don't have answers for, but if there is something in the data maybe I can get the answer. I'm widening the data and casting out the fishing rod," the retailer said.

Regardless of the granularity of the data, companies wondered **where to consolidate all the data streams**. "It's impossible to get it into our ERP system, so where do you put it?" asked a manufacturer. One retailer is starting an effort with a third-party, cloud-based supply chain platform provider that it thinks can handle all the external data sources and help the retailer spot the exceptions. Another retailer agreed that third parties do a good job of aggregating the data, providing data security, and other tasks so shippers don't need to do those tasks themselves. That retailer reported successfully using a third-party data blending and analytics platform that can handle petabytes of information. A third retailer reported trying to manage EDI messages within a centralized PO management system, but the system was too slow to offer real-time.

Portals represent another strategy for **gaining visibility through the data aggregation and tracking services that portal companies can provide**. Rather than every shipper establishing individual IT links with every carrier or service provider, each side can link with a portal. Even if the shipper does not book through the portal, the portal can help aggregate shipment data by merging shipper-provided information with portal-managed vessel tracking. Depending on the mode, about 1/5 to 1/3 of those surveyed reported getting visibility through third-party portals. Portals were the second-most common channel for getting visibility on shipments, behind manual methods. Portals are expanding the scope of their systems to including tracking of transshipment and rail activity, a portal provider said.

The roundtable attendees discussed the issue of data security. **Visibility is a double-edged sword** in that thieves, competitors, terrorists, or unfriendly governments can use ocean shipping data for nefarious purposes. An added challenge is that of the cross-leakage of proprietary and public data -- the vessel location could be easily found on public tracking sites. One European shipper was concerned about all of its sensitive shipment information being in a portal or cloud server. Its corporate headquarters has mandated that all of its data be hosted only in the EU, which is curtailing that company's efforts to use US software providers.

Service providers were **taking action to ensure security**. A carrier said that it gets requests from large companies about data security and data integrity. The companies want certifications. A logistics company said that it is investing in tighter

security accreditation. Portals require the shipper's authorization before accepting a carrier's data on that shipper. And when shippers share forecast data, they do it under NDA (non-disclosure agreements). But the issue of restricting a company's data to one region appeared very difficult to achieve.

2. From Data to Action

Business users tend to have "I need a report" syndrome and ask for more columns in every spreadsheet than they can really use. "Customers shop for capabilities because think they need it," a 3PL said. Companies say they want information, but the key question to ask is, "If you have that information, what activity will it elicit?" If getting more information doesn't imply getting improved performance, the information is not adding value. "A certain amount of visibility seems to be table stakes, but there's question of whether taking it one step further offers a return," a 3PL said.

A shipper said that visibility offered no value if it didn't reduce variability. Some participants worried that improved supply chain visibility just let them see that something bad was happening sooner, but with no way to stop or mitigate the event. If the temperature of a reefer container goes out of range in the middle of the ocean, there's not much that can be done. Much of the discussion concerned the actions companies take to handle exceptions, such as when a shipment becomes delayed. A key part of turning data into action is in realizing that **location data by itself is not sufficient**.

2.1. Context Matters

In isolation, raw data about the location and movement of a container does not mean very much. Converting raw visibility data into useful information requires knowing the context. Participants mentioned **two categories of contextual information that are often lacking in the raw data and yet are crucial to making decisions** about that data. This includes the history that contributed to cause the event in the data and any expected future action to change the status of the shipment.

"I want to know why an exception exists so I can mitigate it," said one retailer. Whether a delay is caused by fog, typhoon, or a strike can have significant effects on the timing and variability of future progress of that shipment, as well as affecting the feasible actions that the carrier, freight forwarder, or shipper might take to mitigate the situation. A second element of context that is missing from current raw data streams is any planned actions by the carrier or service provider. A GPS tracking tag can tell the shipper that its container is sitting somewhere but not why it is sitting there or when it is going to move. Unfortunately, EDI isn't the best tool for providing that "what the carrier is doing about it" message, a portal provider added.

