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**An Investigation into Dysfunctionality within Intermodal Transportation with a Minor  
Focus on Refrigerated Containers**

**By:**

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**An Honors Thesis in partial fulfillment of the requirements for the degree Bachelor of  
Science in Organizational Leadership and Supply Chain Management**

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**May 14, 2022**

**Abstract**

This paper will contain a discourse regarding intermodal transportation, with a focus on refrigerated containers. It will also give insight into the current issues facing the intermodal market with a selection of suggestions on how to address them. The discourse will take factors such as cost, service, reliability, capacity, the characteristics of the different modes of transportation, and several other factors into consideration. This shall be accomplished through a qualitative interview series conducted with involved parties with different perspectives. Additionally, quantitative data gathered from industry and governmental resources will assist in the analysis. The output of this paper will be a greater sense of understanding of the limitations and current issues faced by intermodal transportation, gathered from different stakeholders along the value chain. The conclusion will summarize the findings as well as offer possible solutions. The intention is for this paper to be accessible and informative for individuals of varying degrees of education and as such it will contain some general information regarding intermodal transportation as a whole, offering insight to the uninformed and a refresher to those who are already involved in the industry.

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## Introduction

Transportation is the vital circulatory system of the modern world. Figuratively, it pumps the lifeblood of economic activity, primarily goods, throughout the far reaches of the globe. Those goods then can be transformed into more diverse products that fuel further economic activity and growth. This increased economic growth due to the influx of foreign goods allows for domestic production, employment, and further specialization into worthwhile economic ventures on both the individual and national levels. Without the connectivity transportation brings, Russian children couldn't play with Chinese toys, Brazilians couldn't enjoy beer made in Germany, and so on. It links distant corners of an otherwise huge world together through its many modes. Built upon getting goods and services from one point to another, society has grown tremendously from gains in specialization and efficiencies born of transportation's effect. Transportation is necessary for life as we know it to exist, it is the linchpin that binds together our highly mobile world. Specifically, intermodal transportation. We need it: more than we know.

Intermodal transportation began, in its current form, around the 1950s (IANA Factbook) with the introduction of the shipping container. The shipping container or "box" gave shippers a consistent format on which to base their standard processes. Previously, this manner of efficiency and consistency currently enjoyed by intermodal shippers was all but a pipedream. Their older methods relied on irregular and erratic containers in which to store products. With methods like this, no real economies of scale can be achieved. However, it changed when the international shipping container came about, giving many members of supply chains a unified format in which to ship their goods. Reliable, durable, and most importantly – standardized, the shipping container revolutionized intermodal transportation. Today these containers constitute approximately 60% of all seaborne trade (Placek, Martin), with a capacity of around 25 million TEUs (twenty-foot equivalent units) as of September 23, 2021. The introduction of shipping containers marked the beginning of intermodal as we know it today, the large ocean ships laden with thousands of TEUs, the port yards full of containers, and the offloading of those containers onto trucks, rail cars, and occasionally aircraft. These all became the easily recognizable signs of international and domestic intermodal activity, and more so the signs of a thriving economy in places like the United States of America, The European Union, and China. Many nations such as these have benefited from the trade that is facilitated by intermodal transportation. It is a valuable activity to those nations, and even more so to the individuals and businesses that benefit from it. Disruptions in the flow of goods through functions such as intermodal transportation are a matter of personal and national concern, evidenced by President Biden's plan to have port operators remain open 24 hours a day and 7 days a week to ease supply chain issues (Wilkie, Christina). These unilateral actions have become more common in the supply chain in light of the COVID-19 pandemic and the resulting conditions from its disruptions: which have been numerous to say the least.

Disruption has become almost commonplace since early 2020 when COVID became widespread (Center for Disease Control). From shipping delays to part shortages, few industries have not felt the sting of this pandemic. Intermodal is no exception here. It too has suffered under the virus. Due to the cooperative nature of intermodal transportation and the elevated number of involved parties, it has experienced a different kind of disruption than other modes. Where an over-the-road (OTR) shipment only has to worry about the functionality of a single truck, intermodal shipments are concerned with the functionality of ocean liners, trucks, aircraft,

ports, and so on. If anyone's partner suffers a significant delay or disruption, it has a cascading effect down the chain... akin to a relay race. This vulnerability has yet to be turned into a strength and as such, when significant pressure was applied, those vulnerabilities were exposed to the world at large during the pandemic. Supply chain, over-clogged ports, and a myriad of other logistical issues become a common headline – damaging the reputation of the supply chain industry and creating significant coverage of the issues experienced by logistics professionals. This is not something to desire. With the everyday citizen being familiar with the vulnerabilities within the industry and experiencing them when they visit their local supermarket, attempt to order any sophisticated electronic device, or secure gifts for Christmas, the supply chain as a whole missed an opportunity to exceed expectations in trying times. Intermodal missed this opportunity as well, and even more so due to the number of possible involved parties that could offer solutions through cross-functional teams and boundary-cutting processes. The potential to excel was had and was not capitalized on. In light of that, the inconsistencies, dysfunctionalities, and potential areas of improvement within intermodal transportation are worth investigating. The potential yields of correct identification and addressing are significant; combined with the number of involved parties, the addressing of these issues can affect many individuals within the value chain as they continue to grapple with the long-term effects on the supply chain of the pandemic.

Within the confines of this short paper, a domestic focus will be taken, and a minor focus on refrigerated containers. This is due to the ease at which first-hand information inside this part of the supply chain can be obtained. The structure of the paper shall be as follows: a characteristics overview of different modes of transportation as compared with intermodal transportation, followed by a literature review detailing different observations in the supply chain that pertain to intermodal transportation, followed by a central question and hypothesis, trailed by a short description of the methodology used in conducting the qualitative and quantitative research, then a review of the findings of this research, of which lead to the applications and conclusions of the research, and lastly a section featuring the sources that assisted in the construction of this paper.

