Global Ocean Transportation Project

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1. Introduction

The design, procurement, and management of a global ocean transportation (GOT) network is a challenging task. By definition, the network spans multiple continents, involves a variety of business units, and can impact and influence operations from procurement to final assembly. Additionally, the ocean carrier industry has particular pressures in terms of market structure, levels of competitiveness, and transparency (or lack thereof) of pricing and service levels. While the ocean carrier market appears to be global on the surface, in reality most of its activities are directed at supporting specific trade lanes. Rather than a single global market with many players, it is better seen as many individual markets with a few players within each market (trade lane).

Ford Motor Company partnered with the Cranfield School of Management's Supply Chain Research Center and Massachusetts Institute of Technology's Center for Transportation & Logistics to explore the ocean carrier market to better understand how a large manufacturer should procure and manage their ocean transportation needs. The scope of the research focused on the movement of containerized product from point of manufacture to assembly plants across the world. Due to a compressed timeline, we did not examine the finished vehicle movements – such as roll-on/roll-off equipment. We did include all of Ford's global regions (North America, APA, South America, and Europe) in the analysis.

This report is intended as a pre-read to the 6 June 2011 workshop to be held in Dearborn, MI at Ford's facilities. The objective is to summarize the analysis conducted by the research team so that we can have a more engaged and far-reaching discussion at the workshop.

This report is organized as follows. Chapter 2 describes the state of the ocean transportation industry - including its market forces, prevailing contractual concerns, and actions being taken by the carriers. Chapter 3 presents the ocean strategy for Ford and outlines how this strategy matches up to its procurement and management practices. Chapter 4 takes a deeper look into the concept of reliability as it applies to the ocean transportation industry. Finally, Chapter 5 summarizes the findings and makes specific recommendations to Ford management to improve their global ocean transportation practices. An appendix is included with more detailed tables and charts.

2. State of the Ocean Transportation Market

Chapter 2 reviews the global ocean trade and industry characteristics. We interviewed executives from Ford as well as from a number of carriers, including Maersk, CMA-CGM, and NYK); logistics service providers like CEVA Logistics, Kühne and Nagel, Pusan Logistics and Damco; the port operating company, Forth Ports; and industry analysis company, Sea Intel Maritime Analysis. We also collected data from academic sources, and industry reports like Drewry and Alphaliner. We did not disclose the Ford connection with this project during these investigations and used our own contacts to obtain the data used.

2.1. State of the Industry

In 2009 the world experienced the worst global recession in 70 years, which fuelled the sharpest decline in the volume of global merchandise trade (UNCTAD, 2010). One obvious casualty of the sharp decline in international trade was international sea movements, with containerized trades suffering the biggest contraction.

Container trade fell globally by 9.0% in the course of one year. Container traffic along the three major east–west container trade routes (trans-Pacific, Asia–Europe, trans-Atlantic) was most affected, with double-digit declines in volumes (Table 2.1). Notably, the intra-Asia market was unaffected.

	Trans - Pacific	Far East - North America	North America - Far East	Europe - Asia-Europe	Asia - Europe	Europe - Asia	USA - Europe – USA	USA - Europe	Europe - USA
2008	20.3	13.4	6.9	18.7	13.5	5.2	6.7	3.3	3.3
2009	18.4	11.5	6.9	17	11.5	5.5	5.3	2.5	2.8
Δ	-9.4%	-14.2%	0.0%	-9.1%	-14.8%	5.8%	-20.9%	-24.2%	-15.2%

Table 2.1 Estimated cargo flows on major east-west container trade routes (2008/09) (millions of TEU; Δ = annual percentage change) Source: UNCTAD, 2010

The scale of the problem is illustrated by the magnitude of the financial losses reported, and the extreme stress facing shipping lines. In some cases, lines sought state aid to refinance and restructure their operations. Maersk lost $2.1bn in 2009 (compared with $583m profit in 2008), in spite of making $1.6bn of savings through restructuring, renegotiating supplier contracts, optimizing networks and reducing fuel consumption[1]. Total losses for the sector for 2009 are estimated to be over $20 billion.

Operators interviewed as part of this project all indicated that their firms had been slow to react to changes in the market. Maersk and CMA-CGM had placed large investments in establishing market share on the back of ever-increasing volumes of global trade.

For example, Maersk's contract with Wal-Mart has to be relatively integrated and long-term because it would be difficult to shift the large volumes of global business at stake.

[1] A.P. Moller-Maersk plunges into red. JOC

Similarly, the contract with IKEA has a ± 10% banding clause to allow for rate variances. In both these instances changes were slow to come, purely due to the size and complexity of the contact. However, large-scale, ongoing contracts like these are the exception.

The client base is mostly formed by large numbers of smaller import/export businesses under inflexible conditions of contract which favor the carriers. Shipping markets tend to be very volatile, and contracts tend to be relatively short term (3, 6, 12-month contracts are rarely exceeded in the sector). It is therefore attractive for customers to 'play the market' by exploiting the opportunities for cost savings created by differences between supply and demand. Forecasting demand is tough for carriers to perform accurately.

When the downturn came the adjustments were made too slowly to stop the sector as a whole from plunging into heavy losses. Ships were laid up and new receipts delayed where possible, which removed capacity from existing fleets. Such actions attempted to maintain an artificial floor on the cost of freight. What was not fully taken into account was the significant numbers of vessels that were either owned or on long-term charters, both of which needed payments to be maintained to financing institutions or owning companies.

Capacity was also reduced by early disposal of aged vessels or - in some instances - conversion of cellular vessels to either bulk or break bulk transports. Many liner operators initially cancelled or deferred existing vessel orders; when this was not possible operators postponed commissioning the vessels into service.

To combat the effects of laying-up vessels, liner operators implemented a policy of slow steaming, which increases fleet utilization and reduces operating costs. A ship that reduces speed by 20% uses 40% less fuel (Fig. 2.1), and the operator adds extra 1-2 vessels per route, or string. The advent of slow steaming provides environmental benefits relative to the CO_2 emissions per container moved.