Providing context on the shipper's side is also important, such as the **transportation requirements for the shipment in terms of cost, speed, and reliability**. One retailer claimed that for any shipment you could only expect two of the three primary performance objectives: cheap, fast, and reliable. As a result, they ship raw bulk commodities via cheaper transportation arrangements and ship items supporting speed-to-market initiatives via faster arrangements. In both cases, the company wants visibility onto the shipment, but only with its speed-to-market shipments does it take action if there is a delay. The shipper's context includes variables such as local inventories of the shipped goods, flexibility of the manufacturing operation to change the schedule if particular raw materials are delayed, or the end-customer's situation. This contextual data affects what the company can do if there's an exception.

2.2. Managing Exceptions

The survey found that "exception alerts" were by far the highest-rated (4.5 out of 5) visibility feature. Nearly two thirds of respondents (65%) said exception alerts were extremely important. Moreover, "event tracking" came in as the second most important feature, with a rating of 4.1. As one retailer said, "We don't need to see that it's working -- we need to see if there are issues." A 3PL argued that companies need to manage by exception but instead get a firehose of data. Exception management dominated many the roundtable discussions.

One question implicit in exception management is the question of **who defines "on-time" and the tolerance or window for being late**. Some carriers tout 98% on-time performance, but that is because they remove the exceptions, a consumer products company said. In other cases, such as cross-docking, the definition of "on-time" falls in a narrow window. An early shipment is as bad as a late one. Leaving aside the issue of exactly how "on-time" is defined, the survey results found "on-time" delivery rates between 75% and 82%, depending on the lane. These numbers seemed much higher than the anecdotal on-time rates experienced by the roundtable members, which were as low as 60%.

Related to the complex definition of "on-time" are the **multiple intermediate milestones in ocean shipping**. These milestones set expectations for the timing of intermediate events, such as when the supplier sends the shipment or when the shipment is expected to arrive at the destination port. A shipment could be "late" in arriving at the origin port, "on

time" at departure, "on time" at the destination port, "late" in being discharged, but then "on time" to the final destination. To some extent, only the last milestone really matters. For two of the retailers, the ultimate milestone is having the goods on store shelves on time for the intended season, promotion, or to avoid a stock out. Similarly, manufacturers want to avoid a production line going down due to a lack of parts.

Defining the other milestones comes down to pain thresholds in terms of managing transportation or other contingencies after that date, said one retailer. The milestones are a function of the known days from origin to port to port to shelf. **Precise KPIs help a company manage where there's an accordion of flexibility** (e.g., team-driving the ground portion to catch up) and where the times are static (e.g., the port-to-port time of the ocean vessel). Another retailer saw lower-tier milestones as diagnostic information.

Some companies faced frustrating and repeated problems in which **containers got rolled but the company did not know that the container was not on the ship**. In some cases, no one sent a message that the container was not loaded; in other cases, the message was buried in a bunch of other status messages. "Our container gets bumped and we don't know it until week later," a manufacturer said. "The EDI message can't kick to you until it exists," a portal provider added. The MIT survey confirmed that 20% or more of respondents say they "never" have visibility on such events as gate in, loaded on board, in transit status, container discharge, and gate out. This issue of missing information led one retailer to define two levels of exceptions. First, the status of the shipment becomes yellow if the company has not received appropriate status data at the time of an expected milestone event. Second, the status goes red if the company gets data that says there is a delay.

The discussions about "on time" milestones and thresholds sparked a debate about the roles and responsibility of the players. In particular, **carriers argued that they needed to understand more about shippers' business rules**. An ocean carrier suggested that the data and rules need to sit with carriers -- carriers have to enrich the EDI messages with context and actions but need to understand the business in order to be able to do that. If carriers are to send messages highlighting exceptions in ETA, temperature, or other variables, they need to know the shipper's rules for those exceptions. A trucking company said, "My driver needs to know the standard of care for this customer and for this type of shipment." Carriers also have the best understanding of the context of transportation events, such as whether a delay is due to a damaged bridge, congestion, or a storm, because these facts affect how exceptions are handled.