### **Modal Characteristic Overview and Comparison**

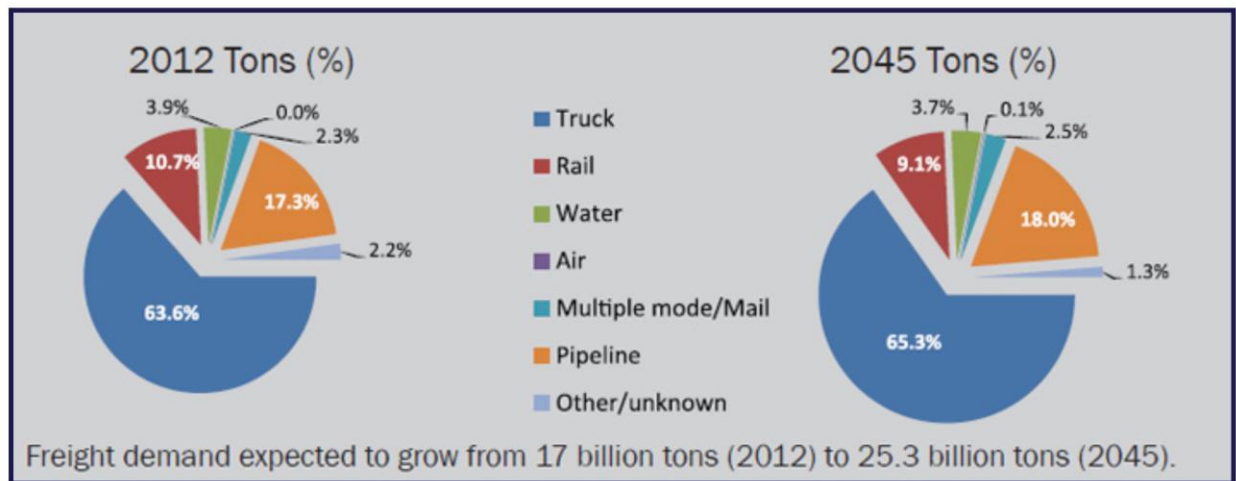
This short section will attempt to give a brief description of several modes of transportation that may be used within intermodal transportation so that effective analysis can be performed while ensuring all readers of this paper have a basic understanding of how the different modes function. This is not intended to be an in-depth description but rather one that gives a passing familiarity. The modes described are as follows: Water, Air, Over-The-Road (OTR), Rail, and Pipe. After a short description of what each mode is best suited for, a comparison shall be given about their usefulness in intermodal transportation.

1. Water: Freight is loaded onto waterborne vessels. The methods are bulk, break-bulk, containerized, and “RORO” or roll-on roll-off. Bulk loading is often used for large quantities of commodity goods such as coal, grains, ores, and other large bulky goods. Break-bulk is similar to bulk but more so for larger goods that are impractical to ship in containers. Containerized cargo utilizes the standardized international shipping container for a wide variety of goods. RORO is for objects such as vehicles. Characteristics of waterborne transportation are that it is slow, more inexpensive than other forms, is primarily used for international goods, and can be used domestically in

- large rivers. It lends itself to shipping large quantities of inexpensive goods over long distances. It is not suited for methods such as “Just-In-Time” inventory strategies or other time-sensitive approaches. It is also limited by the presence of maritime terminals to enable offloading.
2. Air: Freight is loaded into containers that are then stored in either a dedicated cargo aircraft or more commonly the underbelly of passenger aircraft. Often, time-sensitive or expensive objects per unit of weight such as flowers, electronic components, parcels, and jewels are the types of cargo an aircraft may carry. This mode is limited by the presence of airfields in which the aircraft can operate. For larger aircraft, a much larger terminal is required in processing all the freight contained. Per pound or cubic unit of volume, transporting freight via aircraft is expensive when compared to the other modes.
  3. OTR: Freight is loaded into, predominately, 53-foot containers on trucks. Those containers can have a variety of extra characteristics such as being refrigerated, dry, having partitions, being loaded by pallets, layers, cases, or in bulk objects. There are almost an unlimited number of ways to customize a load, like a single consumer of transportation choosing between utilizing Full Truck Loads (FTL) or Less-Than-Truckload (LTL) services. OTR freight offers the greatest amount of flexibility in most situations, able to go wherever there is pavement. It is the most popular mode (U.S. Bureau of Transportation Statistics) and that is due primarily to its ability to service almost any location at a competitive level of service and cost.
  4. Rail: Freight is loaded into cars that travel via the railways present around the United States. It can be loaded into flatbed cars, inside boxes with free moving cargo, but primarily it uses the TEU. It mirrors the characteristics of ocean freight by being best suited for the TEUs and bulkier cargo while moving relatively slowly when compared to other modes of transportation. For these reasons, it is best suited for bulky, commodity, lower-cost goods that can be stocked easily.
  5. Pipe: Unlike other modes, freight isn’t loaded in the conventional way here. Liquid cargo is pushed through various pipelines to reach preset destinations. It primarily is used to transport oil in its various forms. It is a limited mode but is very useful for its narrow selection of products.
  6. Intermodal: This mode represents a combination of any 2 of the other modes and thus is varied in its methods depending on the combination. The most common type involves initial transportation using a seafaring vessel bearing many TEUs, that are then transported to docks waiting at maritime ports via drayage, using chassis to assist in the process. From there, freight is often moved to distribution centers via OTR trucking or to an intermodal capable rail yard where the containers can be shipped long distances. Intermodal relies on significant coordination between parties and a seamless transition of product through several modes. It is known to be slower than modes such as OTR but comes, usually, at a lower cost.

The market share distribution of modal freight by Tonnage as of 2012 is pictured below (U.S. Bureau of Transportation Statistics). It shows that OTR trucking is by far the most utilized type of transportation, followed by pipeline, and then rail. It then predicts what the distribution of freight will be in 2045. There is to be a growth in the overall freight market while the distributions remain relatively similar. OTR, pipeline, and rail maintain their dominance.

### Modal Freight Share by Tonnage, 2012 and 2045



When comparing the different modes of transportation, it is clear why, given current consumer preferences, OTR has obtained the “lion’s share” of freight. It offers the flexibility that many parties desire when moving their freight. It can go almost everywhere, is relatively speedy, and offers a competitive price. Modes such as rail and water offer notable savings in price, but that is paid for in speed and potential disruptions. For many firms, it becomes a balancing act of attempting to obtain savings wherever possible while continuing to meet consumer demand at the appropriate velocity. For each type of product and business, the factors of cost and service must be considered.

For this next section of the paper, a literature review shall be performed as it relates to intermodal transportation. It will still contain some information that is helpful for an overview of market conditions through time, but it will also begin to address common themes found present in intermodal that shall shed light on the current issues plaguing it.