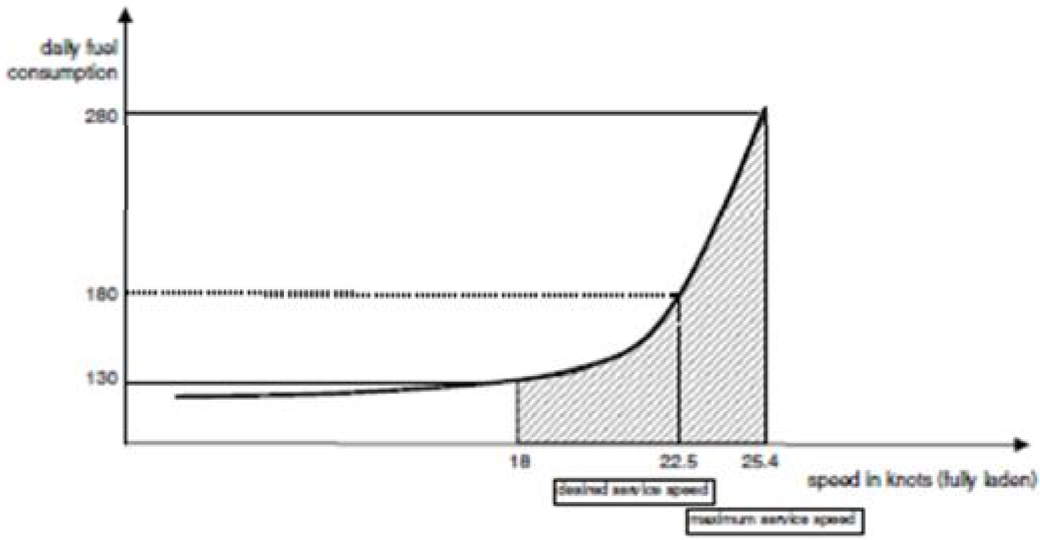

Figure 2.1 Fuel consumption relative to speed

But slow steaming created adverse effects to client supply chains. Changes in schedules across the various operators increased congestion at ports, and at other bottlenecks such as the Suez Canal. In turn, this impacted schedule reliability and port turn-around times. Further problems for client supply chains resulted from the slower rates of material flow, which increased pipeline inventories and associated financing costs. The bullwhip effect amplified these changes to flow rates.

In theory, slow steaming should improve schedule reliability because vessels can adjust speed to make up time over the route. However, this requires willingness by the companies to manipulate speeds between ports, and the actual ship engines to be capable of operating at different speeds.

Strategies to cope with trends over the last 3 years

We captured trends in the contract logistics market over the last 3 years by means of a range of indices shown in Appendix 1.2. The recession of 2008-2009 was followed by the extraordinary rebound in the first half of 2010. The pace of recovery has since plateaued, and the market is showing signs of weakness again in 2011[2]. These trends are also reflected in the ocean transportation market.

Over the course of 2010, many of the liner operators returned to profit as trade volumes recovered. Of the top 20 liners, 17 posted positive operating results for the first half of 2010. A number of these carriers, including Maersk, CMA CGM and Hapag-Lloyd recorded their best ever interim results. Alphaliner surveyed 20 carriers and identified that collective operating profits for the first quarter 2010 had reached $3.78bn compared to a loss of $6.90bn in the same period of 2009.

It has been the pace of recovery in the liner markets in the first half of 2010 that has been surprising. Many of the carriers had previously predicted that losses would continue at least until 2011. The carriers surveyed recorded an average operating profit margin of 7% in the first half of 2010, compared to –17% in 2009. These improvements were carried through to the end of 2010, with the latest figures from Alphaliner indicating that 2010 was the most profitable year ever for the carriers.

A large degree of the correction occurred early in 2010 with companies attempting to meet renewed customer demand and replenish global inventory positions. This increased demand for capacity across the shipping network plus the scarcity of containers, particularly in the Far East, where demand quickly exceeded supply and pushed freight prices up. But prices softened markedly in the second half of 2010, and have continued to fall in Q1 2011. Figure 2.2 shows the trend of Shanghai Containerized Freight Index (SCFI) prices since April 2009.

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[2] Automotive continued to post an overall sustained 6-8% growth into Q1 of 2011.

Figure 2.2 SCFI Spot Rates to Europe and US
USEC = US East Coast, USWC = US West Coast
source: Alphaliner, 2011, refer Appendix 1.3

The forecast for the rest of 2011 is for prices to remain subdued. A significant flow of new vessel deliveries and new service launches over the next 3 months could thwart carriers' attempts to raise rates. Much of the capacity increase is targeted at the Transpacific trade this year, with 8 new strings currently confirmed. The increase in supply will comfortably exceed Transpacific Stabilization Agreement (TSA, http://www.tsacarriers.org) forecasts of 7-8% growth in demand this year. Alphaliner estimates that the capacity growth on the Transpacific routes could reach 14% on an annual basis. Drewry Research concurs "there is once again a serious risk that the desire to increase or protect market share has overtaken the need for profitability."[3] Meanwhile, slow steaming is likely to be extended rather than reduced.

Containers

The standard measurement of container availability is the box-to-slot ratio, which aligns the number of boxes to available capacity. A declining ratio indicates either an increase in global capacity, a reduction in the available containers or combination of both factors. Over

[3] Spotlight report "Unmasking Freight Rates", March 2011 (http://www.drewry.co.uk/publications/view_publication.php?id=365

the last decade the box-to-slot ratio has been in gradual decline from 2.99 boxes per slot in 2000 to 1.99 in 2011[4]. The decline can be attributed to four main factors:

1. Over the last decade carriers have improved box management and utilization, thus they required less box stock to meet existing demand.
2. When the market contracted in 2009 many companies saw this as an opportunity to reduce the number of boxes they had in circulation and correspondingly disposed of a large part of their older stock as utilization levels fell.
3. Increases in capacity over 2009 and 2010 served to increase the number of slots available.
4. An almost total shut-down of the container manufacturing facilities in 2009 in response to the financial crisis reduced the number of containers significantly.

These factors combined to intensify the pressure on prices. As demand for new boxes in 2009 fell away, the main container manufacturers, all located in China, wound down their respective facilities to a point where production effectively ceased on all but reefers and specialist containers. The rapid surge in demand in early to mid-2010 caught the market unaware, consequently leading to a rapid increase in demand for new containers. This problem was exacerbated by the long time taken to re-start container production lines, some of which took longer than six months to become fully operational.

The shortage of containers was most acute in the Far East, which accelerated repositioning of empty containers from Europe and North America. The container imbalance stabilized in July 2010, as the production of boxes took off again, whilst the scrapping of older containers was virtually halted. Additionally demand fell away in the fourth quarter following the end of the summer peak season, which also helped to redress the container balance. APL President Eng points to a variety of factors that could actually create box shortages again later this year[5]. Hinting at The Containership Company's recent withdrawal from the market and the suspension of some US services by other carriers, Eng says "the situation last year, when rampant rate rises and equipment shortages resulted in many lines failing to honor transpacific contracts, could be repeated. It rams home the message: beware who you contract with."

Way forward strategies

As we've seen, liner operators initially responded slowly to the financial crisis. When they did respond, the actions were often not fully thought through and caused further headaches in the short to medium term.

Looking forward, carriers have adopted a number of strategies to ensure that they are better placed to deal with any future changes in the market.