Yet the **shippers weren't sure that this sharing of the rules with the carriers was desirable or even feasible**. Some companies ship many types of freight and have many business units, which implied very fragmented definitions. "We have different thresholds for every business, so what is "late" for one business isn't late for another -- carriers wouldn't know that one business needs it within two hours and another can tolerate three days," said a manufacturer.. Shippers might prefer to simply get the raw visibility data on the status of the shipment as well as other data on how that shipment fits into the company's plans. The shippers could then consolidate the data themselves. Portal companies could aggregate the information, but some shippers wanted the information in their own business systems.

Ultimately, it comes down to "who owns risk mitigation" in ocean freight, a manufacturer said. To the extent that shippers want service providers to "manage our business for us," then those **service providers need a deep understanding of the business**. One 3PL presented a view of transportation as a black box with 3PLs, freight forwarders, or carriers taking full responsibility for door-to-door movement within a given time frame. The shipper may only care when the shipment will arrive and not how it gets there. The modes and routing would be left to the service provider to manage. Within that kind of service arrangement, the raw visibility data does not mean much to the shipper, and the shipper might only need event data on true exceptions.

One manufacturer uses a **four-step process for gradually converting manual exceptions into automated processes**. First, it monitors process performance for problems. Second, it creates alerts for common problems. Third, over time, it codifies its responses to an exception into a recommendation. Fourth, if the recommendation is subsequently and successfully used enough, the manufacturer automates it.

The discussions about managing exceptions raised the issue of **true automation vs. decision support**. Given the dynamic and messy nature of global transportation systems, the rules for a decision may never cover every contingency. Instead of hands-off automation, a company might use decision support that gives the planner or dispatcher a recommendation. The rules might work 95% of the time, but a skilled employee can find a better solution the other 5% of the time. If the dispatcher is overruling the system too often, there's a problem with the dispatcher or the system. But if the dispatcher never overrules the system, the dispatcher is probably not doing his or her job.

The development of tools to define and manage exceptions faces challenges. Several participants struggle with **fragmented IT systems across multiple business units** or as a result of acquisitions. Multiple ERP systems or the independent IT initiatives in different business units complicate holistic supply chain visibility.

One participant cautioned that **"perfect" is the enemy of "good enough"** and advised thinking about what the business needs. For example, developing playbooks for common categories of exceptions such as the annual seasonal problem of fog in Shanghai might be more cost-effective than investing in an expensive, highly-optimized weather-forecasting system. According to a 3PL a key part of developing systems for visibility and events is in distilling things down to 5-10 elements that will trigger the phases of the process. When someone says, "I need this column," the first question should be, "What activity will it trigger?" to avoid having too many distracting pieces of data.

3. Turning Data into Dollars

Most participants were eager to develop a business case for ocean freight visibility. Shippers wanted to understand how visibility could drive meaningful changes in business performance. Carriers wanted to understand the value of collecting additional data for shippers. And the 3PLs and software providers wanted to understand what kinds of data, information, and services would be most valuable to their clients. Yet there was a vague sense that companies and business users were hungry for data but having trouble finding an ROI.

The discussions revealed **three very different categories of value**. The first was on-going visibility data used to make short-term tactical decisions such as managing exceptions on individual shipments. The second was in aggregating and analyzing ongoing visibility data to make longer-term decisions such as carrier choice, route design, or inventory levels. The third type was one-time visibility data to diagnose internal or external supply chain problems. These different applications called for somewhat different data collection strategies.

3.1. The Value of Visibility in Tactical Operations

Performance improvements and cost reductions were the two highest-rated benefits of visibility, according to the MIT survey. One value of visibility is in more effectively recovering from exceptions to reduce stock-outs or other service failures. Better handling of each shipment could improve service, reduce expediting, and improve compliance with regulations.