### Literature Review

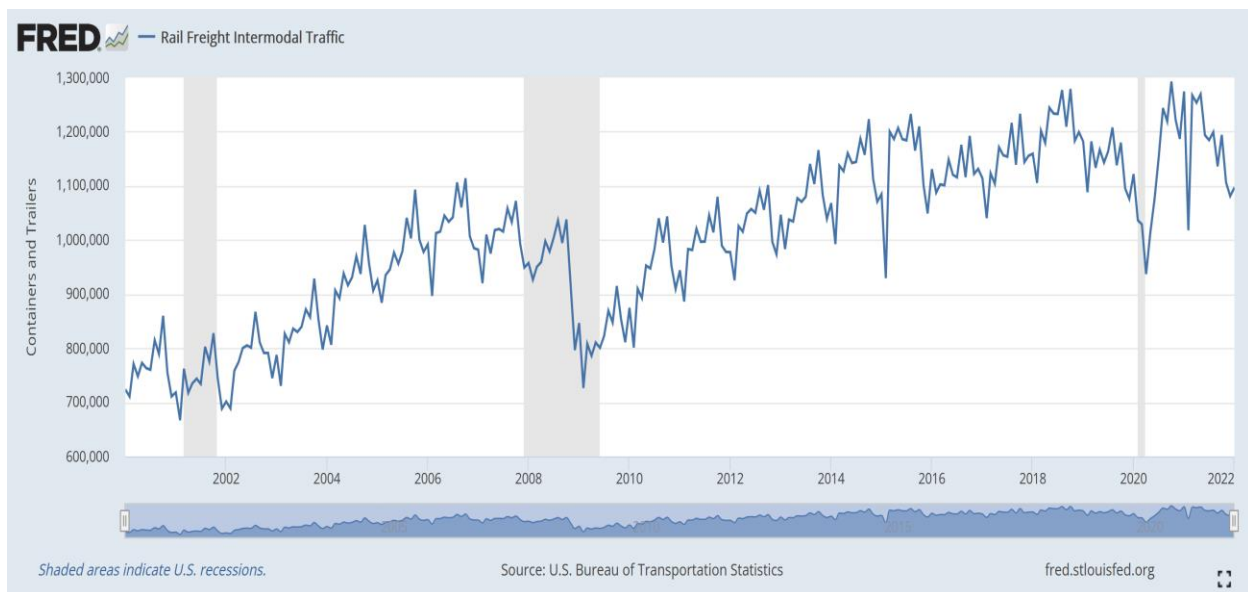
In the following section, an investigation into the topic of this paper will be had by analyzing the published literature surrounding the subject. The first few of the following articles and references will contribute to a general understanding, while later the sources will dive deeper into the specifics that industry experts have noted. A holistic conclusion regarding these sources will follow the main body of research reviewed. Each piece of literature and figure that contributes to an understanding of the subject will be cited appropriately.

Before COVID-19 became prevalent (circa 2019), one of the greatest factors affecting intermodal transportation was, like many modes of transportation, the price of fuel and

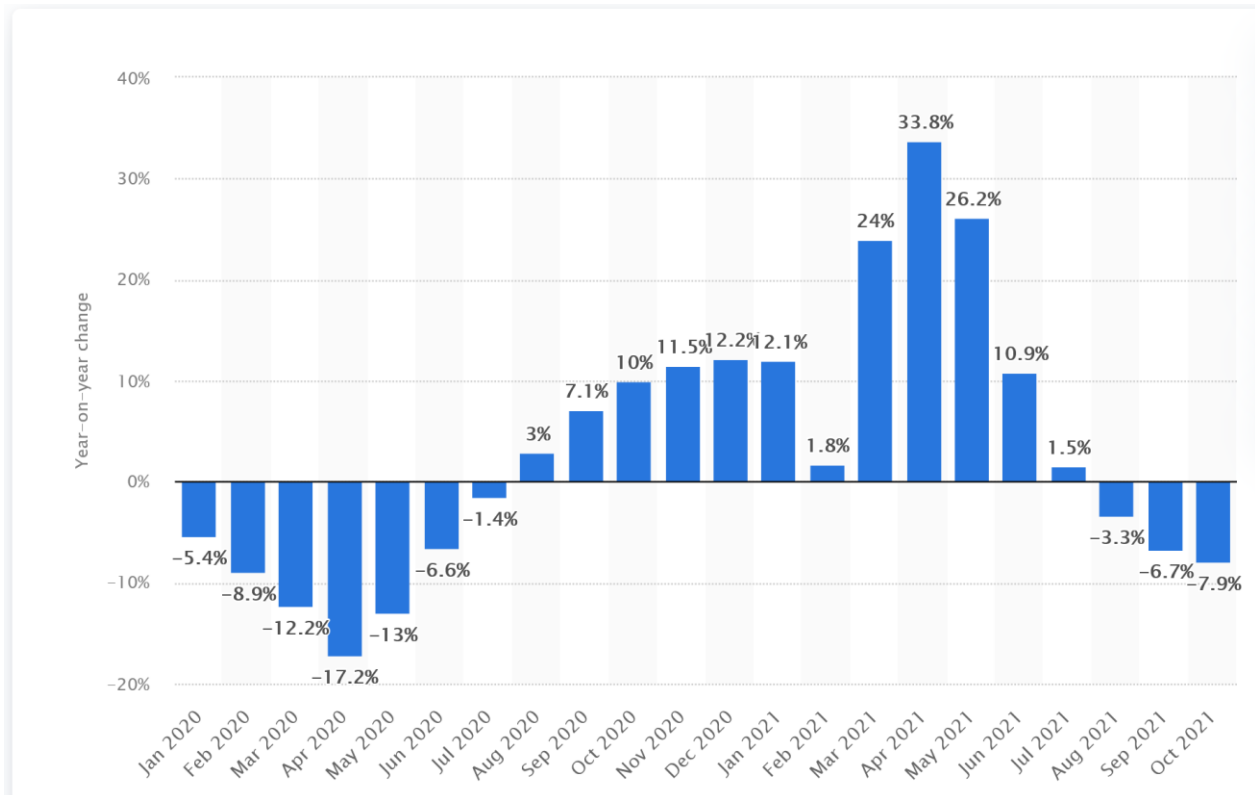


increasing driver wages. (Federal Highway Administration) Both problems were present before the pandemic and are still necessary to consider when considering intermodal transportation. The national driver shortage creates significant capacity constraints for all modes that involve CDL-certified drivers. When combined with a generally elevated price of fuel, conditions become more conducive to supply chain partners seeking out the least cost solution to moving their products as margins for both consumers of transportation services and the providers continue to shrink. These problems are still large considerations for consumers of transportation services, but before the pandemic, they were the main ones and thus occupied most of the attention. The fluctuations in both of these caused reactions such as the following quote: “With the current capacity crunch, shippers are trading off cost pressure to secure capacity and develop stronger relationships, trying to minimize the reliance on the spot market,” says Hodgson. “A number of shippers are moving to or expanding their dedicated fleets. This provides much more predictability to capacity which is critical for the customer experience.” (Burnson, Patrick) It can be seen that the reaction of many supply chain partners was to continue securing as much capacity as they could and deepening long-term relationships to combat uncertainty.