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[4] http://www.jocsailings.com/tabid/74/ArticleId/10698/Carriers-Face-Renewed-Container-Shortage.aspx

[5] http://www.ifw-net.com/freightpubs/ifw/interview/an-improving-picture-for-hard-pressed-carriers/20017866248.htm

Increasing ship size

Most ocean carriers are shifting to using larger ships for containerized traffic. The logic is straightforward since the economies of scale for the water portion of the movement dominate the overall global trip. Maersk, for example, has continued to place orders for new capacity. Headlines have been created by the new class of liner, the Neo-Panamax, 10 of which have been ordered. Capacity is listed at 18000 TEU, but the market view is that this is likely to be closer to 20,000 TEU because "Maersk consistently understates." The vessels will not be able to move through the Panama Canal or dock at any existing ports in either North or South America. The 10 vessels will be used to operate a harmonized string between Asia and Europe.

The introduction of larger capacity vessels into key Asia-Europe routes will have two effects:

- There will be a demand for more feeder services into and out of key ports along the string. This will cause added port congestion - exacerbated by inability of cranes to span the vessels, slowing load and discharge.
- The large ships will displace existing vessels. This displacement will cause a 'ripple' across the existing network as displaced vessels are then moved to another route. Those vessels are displaced in turn, and are moved to other new routes - and so on.

Increased levels of feeder services will open up a wider range of secondary ports, however if feeders are not effectively integrated into the scheduling process so that transfer and on-carriage take place with minimal disruption, there is an increased likelihood that delivery times will be increased for customers that are unable to deliver directly to a key port along the string. Feeder systems will require a network of smaller vessels, often coastal freighters, to distribute and collect freight.

Environmental focus – More fuel efficient operations

The move to slow steaming has significantly reduced CO_2 emissions and thus the carbon footprint of the shipping industry. The change in speeds has, in some instances, required ships to be fitted with new engines, as most of the existing fleet had engines that had been designed to idle at much faster speeds. The move to new engines and slow steaming has prompted carriers to look at other environmental measures. Maersk recycles waste heat, using it to generate electricity for use elsewhere on the vessel. NYK is investing heavily in ships that float on a bed of air, and other forms of propulsion - such as kites and sails.

This shift is important to large shippers because it might indicate that slow-steaming is here to stay. This means that shippers need to adjust their overall manufacturing and inventory systems to accommodate longer ocean transit times. Also, we can expect carriers to make these changes under the banner of environmental rather than economic justification.

Moving to an 'asset light' fleet configuration

The smaller 'top 20' operators are moving towards an 'asset light' configuration, which will provide them with greater flexibility should there be another downturn in the market. These operators are starting to return ships on longer charters and take on new vessels on new short-term charters. Most have ceased to order cellular container ships. This re-balancing of the fleet is intended to allow the smaller operators the ability to quit leases at short notice in order to minimize costs.

The focus of the asset light operation is maintaining profit per piece moved. To facilitate this, operators are investing in improved levels of EDI to support rapid cost analysis of proposed pricing. To maintain an asset light approach, it is likely that most operators would sub-lease space on other carriers to enable the provision of service to global clients in areas where they don't currently service or to gain strategic market share as part of a wider growth strategy.

Cost versus service and cost approach

A number of the liner operators like MSC pursue a lowest price policy. However these operators also tend to exhibit the highest port-to-port transit time variability as shown in tables published by Drewry. At the other end of the scale, the higher costing carriers - or those with slightly longer transit times across the same string - tend to have lower levels of variability. Interviews indicated that the reasons for low variability and higher costs include the following factors:

- Greater port buffer times across the string. Increasing the buffer time allows the vessel to complete all the necessary quayside tasks, even when there are problems in the port.
- The ports used were either owned by the same company as the vessel, or there were specific port/terminal servicing contracts in place that reduced the levels of variability.
- The companies were able and willing to flex slow steaming to make up time during transit to reduce schedule variability across the string.

We have not been able to identify this same effect in the actual Ford data at this point. The data is insufficient to validate this within Ford's network at this time.

Centralized pricing on a global basis

Pricing is a regional activity for the majority of liner operators. Whilst there are often clear lines of string responsibility, this regional approach precludes the ability to look at customers on a truly global basis. The only operator that appeared to be able to offer centralized pricing on a global basis was Maersk, who cited the relationship with IKEA (referred to above) as a global client. It is unclear, however, if more ocean carriers will adopt this global approach over time or if the market will remain primarily "trade-lane" focused.

2.2. Variability within routes

As a transport mode, ocean shipment has proved to be resistant to Ford Production System (FPS) thinking. Comparatively heavy on pipeline inventory, this transport mode has to be further buffered to address variability of transit times. Once a delay has set into a string it can be very difficult to rectify unless the carrier is willing to skip a port or ports, which inevitably leads to backhauling via land or sea and further delays for shippers.

Variability undermines the *dependability* by which a product is transported from supplier to final assembly. Within 3PL operations, dependability is monitored in such terms as:

- *On time*: % of orders delivered on time, and variability versus target
- *In full*: % orders delivered complete and variability versus target
- *On quality*: % defects and variability versus target

The focus in shipping is most often based on overall port-to-port timings, measuring the time from departure from originating port to arrival at port of destination. These metrics show that overall (port-to-port or on-the-water) performance in the sector is awful: the quarterly Drewry report shows an *average* 50% on time vessel arrival time. From April to June 2010, the leading 10 of the top 20 liner operators (in a study of 53 operators) managed to exceed the industry average. Maersk led the pack with 77% on time, against a publicly stated target of 95%. Competitors ranged from 59% - 64% [Appendix 1.1]. The Drewry report follows a restricted (shipping-only) view of customer needs, as it focuses on the sea transit element of the string - not on overall customer requirements, which are better defined as "door-to-door." It is also measured at the ship rather than container basis – which further reduces its value to Ford.

Port to Port vs. Door to Door

Customers are most interested in measuring both the expected transit time and its variability from door-to-door for their goods movement. Unfortunately, many statistics in the ocean industry literature are based on the water-only or port-to-port transit. While port-to-port time is usually the largest component of a movements total average transit time, it is only a subset of the overall door-to-door time. It captures the amount of time that the ship is at sea and is influenced by any slow-steaming practices as well as the number of intermediate port stops that occur between the customer's port of departure and arrival.

The door-to-door metrics, on the other hand, cover the entire movement lifecycle, to include all origin and destination land-based movements at and within the ports. Studies and interviews both indicated that the greatest levels of variability reside in land-based activities, but data in the literature to support the assertions was not found. We did find evidence of this in the Ford data (see Section 4.4). Figure 2.3, below, shows how the industry (and this report) will segment the door-to-door movement into five time segments: Origin landside transit, Port of departure, Ocean transit, Port of entry, and Destination landside transit. While the main concern for Ford, or any shipper, is to manage the door-to-door transit times, it is important to also collect and analyze the segment transit times in order to locate sources of variability.