In the survey, **reduced transportation costs were the highest-rated cost reduction benefit of visibility**. Some shippers found value by being able to do less expediting. Currently, two shippers expedite from rail to truck when they do not have visibility on rail and cannot afford t to cause a stock-out at a customer site. So, they routinely expedite a lane due to lack of visibility on that rail route. Indeed, one shipper was duplicating transportation cost due to lack of visibility. In addition to the transportation cost reduction, visibility would also accelerate the smooth flow of freight by reducing the delay in tendering loads.

Participants in the pharmaceuticals and chemicals businesses suggested that visibility could reduce the costs of shipping products that require controlled chain of custody and controlled shipping conditions. These included high-value goods, controlled substances, hazardous goods, and defense technology shipments. Better visibility could **reduce the chance of spoilage, tampering, and theft, which would reduce insurance premiums** for covering sensitive freight. Visibility would improve conformance with GMP (Good Manufacturing Practices) and GDP (Good Distribution Practice) for food and pharmaceutical products. This has the potential to save very large amounts of money on transportation because firms could switch freight from air to ocean if ocean freight were more controlled.

Visibility would also **reduce the overhead costs in tracking down inventory and arrival dates** on behalf of internal or external freight customers. This includes reducing the related costs of reporting on status across functions or divisions in the organization. Visibility would enable more accurate invoicing and payables of charges such as demurrage and detention based on accurate data of the shipment's movement.

Better visibility in terms of more accurate data on the contents of shipments and the cargo loaded onto vessels could also **improve compliance with increasingly stringent customs regulations**. In particular, the U.S. "10+2" rules on Importer Security Filing (ISF) require transmission of documentation 24 hours prior to loading U.S.-bound freight on a vessel at port of origin. Although the requirement was originally enacted in 2009, the U.S. has given companies years to implement the requirements. Enforcement might now begin, and shippers that do not comply can face a $5000 violation penalty from Customs & Border Protection. Better visibility onto freight coming to and being handled at the port of origin would ensure that companies know what is going to go on the ship in time to meet the filing deadline and reduce the chance of having to pay penalties.

In addition to reducing the chances of stiff penalties, better compliance through better visibility **reduces the chance of a secondary inspection from 1 in 100 to 1 in 2000**. A technology provider said that automobile manufacturers who import from overseas find value in that reduction because they have very expensive assembly lines that could be shut down if a secondary inspection had to be done. Some companies are also looking at C-TPAT (Customs-Trade Partnership Against Terrorism) certification, which could improve the security of their supply chains and give them more favorable status where inspections and delays are concerned.

3.2. The Value of Visibility for Long-Term Change

For supply chains that are working 99.5% of the time, paying $500,000 for a system that would email exception alerts on the final 0.5% might be cost prohibitive, said a technology provider. The lower the rate of exceptions, the greater the required savings on each exception needed to justify investing in visibility. But instead of focusing on catching and correcting problems, **there might be greater value in improving the performance of the 99% of shipments that don't generate exceptions**.

Toward this end, aggregating and analyzing supply chain visibility data can provide value through tuning the supply chain. This involves accumulating long-running data on carriers, routes, lanes, and the related in-transit operations along the way. Aggregated visibility data would enable better supply chain design, freight allocation, and inventory policy decisions. Indeed, internalizing visibility would enable strategic change.

Reducing safety stock was mentioned as a way to find value in visibility. A consumer products company tracks its end-to-end supply chain because it commits a delivery date to its customers. On a particular trade lane, the end-to-end committed transit time is 50 days, and the company expects variation of 2-3 days but can experience variation of 12 days. If it could remove some of that variation, the company could reduce its inventory levels on that lane substantially. But, many companies fear reducing their safety stock in case they guess wrong.