Below, a historical view of rail freight intermodal traffic can be obtained from the Federal Reserve Bank of St. Louis. (U.S. Bureau of Transportation Statistics) The data referenced is from January 2000 to January 2022. The trends found within point towards a continued growth within the intermodal sector with significant seasonal variations. The infamous “Peak Season” of increased consumer purchasing before the holiday season is represented by the peaks seen yearly below. Furthermore, significant world and domestic events can be observed from the graph such as the 2008 Housing Crisis/ Recession, the appearance, and rise of ISIS around 2015, and the beginning of COVID in 2020, as well as the discovery of its variants in subsequent years. From this, it can be seen that intermodal transportation is tied to the economy in general as well as to the general confidence that consumer demand will continue to pull products in sufficient quantities. The variations such as those leading up to “Peak Season” are well accounted for: forecasted out long in advance. Yet, the aforementioned “black swan” events cause significant disruption in the supply chain; coming from both availabilities of supply and certainty of consumer demand.



The below shows the year-to-year change in monthly intermodal freight volume from January 2020 to October 2021 (as compared to the previous year). (Carlier, Mathilde). This data comes from what some would call the height of COVID, and it shows how significant the variability in intermodal demand was during the timeline of COVID. This graph closely matches the timeline of COVID (Center for Disease Control) and provides insight into how recessionary pressures were alleviated through strong consumer demand despite global challenges. It could almost be said that too much consumer demand overstimulated economic production worldwide, resulting in current congestion.



Reactions to disruption vary depending on a host of factors, but for carriers like JB Hunt who are looking to expand their service offerings acquisition can be an answer. Recently, Hunt acquired Zenith Freight Lines, which delivers furniture, expanding Hunt's ability to service a variety of consumer demands while maintaining high levels of satisfaction with its services. (LM Staff, January, 2022) Actions taken by The United States Government under President Joe Biden have attempted to alleviate congestion issues at the port by mandating a 24-hour work schedule for port operations (Wilkie, Christina). The issue with that variety of hyper-focused mandate-based change to the supply chain is that it just shifts the congestion over to other partners within the chain. It produces good publicity but poor results as additional expenses and frustrations mount through inefficient methodology employed due to external mandates such as these. (Hanbury, Mary) It may assist choice parties in the supply chain, but it is not the holistic kind of action taken by partners throughout the chain in cooperation with one another that would help solve those challenges. The following demonstrates the effectiveness of external interference with supply chain operations: "President Joe Biden's plan to run California ports 24-hours-a-day,

seven-days-a-week is redundant if truckers and warehouses aren't running all night too, a logistics executive said.” (Hanbury, Mary). Without the cooperative use of supply chain talent, issues such as port congestion will continue to plague domestic intermodal transportation as it shifts down piece by piece through the supply chain.

The rate predictions from the consulting group Oliver Wyman for 2022 are grim. Rates will escalate as power continues to shift to carriers because of an excess of consumer demand present during 2021. (Burnson, Patrick) That pressure will continue in lessening measures throughout 2022 with increasing inflation, higher bills, and other unforeseen factors such as the Russian-Ukrainian War increasing uncertainty. As these factors relate to intermodal transportation, increased cost pressures usually result in the budget-conscious seeking out methods to meet their goals, and that means intermodal. However, “He (Jason Kuehn, Vice President of consultancy Oliver Wyman) notes that until intermodal delivers a more reliable service product it will continue to be whipsawed by the trucking market. Intermodal rates, as usual, will lag general trucking trends, creating demand as rates rise, but suffering faster defections when truck rates fall.” (Burnson, Patrick) the market consensus is that intermodal is competitive on price and lacking in consistency/ service. If consumers continue to demand the exacting standards they currently do, it is unlikely that intermodal will be able to satisfy certain kinds of demand as intermodal currently operates. Even should consumer demand fall: “These factors taken together argue for rates to be flat to up, even if we see some easing in demand. Once prices rise, they tend to be sticky and not come down quickly,” concludes Kuehn.” (Burnson, Patrick), those prices are likely to continue their elevated levels for some time. The continuing demand pressures combined with restricted supply cause elevated prices, basic economic principles applied on the macro-scale. Without improvements in one of the two factors, improved service or reduced costs are unlikely for most modes of transportation. The continued increased prices again drive more volume to intermodal and combined with “a restocking of inventory in the face of falling demand will favor intermodal for several months as transit time and reliability will be less of a factor until demand and inventory levels reach a new equilibrium, says Kuehn” (Burnson, Patrick) intermodal will continue to have pressure put on it that it was not built to handle. The large-scale panic-buying patterns at the beginning of the pandemic lead to massive out-of-stocks. Industry responses to this demand pattern were almost as sudden as the event itself: massive orders and lots of them! Thereafter, demand lessened, and restocking was necessary, as Kuehn says above, driving non-urgent freight to intermodal. Once again, this contributes to the bottleneck and congestion present in both intermodal and the general transportation market.

It could be asked what the tangible result of transportation market congestion is. Suffice to say, it was and still is large. The following will give insight into a more specific set of prices given to consumers of transportation services. “Vessel operators have no extra ships to meet a tidal wave of freight demand, containers are in short supply or can’t get quickly repositioned where needed, and destination ports are piling up with boxes because they can’t keep up with the volume. The logjam, which is adding weeks of delay for major export trades from Asia, has been exacerbated by a series of weather- and COVID-related events, as well as operational mishaps. How extreme is the situation? One ocean carrier told a company it would cost \$32,000 to ship a group of standard containers from Shanghai to Los Angeles, Craig Grossgart, senior vice president of Ocean at SEKO Logistics, said during a briefing for reporters late last month. “It was a nice way for the carrier to say, ‘We’re not interested in any more business,’” Grossgart

said. The quote was an outlier — the type primarily for customers asking to move large backlogs of boxes all at once — but is an indication of how desperate some shippers are and how selective carriers can be when they hold the cards.” (Kulisch, Eric) Of course, these are the highly elevated costs as of 2021, when this piece was written, but the trend continues. Carriers bear higher than average costs and pass them off to their customers, up to six times higher quoted transportation costs than the previous year (Kulisch, Eric), around \$18,000 per TEU. With no current price control implemented, it is unknown what a realistic timeline for a return to “normalcy” would be. If large disruptive events continue to occur, such as war, disease, natural disasters, and so on it is unlikely to be soon. Then again, with an ounce of my speculation: amid the greatest difficulties so too do the greatest innovations.