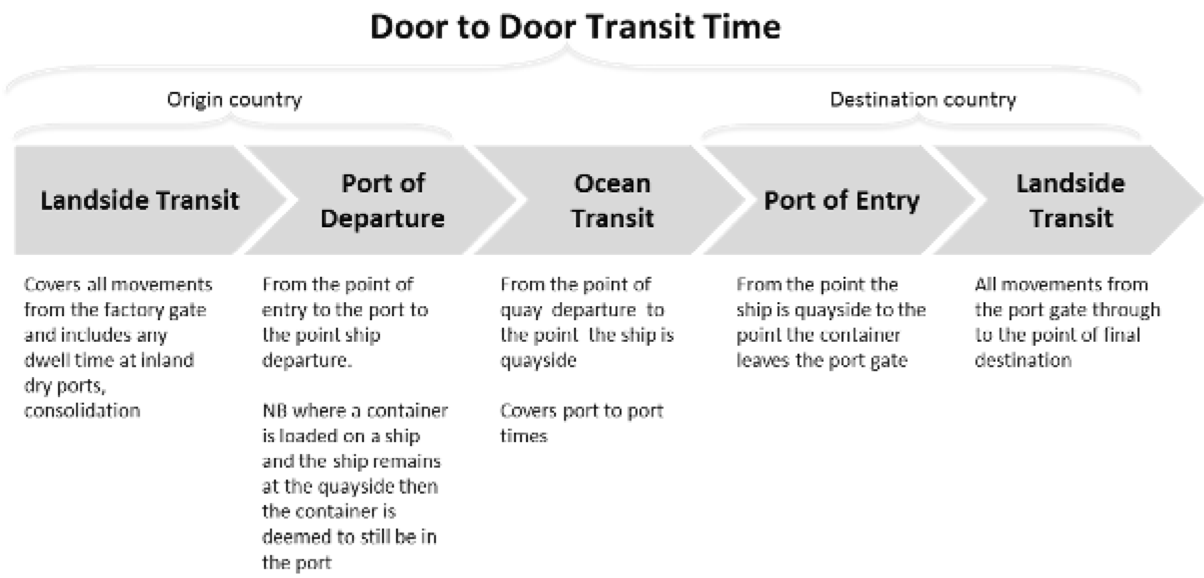

Figure 2.3 Door-to-door transit characteristics

The *sequence* of the pick-up and delivery ports is also a major factor in determining transit variability. For example, if a container is loaded at the last port of a departure string and unloaded at the first port in the arrival string it is expected to have minimal variability since there are no interim ports. If, on the other hand, a container is loaded at the first port in the departure string and unloaded at the last port in the arrival string, it has a higher likelihood of being interrupted due to potential delays at the intervening ports in the string. Whilst this is cited as a common cause of variability in research, we were not able to prove or disprove this hypothesis within Ford's data.

Schedule variability vs. transit variability

The global ocean network is defined by time-tight schedules consisting of multiple journeys or strings. Each string takes a significant amount of time to develop; the ideal result being a combination of a number of ports located close together (short transit times) with a high degree of schedule reliability. The short transit times mean more boxes can be loaded and unloaded; and the schedule reliability enables carriers to maximize their time in port. The combination of the two enables customers to effectively plan their operations.

The driving factor in ocean freight is schedule variability, which is defined – somewhat ambiguously - by Drewry as:

> *"the scheduled day of arrival at the destination port (announced by the carrier at least two weeks before the date of departure) and the scheduled day of arrival for the same ship at the destination port"*

Drewry Schedule Reliability Insight (2010) p19

Simply put, this is the difference between the planned arrival date and the actual arrival date. Where variability does occur, it affects both carrier and customer. The carrier incurs costs in the form of additional operating costs, linked, for example, to unproductive vessel time and the rescheduling of vessels. As noted earlier, the introduction of slow steaming does theoretically provide the carriers with options that can address some degree of the variability if they are willing to break slow-steaming protocol to rectify schedule slippage. The customer incurs logistics costs relative to holding additional inventory in the form of safety stock and pipeline stock and where the materials are part of a wider production process, additional production costs, e.g., stoppages whilst the line waits for delayed materials.

Transit time has a number of definitions, for example the number of sailing days on a port-to-port basis. In a wider sense, transit time can be the total time (normally in days) on a door-to-door basis. This by nature includes dwell time at relay points across the network, and time needed to move between each relay point on the network. The approach adopted in the literature and by the people interviewed was that transit time, in the shipping environment, refers to the narrow view, i.e., the number of sailing days or ocean transit between ports.

One way of maintaining schedule integrity is to effectively manage transit variability in conjunction with slow steaming e.g., should a vessel depart late from a port, they can increase speed during the ocean voyage to bring the schedule back into line again. This does require the carrier to be willing to increase speed, thus consuming more fuel in the process.

Utilizing these two definitions, it is possible for liners to show significant ocean transit variability between port pairings, but very low overall schedule variability across the string. The other key factor that can influence the schedule variability is the number of ports visited on a string (i.e., the more ports the greater chance of schedule variation). Conversely, on a string covering Asia-Europe, loading goods on at the last port in Asia and off-loading at the first port in Europe provides consistent schedule and transit performance.

Given the high degree of variability in transit times of ocean freight, 55% for the first quarter 2010, movement by sea is not viewed as an effective option for a JIT environment. Carriers and 3PL operators both advise that scheduled delivery times should be buffered. The exceptions to this are the carriers that are heavily focused on service

The ideal arrangement for a customer needing to reduce schedule variability is to load goods on at the last port in the string relative to the originating location, and then to unload them at the first port relative to the destination. The inherent risk is that no space is left on the carrier to take the goods. To minimize this risk, customers need to be able to effectively forecast requirements and to make the corresponding cover bookings.

The Drewry schedule variability report (Appendix 1.1) relates to the variance between the published scheduled time of arrival at the port and the actual time of arrival at the port in calendar days. This has become, for some operators, the effective industry standard. However, there are some shortfalls that limit use of the report by the end-customer. The most notable is that the Drewry report only covers a subset of global routes, and is designed to provide an overview of schedule reliability across the carrier companies. The second factor is that measurements are from port to port, and do not reflect potential delays within the marine terminal of the port of arrival (from the ship to the terminal gate) or further inland delays resulting from factors such as shortages of land based carrier capacity, congestion or staffing. The final aspect is that the report does not indicate the number of ports on a string, so it is impossible to establish port departure times. Thus, the main aim of the report, from an end-customer point of view, is to provide a snapshot of which carriers provide the most reliable services in a particular region.