An MIT study of slow-steaming found that companies did not increase inventories even though the in-transit times increased significantly. Instead, slow-steaming reduced transit time variability because carriers could make up the lost time of a late departure. In the long run, visibility can be used to reduce the variability of transit times. Visibility would also give companies **more confidence in their knowledge of levels of in-transit inventories so that they could reduce local inventories.**

Better visibility can also **add value for carriers through improvements in utilization**. Container ships routinely operate with 30% of their slots empty. Carriers want to reduce booking cancellation rates.. If carriers could operate with only 5% empty slots, they'd save 1/4 of vessels. Borrowing techniques from the airline industry could help. "If we could pack container ships the way airlines pack airplanes, utilization would improve," a manufacturer said. If containers could talk and use online check-in the way air travelers use online check-in, the carrier would have much better visibility on future utilization. Containers don't need legroom, the manufacturer added.

One company suggested that companies also focus on value driven by future sales. Rather than view visibility as a cost-reduction strategy, **visibility could be used to grow revenues**. Better visibility onto freight and commodities would help companies learn of opportunities to grow sales. "If you know it's out there, you can sell it," said a participant. Similarly, shippers might create innovative new business models built on widespread visibility, rather than simply optimizing the performance of the existing supply chain or business strategies. The value of visibility might be far larger than tweaking the rates of on-time deliveries or exceptions.

The group joked about "Uber" coming to ocean freight. All the horror stories of stranded freight and miscommunication made people wonder if a **new system could more easily match freight and carrier assets** the way Uber matches riders and drivers. Similarly, parcel delivery companies are starting to solve the problem of mis-deliveries by coordinating deliveries via mobile phone with recipients. If freight and carrier assets had iPhones, they could talk to each other and more effectively coordinate freight movement.

3.3. The Value of Visibility for Diagnosis

Several companies mentioned using visibility or tracking devices in short-term experiments or tests. "Visibility helps us understand our own dysfunctions, which are often internal," said a retailer. A 3PL did a visibility pilot test which has proven to be valuable because it showed areas where there was breaking down. Specifically, piloting a visibility solution for a month with one customer enabled that customer to gain diagnostic value in terms of where its process was defective, for example where a shipment of fresh produce sits on the dock for 48 hours in hot weather.

This **diagnostic application of visibility has much lower costs than full-time, full-scale visibility**. A small number of monitoring devices can be used to get a sample of the actual dwell times, delays, route deviations of freight, freight handling, and discrepancies between the actual versus reported locations of the shipments. This kind of diagnostic use can be a supplementary benefit of piloting supply chain visibility to assess its value. Even if the company decides not

to pursue full-scale implementation, the company will gain a better understanding of the root causes of variability and exceptions in the in-transit supply chain.

Ironically, the diagnostic value of visibility during a short-term project or pilot effort could erode the value of visibility in operational settings. If the short-term project helps the company fix the process, then the numbers of exceptions might drop significantly, which reduces the value of having visibility onto exceptions. The better the supply chain performs, the less value it gets from the visibility to catch and correct problems.

3.4. Information Wants to be Free, but Devices, Bandwidth, & Services are Expensive

If the value of visibility is not yet clear to shippers, then the business case for investments by carriers and service providers is not clear. That's especially true to the extent that the carriers are making most of the investments while shippers are earning most of the returns. Carriers and service providers at the roundtable were most concerned about **who was going to pay for the various proposed tracking devices, communications bandwidth, and IT systems needed to create real-time visibility**. A 3PL noted that the export community doesn't have much money and therefore relies on carriers to provide data. Would 3PLs have to pay for these data in the future?

Or, visibility might become table-stakes as shippers preferentially award contracts to carriers who can satisfy increased expectations for real-time visibility. Already, short sea shipping is losing freight volume to truck and rail, where people are willing to pay more for more visibility. **If visibility becomes a prerequisite for transportation providers, then the costs will be rolled into the base-rate charges.**

An ocean carrier mentioned that various kinds of information and special services are available, such as monitoring shipboard reefers, ensuring that equipment temperature gauges are functioning properly, and so forth. But, are customers willing to pay for the information, and if so, what is the price they feel is a fair return for the information? If shippers cannot put a figure on how much they are willing to pay for visibility, **service providers do not know what price point to target if they were to develop a solution**, a 3PL said. Estimating the ROI on visibility when available as a special service also implies trying to understand the rate of utilization of the service as a function of price. For example, one 3PL provides visibility at a cost of $30 per trip, but few companies have been willing to pay.