Predictions for that improvement vary depending on the individual, but of those observed, they quote the tipping point in late 2022”-and the light at the end of the tunnel is not to be expected until the second half of the year at the earliest.” (Trepins, Dagmar). As recovery proceeds, a reduction in equipment cycle times must occur. Currently, discharging a container can take between 38 and 45 days, obviously contributing to the congestion. Additionally, congestion is difficult to work through when investment for various parties involved is as costly as it is for rail providers, costing around \$1-2 million dollars per mile of track. (Menzies, Anthony) This figure does not include the additional charges that would be incurred in making rail interchanges and the yards themselves. With costs like these, it is easy to see why investment is slow.

Given this generous amount of information, several conclusions can be arrived at both in the general transportation market and by extension the intermodal market as it reacts to the trends in transportation. While this is not an exhaustive list of conclusions that can be made from the above information, it attempts to relay a portion of the important points.

1. The transportation market is compressed and strained significantly.
  - a. Costs are up
  - b. Service is down
2. A variety of factors contribute to this compression:
  - a. COVID-19
  - b. War
  - c. Natural Disasters
  - d. Consumer purchasing patterns
  - e. Industry responses to consumer patterns
  - f. Long turn times for equipment
  - g. Lack of equipment to service port needs
3. Current carriers “hold the cards” and are experiencing increased costs themselves.
4. Intermodal has absorbed excess capacity where possibly from budget-conscious firms.
  - a. Firms that rely on quick service will continue to shy away from intermodal.
5. Intermodal is not built to handle large influxes of volume in response to price pressure from the market, yet it is often used as a “pressure release valve” for freight.
6. Improvement has begun but has significant ground to cover.
  - a. Investment into their networks by carriers has similarly begun but has not yet been able to meet the market’s needs.

- b. Improvement is most dramatically needed at port locations and intermodal rail yards, as they function as gateways into the entirety of the United State for many imports.

The following sections provide both a research question and a hypothesis from which the qualitative information gathered during the interviews conducted can provide insight. Conclusions then drawn from the qualitative data will be applicable in the intermodal sector of transportation, and to attempt to extend them further lies beyond the scope of this dataset.

**Thesis Question:** What restricts the growth of domestic, refrigerated, intermodal transportation?

### **Hypothesis 1:**

The lack of growth in domestic, refrigerated, intermodal transportation is due to a lack of investment in the critical infrastructure necessary to support the intense requirements of intermodal transportation: this lack of investment is due to the absence of consistency, trust, and consistent demand among partners within the domestic, refrigerated, intermodal transportation. Developing a greater working relationship based on trust, investment, and continual improvement to meet modern standards would address many current issues within this sector of intermodal transportation. Furthermore, the characteristics inherent in intermodal transportation require large up-front costs with a longer payback period than is often desired by any firms – thus the investments necessary to improve intermodal service and cost, as compared to other modes of transportation, are few and far between.

### **Hypothesis 2:**

Intermodal transportation is plagued by slowdowns and a lack of growth in the current environment because of demand and the patterns consumers and other supply chain partners followed before, during, and after The COVID pandemic. These include but are not limited to: layoffs before COVID, a dramatic upturn in demand for select types of goods during the pandemic, access to stimulus payments and external capital during the pandemic, a lack of capacity, equipment shortages, and a lack of infrastructure.

### **Methodology**

The format of this qualitative research is as follows: invitations to interview were distributed to members within both J.B. Hunt and The Fishin' Company to individuals with a broad range of experiences in logistics. Several interviewees are involved in the day-to-day intermodal market while others have a broader set of skills and experiences. Once invitations were accepted and times arranged, one-on-one in-person interviews were conducted with these individuals. Open-ended questions were posed to the interviewees with the possibility of follow-up questions based on the answers given. The same general set of questions was given to each participant, though the follow-up questions differed. The questionnaire is found in the appendix. Rather than providing a transcript, the highlights from each interview will be given with an acknowledgment of the factors that contribute to it. Each interviewed individual will be cited along with their position within the company.

The interviews themselves were styled in the fashion of a journalistic inquiry, with a focus being given to broad questions about intermodal and transportation's characteristics,

constraints, problems, and current actions. Fashioning open-ended inquiries can allow for the maximum capture of information by the interviewer; this translates into the maximum output of actionable conclusions from each interview. The format mirrors that which is often used in industry news sources and journals. This formatting gives a benchmarking from which the quality of the investigation can be assured.

This qualitative analysis methodology was specifically chosen over a quantitative methodology. Most importantly, qualitative research, as was conducted in this thesis, captures nuanced information that is not easily obtained from a quantitative approach. With a quantitative approach many detailed and nuanced questions become black and white rather than the complex series of choices, relationships, and set of experiences that constitute the world. Furthermore, though qualitative analysis, patterns from participants, as individuals and as a whole, are easily seen and acted on, as opposed to the single end result obtained from quantitative analysis.

## **Research Findings**

**Preface:** By interviewing individuals with a variety of perspectives and levels of experience with intermodal, a more holistic and nuanced conclusion can be reached as it relates to what different participants across the transportation industry can do to accurately use and quickly improve intermodal transportation. The reasoning is that intermodal is unlike any singular mode, it relies on cooperation and teamwork between key partners within the value chain. In response to this characteristic, each interviewee represents another partner within the intermodal transportation industry.

The first interview is of Annalise Seifen, a drayage specialist working at The Fishin' Company. The responses given contain mostly an international perspective insofar as it relates to the general transportation and intermodal market. However, specificity in the domestic market is seen in response to problems that arise as well as actions resulting from those problems. The general information is that, from the drayage perspective, carriers are "in over their heads" (Annalise Seifen, The Fishin' Company, Drayage Specialist) severely. An incredible disparity between available work and capacity to handle it exists. Carriers are overworked, and despite best efforts delays are still the norm at the ports. The result: higher costs for all, decreasing communication, and very frustrated partners. Furthermore, a single delay at the port causes even more of the same down the supply chain. A delay with ocean shipping can have multiplicative effects on other partners through now unusable booked appointments, detention charges, and a host of other issues resulting from a single delay.