Sources of variability

As discussed earlier, delay across global ocean movements can be attributed to three areas of operation, the landside movements, the ocean movement and the port based activities.

Sea based variability

An example of a Drewry schedule reliability report tracking the schedule reliability across the major shipping lines is shown in Table 2.2.

Ship early (days)				Ship on time	Ship late (days)										Total arrivals
-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	
Overall frequency of vessel arrivals by number of days early /late															
7	19	31	126	812	346	163	95	71	28	26	31	24	9	4	1792
0%	1%	2%	7%	45%	19%	9%	5%	4%	2%	1%	2%	1%	1%	0%	

Table 2.2 Overall frequency of vessel arrivals by number of days early /late
Source: Drewry schedule reliability insight for Q2, 2010

In the first quarter of 2010 the report showed a 55% on time arrival reliability, increasing to 83% arrival at ETA + 2 days, which would appear to be a very small variation in relation to the overall door-to-door timelines.

This small level of variability in the ocean transit has also been borne out in studies, which have found that ocean movement variability when compared to port movement variability is very low. Notteboom (2006) found that ocean schedule variability or delay is attributed to four distinct groups: terminal operations, port access, maritime passages, and chance, with only terminal operations relating to landside activity. The other three groups all related to sea based operations across the string. Notteboom found that the level of delays in the purely ocean part of the study was 6.2% (chance 5.3% and missed Suez convoy 0.9%) among all of the sources of delay across the group. It is probable that the missed convoy may have been a direct result of delays in port at a point earlier in a string.

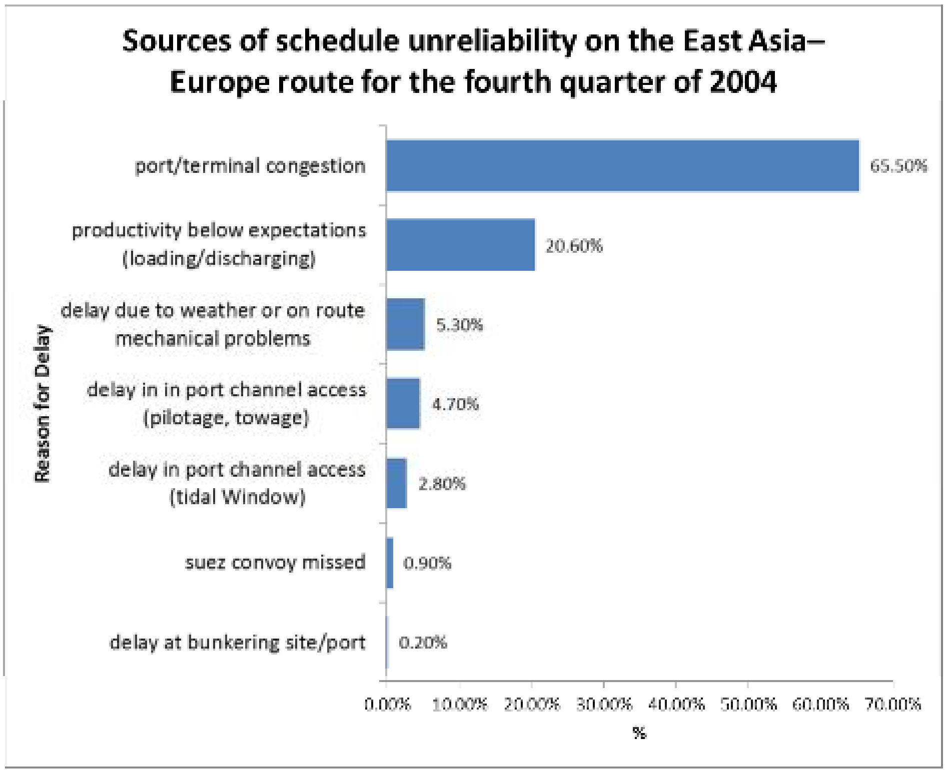

Figure 2.4 Sources of schedule unreliability on the East Asia-Europe route for the fourth quarter of 2004

The interview group responded that port productivity and congestion whilst waiting to access ports are still major factors today, though congestion was probably less of an issue for some carriers because of the downturn in the market, increased levels of port ownership by carriers and greater use of berthing contracts. It should also be noted that congestion at ports is a direct result of the port infrastructure and/or the hinterland distribution network not being able to manage and handle the inflow of traffic, again leading to delay as a result of land based activities. Thus, both the studies and results from the interview panel indicate that actual ocean transit time (i.e., port-to-port) is not a major factor in schedule variability: instead, variability was driven by land and port based activities. Ironically, increasing the level of transit variability was perceived as a way to help reduce the levels of schedule variability across the string.

As a result, customers trying to reduce variability within the door-to-door context should focus on the land based activities that impact the overall variability in the travelling time. This includes the number of ports that a vessel stops at between the customers' pick-up port and delivery port, as each port potentially will add further land based variation to the overall schedule timing.

Land based variability

As indicated previously, land based activities (including port processing time) form a key component of the door-to-door movement. The intermodal nature of these movements has the potential to provide the greatest sources of variability across the supply chain network.

The utilization of intermodal transportation is heavily reliant on the effective synchronization of different freight movement systems and operators across a range of geographical scales. As the number of interfaces increases, the entire supply chain becomes more vulnerable to disruptions, leading to increased levels of schedule variability. Disruptions in any one segment of the supply chain network in a highly synchronized environment, will affect the whole chain. In turn, this causes a ripple effect triggering unforeseen consequences across the network.

Where problems persist, the alternative is to change the routing. From a liner perspective, this does not present too many difficulties - as it simply involves either a new string or new port calls along an existing string. However, for land based operators and particularly for inland distribution systems, new routings and new volumes are much more difficult to accommodate especially where the current network is working at capacity.

The land based movements consist of two key components: landside movements relating to getting the goods to or from the port gate, and port based movements, relating to the activities within the port. Below, we discuss these components in more detail.

Landside variability

There are three key aspects of landside variability; the manufacturing process, transportation and the dwell time or simply put the time that the goods are not being improved or moving toward the final destination. Dwell time can accrue across the supply chain and can be viewed as either good (postponing configuration) or bad (waiting for the next train). In the latter instance this time adds no value to the goods; though it does raise the chances of further delay as it normally denotes a time when the goods are transferred from one operator or transport mode to another. Understanding the dwell time is important as it has the potential to increase costs via increased inventories, demurrage, and detention[6].