Roundtable participants differed in their levels of interest in these value-added visibility services. For one retailer, knowing that the freight was on the vessel was good enough. Yet other companies seemed to need much tighter oversight onto their most sensitive cargos. For example, an electronic tag for visibility makes sense on high-value reefer shipments. Similarly, some segments of the ocean freight chain might benefit from investments in visibility devices. For example, the WhereNet system in freight yards makes sense in terms of bandwidth, value of information, and managing a reasonable number of tracking devices.

People are working to make these devices much cheaper. A technology provider estimated that if the cost was $50 per device all in, it would be a viable product. At one level, the devices seem inexpensive as the basic silicon contained in the device is cheap, but then come the costs of batteries and certifications. The additional costs of communications via cell networks, international roaming, and SIM cards also pose a challenge. Added to the device and bandwidth costs are the costs and challenges of the reverse logistics of tracking devices if these devices are embedded in the cargo and follow it during transloading, deconsolidation, and so forth.

The **scale of supply chain systems makes implementation a major capital expense**. An ocean carrier explained that installing devices for tracking all of its boxes would cost hundreds of millions of dollars, plus the cost of maintaining and repositioning those devices. The carrier was not hearing a universal dollar figure of what shippers would be willing to pay for this service. For the carrier, the asset cost would be enormous. Nonetheless, having carriers install such devices would be cheaper than for shippers to do it. But, the value for shippers and carriers must be there.

For some shippers simply knowing that their cargo is on an ocean vessel is sufficient. The shippers depend on carriers doing their jobs. Once the vessel lands, the carrier hands it off to the terminal, so then the terminal needs to know where it is. RFID or GPS meets that need, but is it worth the expense to the network enterprise of tracking hundreds or thousands of containers to be able to find that one missing container that got rolled? The cost of adding $30 to each container may not make sense. On the other hand, where a network system might make sense is at a DC yard, for narrow bandwidth use. In that sense, tracking certain segments of the business that are prone to losing cargo may make financial sense.

4. A Broader View on Visibility

Improving supply chain visibility will help shippers to become more agile, said a manufacturer. Although the roundtable focused on ocean freight, shippers as well as carriers in the room saw visibility as part of a larger end-to-end system. Some of the problems that occur in ocean freight actually arise outside of the in-transit supply chain; upstream and downstream variability that impacts freight flows, for instance. A holistic view of the system and the interacting players can help minimize costs and maximize performance by fixing issues where they can be most easily corrected.

4.1. Systemic Problems Require Holistic Solutions

The deeper challenge with ocean freight visibility is that **there really is no "in-transit supply chain" as a coherent end-to-end entity**. An ocean carrier said that there are "many fragmented players, different technologies, lots of choices, and no single standard." The value of one carrier's investments in visibility may not be fully realized unless peer carriers (as well as upstream and downstream ground carriers) also invest in visibility and the management of variability. Visibility into only a fraction of a company's shipments for only a fraction of the journey prevents shippers from reducing safety stocks or implementing other kinds of changes that depend on ubiquitous visibility. Creating visibility and controlling variability entails adopting systemic solutions.

A key takeaway for one 3PL was that spending lots of money on supply chain visibility and devices can be difficult to justify owing to the lack of a clear ROI. End-to-end integration of data is expensive, and a solution such as real-time GPS might provide a better ROI. Similarly, **assessing the readiness of the entire supply chain was important**; if a company was not filing documents properly, then visibility was premature.

The International Organization for Standardization (ISO) can play a big part in standardizing supply chain systems, a technology provider said. ISO standards can help to achieve interoperability. To the extent that shippers reference standards such as the new ISO 18000-4 standard for active of RFID tags, it encourages the **development and procurement of standardized devices rather than proprietary solutions**.