To emphasize the impact of a singular, long, delay is the story of China during the earliest parts of the COVID-19 pandemic will suffice. After shutting down in March of 2022 for three months, wherein no significant quantities of product left China, massive urgent orders were placed with Chinese firms by the world. The backlog of almost an entire fiscal quarter's worth of product was urgently requested. Naturally, the Chinese firms produced as much as was possible, and by some accounts were beginning to overproduce to attempt to meet demand. While China was closed, shippers had very little to ship; once the proverbial floodgates opened those shippers wanted to move product as quickly as possible. The lengthy process it takes for a container to return to the original user after being unloaded was far too long to be financially feasible when faced with such overwhelming demand. Thus, shippers left without their containers, leaving thousands of TEUs sitting around in yards. Those shippers would then find new containers upon returning to China and the cycle would repeat. The velocity of demanded imports by the

American consumer destroyed their ability to receive those desired imports. The continual pile-up of containers crippled the ports' ability to offload freight efficiently. Issues such as this continue to spring up, where a single delay (China being closed) contributes to massive backlogs and delays further down the supply chain. (Annalise Seifen, The Fishin' Company, Drayage Specialist)

The impact on drayage is that it becomes exceedingly difficult to move product either way out of the port, restricting the follow for all partners down the chain. Though responses to events like COVID-19 will never be perfect, through awareness of specific challenges certain patterns of behavior create, improvements can be made.

The second interview was conducted with Nick Vaught, a transportation specialist within The Fishin' Company. These responses originate from an individual who often will book freight and connect with various carriers to begin partnerships with The Fishin' Company from a domestic perspective. Experienced in creating significant synergies to achieve company goals, Nick Vaught analyzes the business needs and books the appropriate mode, including intermodal.

The most significant difference noted by Nick was that intermodal can be upwards of 40% cheaper than OTR shipping in the current market, but that "you get what you pay for" – meaning lower service levels and longer transit times. To exemplify this: "A lane going from Los Angeles to Baltimore OTR can be 4-5 days, but the same lane via intermodal can be 10 days or more". At significant cost savings but longer transit times and a greater degree of uncertainty, intermodal can "make sense" for a company like Fishin', which deals in frozen fish. Yet, it cannot often service most customers well. It was noted by Nick that "intermodal can take upwards of a week to even pick up freight, let alone transport it, and this is especially true in the Southern United States" quotes Mr. Vaught. (Nick Vaught, The Fishin' Company, Transportation Specialist) Intermodal prices and services within the United States seem to greatly depend on regional factors as the unequal distribution of rail services hampers the capacity of intermodal within a region such as the Southern United States. The timeframe in which products must arrive at customers is usually prohibitively short compared to what intermodal capacity for some regions is. That is, intermodal takes too long to service most customers and thus is underutilized by many. Opportunity lies there for both intermodal and many firms to both increase their planning windows and timeframes and also to improve service abilities such that more freight can move via intermodal. The capacity and pricing of refrigerated freight, which is required for transporting frozen goods, are different but not significantly so. The cost is higher due to a more limited supply but is not prohibitively so.

Another limitation noted by Nick is that intermodal operates with far less capacity for "spot market" rates, meaning that short notice freight is virtually nonexistent. Most of the service is dedicated and "spoken for" in some manner, limiting growth opportunities with different parties. Though this does ensure that prices are relatively consistent, it does not allow savings to be captured as effectively by booking parties on the spot market. Capacity is a vital metric for firms like Fishin' and the lack of spare capacity in the intermodal sector limits the degree to which it can be engaged. Current struggles with meeting customer demand dissuade many potential intermodal partners from entering the market (Nick Vaught, The Fishin' Company, Transportation Specialist), and as such improvements are very slow in coming. These slow improvements are needed most in the railroads, as the significant costs and risks that come with

expanding a rail line are difficult to justify without the assurance that significant amounts of freight will flow through it.

“Intermodal has high barriers to entry” (Nick Vaught, The Fishin’ Company, Transportation Specialist) is a note worth repeating. The financial requirements are higher than OTR by a significant margin, and even more so are the relational requirements. Without strong relationships, a firm’s containers could be left sitting for long periods on the rail yards due to the lack of urgency placed on unloading it. This limits any “mom and pops” intermodal firms, unlike OTR which has many. Instances that appear like this in intermodal are usually brokers that book intermodal transportation with carriers like JB Hunt rather than doing it themselves.

Informational transparency is lacking in the intermodal sector. Unless companies take specific freight tracking measures, it is rare to have the same level of communication that comes from the other modes of transportation. Truck drivers can be called, ships communicated with, and so forth, but receiving timely communication from each involved party in an intermodal shipment in time to make actionable decisions is rare. A large opportunity is present here for improvements in communication and data accessibility. It would greatly assist in helping companies track their inventory more accurately, generating better forecasts that are useable for longer periods, in turn allowing for more freight to pass through intermodal.

The last interview with The Fishin’ Company comes from Brandi Brand, another individual involved heavily in the day-to-day operations of transportation but has a more holistic and strategic viewpoint. Their responses pertain to a large-scale view of the market, but they also maintain the focused perspective of an individual engaged in the industry. Her responses focus on the relational and cultural factors that influence intermodal.

During the interview, the relational aspect of intermodal was mentioned heavily. Without an existing relationship, intermodal is next to impossible. Moreover, getting a spot on an intermodal train without a relationship with the rail company is highly unlikely. The spots are allocated well in advance and are generally not available on the spot market. For example: “If a train has 100 containers, it would be divided up to different carriers like JB Hunt, BNSF, and a variety of others” (Brandi Brand, The Fishin’ Company, Sr. Logistics Coordinator). The entirety of the spots become spoken for before most individuals know about a train going out. Created by this lack of openness is a general lack of excitement about rail transportation. It doesn’t currently fit with the American culture of “I want it now!” rather because of the transit time, it takes longer than most planning windows allow. The speed and accessibility of specific modes like OTR garner most of the business because they can service that cultural need. When one mode, OTR in this case, receives a disproportionate amount of business relative to the other modes, a disparity in capacity becomes apparent. The capacity of modes like OTR is significantly larger than the teamwork-requiring intermodal network. Intermodal is a multi-partner chain, and thus it is limited by its weakest link.