Port related variability

Productivity is cited as one of the key reasons for schedule variability. The continuing drive towards larger vessels on key routes, coupled with a slowing in port development, particularly in western countries will only serve to create even greater pressure on the existing port infrastructure and processes. Notteboom (2008) forecasted that by 2010–2015, the performance requirements for a global hub and gateway terminals on mainline vessels would typically take the shape of:

a. A sustainable ship output of 5,000 moves per 24 h;
b. A sustainable ship-to-shore gantry crane output of 40 moves per gross hour;
c. A ratio working time to time at berth of 90%;
d. An average number of gantries operating per main-line vessel of six; and

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[6] Demurrage costs relate to a full container, whilst detention costs relate to holding empty containers, normally the time between unpacking at the destination and returning them to the beneficial owner.

e. An annual throughput per berth of 1.5 million TEU.

Currently a 10,000 TEU vessel with only three ports of call in Europe would imply an average number of moves of about 6,600 TEU (loading and discharging) in each port of call. When the new 18,000 TEU vessels come online, this figure is likely to double. In either event such large volumes pose a significant problem for the density of container cranes per vessel, on yard equipment and on the required stacking area.

The increased pressures on port infrastructure will serve to increase the levels of variability across the supply chain, so it is imperative that customers look to utilize those ports that are best equipped to meet the demands of the carrier used as opposed to the volume that the customer is moving on the carrier.

One of the easiest ways to manage this is to look to carriers that either own the ports they are visiting or have long-term berthing contracts in place; these arrangements will help to minimize the occurrence of port related schedule variability. The expectation is that carriers providing a door-to-door service should be able to provide actual time based information relative to time taken from berthing to departing the port gate and visa-versa

2.3. Scorecard metrics

The move towards a service-oriented approach by some of the operators in the market place provides an opportunity for customers to ask for more performance related data at both the tendering and operational stages of the contract process. The companies we spoke with echoed this, though with the caveat that customers need to understand what the data reflects and how it was gathered. Furthermore, companies felt that there should be a mutual understanding as to how the data would be manipulated or presented. The prime example in this instance is transit time. Carriers are very conscious that transit time reflects a port-to-port movement, whereas customers are looking for a breakdown of the door-to-door movement.

As indicated previously, Drewry provides an industry view of schedule reliability. However, carriers have their own approaches to measurement. This difference becomes critical when the string the customer (shipper) wants to measure is not covered by the Drewry report, and reliance is subsequently placed on the carrier's approach to transit measurement.

For example, APL reported a 95% on time arrival for its transpacific services last year. This does not include any instances where they were working with other carriers as part of the New World Alliance. Drewry reported a 67.7% global on time delivery for the same period: if the Alliance timings are included, a 59% on time arrival for transpacific routes over the second quarter of 2010. Whilst both measures are factually correct, they underscore the need to agree on how and where data will be collected from, and then who is responsible for interpretation and presentation.

As identified in the variability section the land based sections of material movements are often the most variable, so it is important to establish how performance of these movements will be measured and by whom. Our interviews indicated that many of the shipping companies sub-contract land based movements to third parties, so they in turn are reliant on another transport company. Maersk made specific comments on where they had removed service offerings because they could not guarantee reliability of the land based movements.

There are two distinct phases that reflect the need for greater review: the request for information (RFI) process, and the ongoing contract management process. In both instances, there should be a focus on the areas causing the greatest degree of variation across the supply chain.

The core measurements should focus on the complete door-to-door transit time, segmented down to the lowest common portion. The response should enable the assessor to walk through the entire process, understanding the productive times and the non-productive dwell times. Additionally carriers should be able to provide historical support for the timing assertions, including any deviation in the past year, if the string is new then the carrier should be able to provide an indication on how they arrived at the figure.

In addition to this all carriers will need to outline how they intend to measure performance against the contract and who will be responsible for providing the agreed information

The four key RFI attributes identified that impact the variation in delivery times are listed below. The key focus is driving consistency of service that will enable customers to effectively plan their own internal operational delivery. In each instance operators should provide evidence to support the numbers supplied and an indication on how this will be measured going forward.

Transit time – Breakdown of entire transit times (door to door)

The door-to-door transit consists of a number of handoffs, the difficulty is obtaining an accurate measurement of the time spent in each segment and then breaking that down into the time that is actually adding value and the time not adding value (dwell). Even across the simplified process, the five stages have a minimum of seven modal handoffs, each driving two key measurements – value add and dwell.

Therefore, initial measurements should concentrate on the key movements of interest follow Figure 2.3 and are shown below:

1. Origin Landside Transit - Time from factory to origin port
2. Origin Port - Time in port
3. Ocean Transit – Time from origin port to destination port
4. Destination Port - Time in port
5. Destination Landside Transit – Time from port to factory

It is likely that each key measurement will be delivered by a different operator and in some instances timings may have to be deduced from the data supplied by other operators e.g. departure port timings can be arrived by comparing the difference between the delivery to port date and the ship departure date.

Number and location of interim ports on the string

As discussed earlier, the number of intermediate ports within a movement has the potential to increase the overall transit time and, more importantly, the variability.

Is it a consortium string, if so who are the other carriers involved?

If a carrier consortium is running the string, then the variability of the actual ocean transit time might vary by individual carrier. This should be explored further.

Documentation mistakes

This is necessary to understand the details of the contractual terms.

Additional focus needs to be placed on the level of control and information that the carrier has across the string, with particular emphasis on communicating any changes to the string

Once the contract has been awarded, it is important to monitor delivery against the attributes declared in the Request for Information (RFI).

As part of the RFI process, it is important to understand how each carrier deals with the following aspects

a. How changes to the service offering from the carrier will be communicated
b. If the route is consortia route, what happens if a partner has to pull out from the arrangement
c. Key process information
    1. Booking process
    2. Invoicing and payment process
    3. Customer conflict resolution approach/process
    4. How they work to catch up sailing time across a string
d. Capacity availability – many carriers have inconsistent capacity at a weekly level, though this is not visible when they respond to an annual requirement
e. How charges will be calculated and levied, particularly with regard to demurrage, detention and trailer hire.

2.4. Summary

We can summarize our overview of the state of the global ocean transportation market as follows:

1. The shipping industry turned from suffering record losses during the recession to clocking up its best year ever in 2010. This year, however, some carriers are already reporting losses and TCC stopped trading. Over the same period, the industry has undergone radical change. Slow to respond to the effects of the recession, much of the industry has now adopted slow steaming, many have centralized functions and the current focus would appear to be on profit per item moved.

2. These changes have provided significant benefits to carriers. However, it is debatable whether benefits have been passed on to the shippers. Some firms, such as Maersk, are focusing on customer service, with evidence pointing to superior levels of reliability as a result. Others are focused on low rates. While external factors - such as the availability of boxes and the price of fuel - are placing upward pressure on slot prices, the introduction of new capacity is ensuring, for the moment, that prices remain under pressure.