Shippers want visibility into freight movements in transit, while carriers want visibility into future shipment flows. These forecasts help carriers to plan their use of assets. In turn, providing accurate forecasts and working with carriers helps a shipper become a customer of choice, according to a retailer. The company views a **good forecast as helping carriers ensure their long-term profitability**, which in turn helps the retailer during the annual ocean allocation process.

Carriers and shippers have **different forecast horizons**. For trucking, forecasts beyond four days don't provide added value to the carrier. For ocean carriers, their horizon is about six to eight weeks. A manufacturer shares a spectrum of forecasts with carriers that begins with its 52-week demand pattern to show the annual pattern of spikes. The manufacturer then provides a 13-week forecast followed by commitments two weeks out. It then tracks what was accepted and what was shipped. Not all shippers have such predictable freight volume patterns, however. One retailer has both predictable and unpredictable volumes; another company is working to understand their patterns of demand to help improve forecasting.

Some of the problems in the in-transit supply chain are caused, or exacerbated, by upstream milestones. For example, delays or issues in seasonal product development and procurement cycles can propagate downstream to the ocean transportation leg. If the goods are late to the factory gate or if the shipping schedule becomes compressed into a last-minute surge, it creates congestion and fragility for transportation. Another major source of delays occurs if the overnight air-express documents with the letters of credit don't arrive in time and the shipment can't be booked. Similarly, regulatory issues with documentation can also delay shipments. The point is that **other milestones, besides transportation, can impact ocean freight transit time** variability and reliability.

Cycle times for procuring ocean freight interact with seasons. A carrier noted that a shipper's RFP might come in while the carrier is in its winter schedule. The best the carrier can do at that point is to quote pro forma shipping times based on its current schedule. By the time the contract gets awarded and the shipper is sending containers to the carrier, the carrier may have switched to its spring schedule, which brings changes in frequencies of sailings, ports of call, and in-transit times. Analogous issues happen on the inland legs, too. Changes in the trucking fleet over time create changes in the actual-versus-quoted performance of intermodal moves.

In some cases, the **complex structure of the transportation industry can create misalignments of interests**. "If I can sell you airfreight, why fix the ocean problem?" wondered one manufacturer. As mentioned previously, carriers might be reticent in sharing data with a service provider who is also affiliated with or owned by a competing carrier. Cross-

ownership of modes, services, and technologies enables one company to create an integrated offering but might also create obstacles to greater systemic integration and visibility

4.2. Collaboration Unlocks End-to-End Value

Collaboration helps overcome misalignment of interests by sharing risks, costs, and value. "If my origin booking process creates a 15% variability, it impacts me, the terminal, and the ocean carrier," one retailer said. Working together to improve processes to reduce variability benefits all parties. Or perhaps the shipper could commit to bookings three weeks in advance instead of two weeks in advance, which would help the carrier manage its assets and costs. The incentives go both ways. To the extent that the shipper and carrier can collaborate, both come out ahead.

A carrier described joint value stream sessions that it held with a few companies. The companies entered into long-term mutual commitments and focused on specific issues rather than just broad problems. With those customers, the **carrier was able to reduce cancelled bookings from 30% to 5%**. That provided a lot of value to the carrier, who used future bookings to make better asset allocation decisions.

A retailer said that it **works with Class I railroads, even though it has no direct contractual relationship** with them. Yet the railroads move a lot of the retailer's freight through intermodal services that are managed by the retailer's freight forwarder. Having a dialogue with the railroads helps the retailer manage its relationships with freight forwarders and improve performance across the system.

A manufacturer noted that collaboration with carriers is better than just churning the carrier base. The manufacturer discovered that **half of the performance problems it was having with its carriers were caused by problems in their own systems**. Moreover, bringing a new carrier into the manufacturer's system is expensive due to the company's product handling requirements. A collaborative relationship works better than a combative relationship in improving the performance of the system.