An issue that has become all-important recently is the price of fuel. The reason being is because of both international conflict and a lack of energy development inside the United States. The recent increase in the price of fuel has driven up costs without improving any other metric. The result of this is that further volume is driven to cost-saving modes such as intermodal, which, as was previously mentioned, is a long-term partnership-based modal combination. It does not respond well to sudden increases in demand and is usually unable to fulfill them. The transit times of intermodal still do not suit those who rush to it to save their budgets in the face of



increased costs, and they often have difficulty capitalizing and actualizing the cost savings possible through intermodal because they lack the long-term relationships necessary to make it work well.

Zach Roberts, a director of temperature-controlled freight intermodal freight at JB Hunt, provided a different perspective as the viewpoints given reflect that of a provider of transportation services. As a carrier (and the largest intermodal one at that), JB Hunt is often able to take unilateral actions to affect the entire transportation market – tackling problems far too large for many smaller companies. The problems within intermodal transportation are things addressable by JB Hunt, and by extension through the efforts of individuals such as Mr. Roberts. Having operated within JB Hunt for 9 years, mostly in the corporate setting with some field operations experience, Zach has a unique perspective to offer in the discourse of this paper.

Intermodal is restrained by the railroads or linked to be more accurate. Intermodal service inside the United States relies on railways and railway hubs. Intermodal shipments and receipts are tied to the closest rail hub. “Proportional to the size of the local fleet is the radius in which JB Hunt can service from a rail hub,” notes Zach: with growth in their capacity allowing JB Hunt to service more and more difficult freight. Thus, new areas can be serviced as either JB Hunt grows their fleet significantly in an area or another rail hub opens up. Both JB Hunt’s intermodal service and the railyards that service them grow in tandem with each other. If JB Hunt grows, they put more volume through the yard, and if the yard grows they can handle more freight for Hunt or allow things like drop shipments which keep drivers moving and happy. (Zach Roberts, J.B. Hunt, Director II Operations Intermodal Temperature Controlled Freight) Quoted at approximately 350,000 dry and 12,000 refrigerated 53’ intermodal containers in the market, it is obvious that the refrigerated side of the market is still much younger and tighter on capacity than the dry. This lack of development allows for a selective attitude when it comes to accepting shipments. As the refrigerated side of intermodal becomes more competitive and mature, like the dry is, any disparities in rates or service will shrink as established players in the market set the standards.

Having experienced several years in the industry, Zach can give credence that current conditions are abnormal, as they have been for the past three years or so. “In the beginning of COVID, there was a high degree of uncertainty about consumer demand and the general economic direction, resulting in a dip in consumer spending briefly.” (Zach Roberts, J.B. Hunt, Director II Operations Intermodal Temperature Controlled Freight) Soon thereafter, demand roared back up as was mentioned previously in this paper, and it overwhelmed the transportation industry. The capacity to handle the demand was not there. Transitioning through the several years of the COVID-19 pandemic, the product continued to need to flow and was pushed through at almost any cost. Now, as things slow down demand-wise, a more cautious and price-sensitive approach will be taken. Moreso with fuel prices going up and consequently more volume going toward intermodal.

An issue present since 2010 (Zach Roberts, J.B. Hunt, Director II Operations Intermodal Temperature Controlled Freight) is the increasing price of intermodal transportation. Zach has seen inflationary pressures, general cost increases, and increasing demand for transportation continue to drive up costs in all sectors of transportation: resulting in intermodal price increases that have outpaced pressures like inflation alone. The costs of equipment, training, talent acquisition, and many more factors cause the gap between intermodal and other modes to

become smaller. It was thought that the pandemic would help in this regard, as a major recession was predicted by many. Yet, no large recession came, and thus demand for goods did not dip expectedly. Transportation was still needed for these goods, keeping prices climbing.

There are many issues in intermodal transportation. From consumer purchasing patterns, manufacturers' practices, limited capacity, high (and rising) rates, fuel prices, lower service levels, long transit times, poor utilization by many parties, consumer/ cultural preferences, and many more can be seen easily how intermodal does not dominate the current transportation market. The previously mentioned issues are concurrent with those that trouble the general transportation market, but they differ in their magnitude. Intermodal requires that all involved parties work cooperatively, and because of this when a problem arises in one mode it translates into reverberating impacts felt throughout the supply chain.

## **Conclusion**

Intermodal transportation is vital to the nation and the world. It accounts for a significant portion of freight traffic, and it allows for many different types of goods to reach their destination. Through it, efficiencies are maximized, costs are reduced, and service levels are met. Without the innovations that made intermodal possible the world would be a much more difficult place for businesses to operate in. Intermodal operates as the circulatory system that keeps the precious lifeblood of trade flowing globally. Yet, it is not without issues. Furthermore, it is rife with them. Through the interviews conducted an overview of the impediments to growth in intermodal transportation was given. A summarization of those impediments will be given as well as a tentative list of solutions that can aid in the resolution of them. The problems presented are complex ones and individually deserve significant investigation - beyond the scope of this paper.

One of the previously listed characteristics of intermodal transportation is that it relies on a cooperative attitude from all partners. They grow together or fall together, and this is a unique requirement among the different modes. Should a participant not possess this outlook, they become an unfavorable partner and not suited for the requirements of it. To combat the likelihood of this happening, an analysis of previous partnerships that new entrants into intermodal have been a part of would be beneficial. Due diligence of a sort wherein the established partners obtain from the potential member of the supply chain a brief history of their involvements with other firms and how those previous partnerships went. To avoid a bias towards self-promotion, public records can be substituted for partner-provided ones. Should those previous partnerships have ended disastrously it would be prudent to not pursue any further relations with the offending party as far as it pertains to intermodal transportation.

An extension of the partnership-focused attributes of intermodal is that growth must be relatively equally distributed. No one partner can absorb all the profits from the relationship and continually expect their partners to be able to handle the larger and larger volumes of intermodal freight that would be the result of such behavior. A retailer, engaging in intermodal transportation to obtain commodity goods, can absorb the entirety of the cost savings from using intermodal and gain a significant market share, but if it then attempts to ship the additional product through those same intermodal channels it will find those partners without the capacity to do so. Thus, for intermodal to be sustainable in the long-term profit-sharing must be a question asked. The chain of intermodal can only handle as much capacity/ throughput as its weakest member. At that member will the freight pile up as they work hard but cannot handle it. Given

this, investments must be made in intermodal partners. Unequal growth creates problems for the whole supply chain rather than more opportunities. Consistency and slow, step-by-step growth are how intermodal grows. Large leaps can be made to combat current deficiencies, such as the planned addition of 50,000 intermodal containers to the market by JB Hunt and BNSF in the new few years if the actions taken go beyond “catching up” it becomes diminishingly useful.