3. Schedule reliability continues to be the core unit of service measurement, although the approach to measurement varies between operators. The widely-quoted Drewry report indicates a paltry 50-55% on time sector average for 2010 (this rises to above 80% if two further days are allowed). When compared to land-based components of the door to door journey, ocean transit variation is just 5-6% of the total variation across a string. This only includes movements from loading of the ship at the origin, ship to destination and unloading at the port at destination: when other land-based movements are added, the relative size of the ocean transit variation is likely to reduce further.

4. Going forward, there is a greater need to focus on areas that create the greatest variation within a door-to-door transit, with particular focus placed on door-to-port movements and port transit times at both ends of the ocean transit. These have the greatest potential to increase variability within a given delivery timeframe.

5. Key points to note:
   - The shipping sector in 2011/12 is moving towards tighter margins, and in some cases back into losses.
   - The upward pressure from carriers on freight prices is being countered by continued introduction of new capacity into the global cellular fleet and slow-steaming protocols to reduce fuel usage.
   - Schedule reliability in a carrier context relates to comparison between planned transit time and actual arrival time at the port of destination. It does not include loading or unloading of containers. It is influenced by the number of ports visited between the shipper's origin and destination ports, the size and speed of the vessel and congestion experienced along the string.
   - Variability is driven by all five segments that make up the door-to-door movements, of which the ocean transit is just one, with land-based movements accounting for most of the variability.

3. Ford's Current Ocean Transportation Strategy

This chapter discusses Ford's global ocean transportation strategy and the numerous challenges faced. It describes the overall material flow and presents the analysis and findings from more than 17 interviews with executives from Ford and representatives from Ford's contracted ocean carriers.

3.1. Background – Organization and Flows

Ford's Global Material Planning & Logistics (MP&L) organization consists of four major regions: North America (NAM), Europe (EUR), South America (SAM), and Asia Pacific & Africa (APA). Each region has parts suppliers and assembly plants and is managed by a regional MP&L staff. These regional staffs also manage transportation including ocean freight. Many flows are inter-regional and are managed by the destination region. Flows consist of containers of parts and, separately, shipments of finished vehicles.

A Global Ocean Buyer function has been established within the Global Purchasing Organization to run an annual consolidated worldwide bidding and carrier selection process on behalf of and with the active participation of the regional MP&L organizations. These contracts are for one or two years. Each year the Ford team negotiates with selected incumbent carriers and is able to renew many contracts without putting them out for re-bid. Because of two-year contracts and renewal of selected incumbents, the annual global tender has recently included about 1/3 of Ford's annual global container spend.

The bid process includes creating a large spreadsheet that shows the annual forecast of load (containers) on each lane and any other special requirements. Each year in June Ford collects the data it needs to assemble the bid package (e.g. forecasts of loads by lane). The bid document is sent to the carriers annually in late July/early August and they respond with their quotes of transit time and cost on each lane that they are bidding on. The Global Buyer and the MP&L staff in each region then review the bids. In late November the destination regions make selection of carriers with input from the Global Buyer. Once selected, the new contracts and rates take effect the next February 1st. The time from RFI distribution to contact assignment is approximately 6 months.

3.2. Ford's Ocean Strategy & Challenges – from Ford Interviews

We interviewed key individuals at global headquarters and in each region to understand how ocean freight is bought and managed today, to gather their suggestions, and to learn about their carrier reliability problems. Interviews included:

Global Headquarters: S.Harley, A.d'Aliberti, J.Bond, S.Russell, B.Fenech
Ford North America: P.Stec, E.Gilbert
Ford Europe: M. Schulz, J.Buchanan
Ford South America: E.Molina, C.Correa
Ford Asia Pacific & Africa: R.DeMuro

Rather than present summaries of each interview, the remainder of this section combines the discussion along four major themes: Ford's Supply Chain Strategy, Ford's Ocean Procurement Strategy, Ford's relationship with its carriers, and Ocean transportation reliability.

Ford Supply Chain Strategy

Ford has been following a strategy of producing cars where they sell the cars. They have a strong presence of assembly plants in NAM, EUR, and SAM. They are looking to increase their presence in APA. Ford's existing strategy includes shipping parts between regions but usually not finished vehicles – with APA being the exception.

Currently, Ford is transitioning from having a large number of geography-specific vehicle platforms to having fewer globally standard platforms which then get a region-specific body and finishing. This "global platforms" strategy will lead to the growth of primary plants that make many of the single-tooled parts as well as satellite plants that assemble the same vehicle in other regions.

It is expected that this will result in a very large increase in the flow of parts from the primary plants to the geographically dispersed satellite plants. As an example, this could increase the number of containers received at the Focus assembly operation in Michigan from 20 containers per week to 300 containers per week!

The net effect of the "global platforms" strategy will be an increased reliance on and use of global ocean transportation that connects the primary and satellite plants. The ocean transport will become an even more important link in the supply chain and thus appears to warrant additional managerial attention.

Ford Ocean Buying Strategy

Ford uses forwarders and lead logistics providers in most regions (APA the exception) to help manage their ocean freight. These providers include UTi and Exel-DHL. Perhaps because of this reliance on third parties, Ford senior management is concerned that it no longer has deep ocean freight expertise in-house. While the day to day management is outsourced, the annual procurement event is run in-house at Ford.

Ford manages ocean freight regionally but cooperates globally in a single ocean bidding exercise to buy ocean freight. Ford believes that this collaboration enables them to get better pricing by pooling their global volumes. The Global Ocean Buyer orchestrates the process by collecting load forecasts from the regions, assembling the bid spreadsheet, distributing it to carriers, conducting a bidders meeting, collecting their responses, and facilitating negotiations between the carriers and the regions. As stated above, the entire process from data collection to awarding the 1- and/or 2-year contracts lasts over 7 months (August to February).

Carriers submit quoted transit times on each leg of the lane along with the rates. A lane is defined as an origin-destination combination with the same requirements. Occasionally two lanes will have the same origin, destination, and requirements but be in support of different internal cost centers. For the most part each lane is considered (bid) independently although some bundling, usually out & back pairings and clusters of lanes in the same geography, are encouraged. The destination region for each lane is the main decision-maker on which carrier is chosen. Ford states that both transit times and rates are considered when selecting the winning carriers but the precise weighting of these values (and any other levels of service or carrier characteristics) was out of scope of this project.

Ford Relationship to Carriers

Once Ford awards the business for each lane to the winning bidder, the carrier agrees to reserve the average weekly number of slots (based on the forecast in the bid package) for Ford's use. The weekly forecast is usually determined by dividing the forecasted annual volume for each lane by the number of weeks in the planning period.