All of the players affect each other's costs and performance levels. And all of the players have varying degrees of flexibility (or varying costs to implementing some contingency plan). If a ship is running late and the shipper can permit a one-day delay on the arrival, the carrier could save on fuel by slow steaming. Similarly, sometimes a supplier will go to great lengths to avoid a late shipment to a customer, but perhaps the customer would be able to reshuffle production schedules so that the delay would have no negative impact. What's painful for one player to fix might be easier for another player to remedy if only they could collaborate. Rather than spend inordinate amounts of money creating perfect, lock-step operations, **collaboration around these points of flexibility would reduce the total costs of exceptions without compromising the end goal** (e.g., a final milestone such as having goods on the shelf at the start of the holiday season).

5. Looking at the Future of Visibility

The last session of the day covered organizational issues associated with sustainability. The group discussed issues such as how to start sustainability efforts, what to focus on, and where within the organizational structure to manage these initiatives. Many of the discussions highlighted a shift toward integrating sustainability into the business and generating tangible benefits from that integration.

5.1. From Containers to Contents

In the end, **shippers care about the freight, not the container**. "Our customers want SKUs, quantities, and a specific product. So we have built tools that assess freight in motion," said a 3PL. To do this, the 3PL gets a carbon copy of the PO, which is generally good data because that's what the supplier or distributor will be using to assemble the order. If the PO changes, the supplier or shipper updates it. And when the order gets shipped, the 3PL knows which items on the PO are in the back of the truck.

Yet this shift to a more meaningful type of visibility creates a **data explosion as each shipment record expands into multiple records of the items being shipped**. Some participants were concerned about potential problems with this change due to data quality issues in the product catalog and master data. Fortunately, the 3PL that offers these data found that its customers underestimated the quality of their own master data. Shippers have made investments in mature processes to keep their master data updated and clean.

5.2. From Visibility to Control

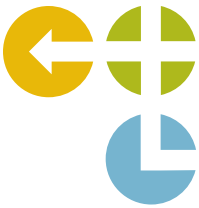
Future software technologies could improve, too. The dynamic nature of supply chains, visibility technologies, and business strategies imply that companies need to dynamically reconfigure systems for making the best use of visibility data. To do this, shippers are seeking **better tools for managing events and defining the business actions enabled by visibility**. In particular, companies are having trouble finding tools that make it easy for business users to configure thresholds for exceptions, define rules, and manage events. Ideally, a business user could readily tell the system, "I need to know about this event, and if it's in this particular lane and inventory is X, then take this action." If end users can't do it themselves, any change or update becomes an "IT project" that adds costs and delays. The result would be not unlike the IFTTT ("If This Then That") app for smartphones that lets phone users automate a wide variety of tasks.

5.3. From Reaction to Prediction

Many of the applications of visibility enable more timely and cost-effective reaction to supply chain events. But some companies are looking **beyond reaction to events and toward anticipation of events**. A food manufacturer is doing a pilot proof-of-concept for predicting potential exceptions and disruptions in order to manage them. The manufacturer has focused on integrating weather risk to predict disruptions in material flows and at facilities. The company can adjust the trigger points such that a snowstorm in Minnesota does not raise the same level of concern as a snowstorm in the South. The system can also help avoid disruptions by, for example, routing egg shipments around avian flu quarantine zones.

5.4. More Tall Poles as Far as the Eye Can See

Some participants wondered if better supply chain visibility will have limited value because it will only fix a specific set of problems.. A retailer countered by saying, "There's no end to exceptions. **As soon as you identify one root cause, you reveal the new next biggest problem**." For example, the invention of the vacuum cleaner was supposed to reduce the time people spent cleaning house, but instead it raised level of expected cleanliness. Similarly, better visibility and management of ocean transport lets companies run leaner, faster supply chains, which just makes them that much more sensitive to variation. With good clean data and collaboration, all of the players in the supply chain will be able to make ongoing improvements in costs and service levels.



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