Issues that trouble the entire market are similarly felt throughout the entire intermodal network. Be it fuel prices rising or general congestion, intermodal feels the same pressures other modes feel. Moreso, when rates rise companies are looking for ways to still meet their budgets and thus turn to the intermodal market. They become willing to sacrifice quick transit to save on the rates. This pattern of behavior is not ideal for any party. As was previously mentioned, intermodal is based on long-term relationships and cooperative growth. It then makes sense that most partners in an intermodal supply chain don't have much excess capacity to meet new intermodal demand. Expansion in intermodal is slow and long-term focused. Behaviors that treat intermodal like a “pressure release valve” because of excess demand or rising rates put pressure on the whole system. The freight won't move on schedule and thus will diminish the possible realized returns from that late freight. Intermodal isn't built for quick expansion.

From these few listed issues, intermodal providers and consumers can seek to improve their practices: both within dry and refrigerated containers, which do not have enough of a difference between them to warrant an entirely different approach. This focus will be expounded on below in the application section. The incentive to follow these practices should be apparent. Intermodal represents a large opportunity to maximize the utility of transportation for the appropriate freight types. It can ensure low-cost delivery and high-quality consistent service should the following practices be followed. Considering the findings of this paper, both hypotheses put forward at the beginning are found to be true, but incomplete. They do not lay out the entirety of the issues currently plaguing intermodal but do pinpoint several of them. Insights gained from each interview contribute to a more accurate and inclusive view of intermodal and the dysfunctionalities within. From Annalise, the impact of a single delay can be seen, especially when that delay is at the point of origin for goods. The multiplicative effect of a single delay reverberating down the supply chain causes significant issues pertaining to equipment availability, capacity, and pricing. From Nick, the value added by intermodal through cost savings can only be realized within parameters that allow for longer planning windows which fit the current characteristics of intermodal transportation. When consumer demand necessitates a “Now! Now! Now!” attitude from suppliers, the longer planning window of intermodal precludes it from being utilized in a beneficial form. From Brandi, the relational necessities of intermodal were expounded on heavily. Without pre-existing relationships with the partners needed to make intermodal work, it cannot. Those relationships raise a higher barrier to entry than most would have assumed. Lastly, Zach gave insight into how, within the domestic market, limited intermodal is by the presence of rail yards. Intermodal only works so far out from the closest rail yard and without continual investment from those partners it will continue to operate in a limited capacity. With the inclusion of these viewpoints, intermodal can be understood in more conducive way moving forward. It has great potential to meet growing consumer demands but can only do so when its specific attributes and limitations are both respected and given the necessary resources to address them.

## Application

How the contents of this paper can be used are numerous. Aside from the simplicity of gaining a fuller understanding of the characteristics of different modes of transportation, the interviews were conducted to grant the perspective of those who are closest to intermodal transportation.

Practices that should be implemented by consumers of intermodal transportation pertain primarily to how their expectations meet reality. The expectation is that intermodal will have the capacity and speed necessary to meet their high requirements. Intermodal costs less than OTR and other modes, and thus it does not have all the beneficial characteristics offered by others. When using rail, it becomes limited by the rail hubs. When using ships, there must be sufficient room at the port for the vessel and its freight. If a firm wants to be free of these types of restrictions, it should employ the appropriate mode rather than the limiting combination of several of them. The greater utilization of intermodal depends on the adjustment of a firm's expectation for what intermodal can do. It is not yet a quick mode of transportation. Nor will it be for some time but given time and assurance of volume when capable it can be. Intermodal would benefit from greater competition, as a general principle. Competition produces innovation, and that is something lacking in the intermodal space currently. A degree of stagnation with several partners often employed, namely, the rail partners exist. The growth of the whole sector is limited often by rail capacity. With a lower barrier to entry, intermodal would be able to bear more competing firms that would further refine what intermodal can offer. A major thing holding back intermodal is service in the eyes of many consumers of it. If the transit times were more appropriate to the planning cycles of its consumers, intermodal could be utilized far more often. As it stands, consumers of intermodal services cannot fulfill the demand they have within the timeframe intermodal offers. Either with increased capacity or a streamlining of processes could this be accomplished. The time to accept and pick up freight is significantly too high. A service improvement is necessary to compete.

In subsequent studies, a quantitative methodology should be pursued. Qualitative research reveals details but is filtered through the lens of the observer whilst data is potentially less prone to the idiosyncrasies of one individual. That quantitative analysis should be center on the effects of "black swan" events like COVID-19 on the intermodal market and capacity utilization. These types of events are prone to exposing the inefficiencies and limitations of any industry they affect. Observing the effects would reveal insight into how they might be corrected. Should more qualitative research be pursued, a greater quantity of interviews with a wider set of questions should be conducted to ensure the validity of this interpretation. Though further investigation, a better understanding of intermodal can be achieved. With that, a more efficient and robust transportation market can be achieved, benefiting and enhancing the lives of individuals around the world.

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## Interview Template

These are the questions asked in every interview. Responses were not recorded verbatim. Depending on the responses given, additional follow-up questions were asked.

- What are the general characteristics for intermodal transportation as a whole? How do those differ from the refrigerated space, if they do?
- What are current conditions like in the dry or refrigerated intermodal sector right now, are they different?
- How do current conditions compare the conditions this time last year?
- What factors in the general transportation market have the greatest impact on intermodal?
- Has cost or service improved or deteriorated in the year?
- How long has that improvement or decrease in cost/ service been the case?
- What has caused that improvement or decrease in cost/ service?
- What are some of the current issues in dry or refrigerated intermodal transportation? Do they differ?
- What factors contribute to the current problems in the dry or refrigerated intermodal sector? Do they differ?
- What is the status of equipment? Have you been able to access the necessary amounts? Why or why not? Are there enough chassis? Containers? Refrigeration units? Where are they?
- Have you seen any relief in problematic areas? From where and why?
- What actions have you been taking to combat the current issues in dry or refrigerated intermodal transportation?
- Have they made a substantial difference? How do you know?
- Have you seen others in the industry take the same steps?
- How long do you think current challenges will continue? Why?
- How specifically, have current issues challenged your business?
- What's the "pulse" of the whole industry right now?
- What's your plan for the future? Are there any drastic actions you plan on taking to rectify current issues? \*\*\* if propriety and unavailable information, just let me know.
- Is there anything else that I should be asking about that I haven't?