One week in advance, Ford's forwarder contacts the carrier and "books" the containers onto the ship. These practices by Ford and its carriers are typical of the ocean freight industry. In reality, Ford's weekly volume can be higher or lower than the forecasted weekly average. Ford, like any other shipper, wants the carriers to accept all loads all the time at the contracted price. Carriers are usually able to do this because they normally have some unused capacity. Conversely, regardless of what the contracts say, Ford suffers little or no penalty for booking fewer containers than the forecasted weekly or annual average. The result is that, under normal conditions, Ford can ship as many or as few containers as it needs with no problems. Ford has apparently become accustomed to this accommodation.

The Reliability Problem

Ford's factories are just-in-time facilities that need consistent, on-time deliveries. If any parts are missing, they cannot finish building a vehicle. Reliable delivery is a hugely important requirement. In the first quarter of 2010 Ford experienced an elevated level of their bookings being either partially refused or their containers being left on the quay due to carrier capacity constraints This became a major concern for Ford, especially since their dependence on ocean freight was about to rise dramatically under the global platforms initiative.

In Q1 of 2010 Ford's requests for container bookings were occasionally rejected and less frequently some containers were even "bumped" off the ship (booking accepted but the container not put on the ship). What usually happened is that when the forwarder called to book the containers, the carrier would accept only the number of containers with reserved slots (the weekly average from the bid package), not any extra containers. This was almost certainly because the carriers had to honor their commitments to other shippers and did not have any spare capacity. However, it caused much consternation at Ford. Some at Ford believed that the carriers deliberately rejected Ford's containers in favor of higher paying freight. Indeed this may have happened occasionally and it is well within the right of the carriers to refuse the "extra" containers from Ford. Note that this is the flip side of Ford submitting fewer containers than the carrier is reserving for Ford.

3.3. Ford's Ocean Procurement Strategy: Carrier Perspectives

We interviewed Ford's primary contact person at seven of its largest carriers: Hapag Lloyd, APL, NYK, SAF Marine, Maersk, MOL, and Hamburg Sud. The purpose was to understand the carriers' perspective on their relationship with Ford including their comments on the Bidding process, contract terms, operational realities, reliability, and performance measurements.

The key learnings from the carrier interviews focus on the bidding process, the performance measures, the relationship with Ford, and the concept of reliability. Table 1 (in the appendix) lists the comments in the interviews indicating how frequently each was made. A summary of the comments is shown below.

Bidding

Overall the carriers believe that the Ford bidding process is well run. Most carriers are generally accepting of the bidding being conducted lane by lane with only limited bundling of lanes. Indeed most carriers are organized by "trades" or regional business groups, and are not themselves organized in a way to facilitate cross-regional bundling of rates. The exception is the largest carriers who are set up to offer globally bundled rates.

The carriers noted that there appears to be duplicate entries for many lanes in the bid. This seems to be a result of Ford defining lanes for internal rather than external purposes. For example, if two lanes have the same origins and destinations, but the parts within the containers fall under different business units within Ford, they will show up as two different lanes – both for billing and managerial control purposes. To the ocean carrier these two lanes appear to be identical and redundant.

The carriers tended to believe that while transit time is "much ballyhooed" it appeared to them that price is much more important to Ford. Also, the carriers noted that while reliability might be mentioned, no carrier reliability data or information is requested or included in the bidding process!

Performance Measures

The carriers commented that there was no Score-Carding of carrier performance. Many noted that periodic reviews of carrier performance are very infrequent if they occur at all. Additionally, carriers noted that shipment reporting by carriers is inconsistent (or non-existent) between regions.

Relationships

Overall, the carriers commented that Ford typically has as favorable a relationship with its carriers as any shipper does. The carriers noted that while it is possible to pay less and get worse service it is not possible to pay more and get better service than what Ford is already getting.

Ford rarely tells the carriers when they will NOT need all their reserved slots – this causes problems with carriers that have pro-actively reserved slots for Ford's containers. The carriers noted that Ford experiences no penalty for undercutting their Minimum Commitment Quantity levels as stated in their contracts.

Reliability

Most of the carriers we talked with were very conscious of Ford's just-in-time operations at its plants and the importance of reliable product flow. They commented that they try hard not to reject (or bump) Ford's containers. Aside from rejecting or bumping bulk containers first (scrap paper, metal, etc.) carriers generally do not appear to have defined strategies to free up space on their ships. We did not find any carriers that practice peak load pricing for Ford.

It is interesting to note that the ship sailing schedules used by the carriers to respond to Ford's bids in December are not the same ones in use by the time the contract is actually in place in February. Sailing schedules – and the resulting transit times - often change during the lengthy contracting process (see Table 2, in the Appendix).

Since our reliability analysis made it clear that most delays occur at the ports, not on the water, we wondered if Ford took note of how many intermediate stops each vessel made before arriving at its lane destination. Although Ford requests the name of the service for each lane being quoted, Ford does not request any schedule information to be submitted as part of the bid. From our discussions with both the carriers and with Ford we do not believe that Ford considers the number of intermediate stops when comparing bids.

3.4. Observations about Ford's Strategy

By assimilating and discussing the results of the Ford and carrier interviews we are able to make six observations about Ford's practices.

Observation 1 – Ford's global volume is not leveraged

The first observation is that the global bidding mechanism is not pooling Ford's volumes as much as Ford might imagine since carriers consider each lane as stand-alone. Once the bids are submitted, Ford can choose any bidder for any lane. A carrier could be awarded very few or even just one lane. There is no volume leverage if the carrier has to bid as though they may only be awarded one lane and thus need to make a profit on every lane independently.

Unfortunately, most carriers do not appear to be organized well enough to submit bundled bids that cross their "trades" (regions). Their comments reflect that the bidding devolves into a lane-by-lane exercise. The largest global carrier (Maersk) would prefer a global bundled price option as part of the bid and appears to be frustrated by the current bidding process. So, while Ford would like to receive some economies of scale effect across its network – the organization of the ocean carrier industry does not seem to support this.

There is a question as to whether Ford is even leveraging its volume within a trade lane as Ford defines lanes based on internal (billing units) definitions. We have not quantified the impact of these "split lanes" or the actual number present within Ford's network.

Observation 2 – Ship routings and strings are not considered during a bid

The second observation is that Ford does not focus on the ship schedule or routings during the bidding. As discussed in Chapter 2, we believe transit variability is highly correlated with the number of interim ports visited during the ocean transit. From our interviews we believe that Ford does not specifically consider how many intermediate ports the ships will stop at along each lane. For door to door lanes, Ford allows the carriers the freedom to use whatever routing they choose.

Since most delays occur at the ports, more direct routes have less chance of additional delays than routes with multiple stops. In addition, some ports are likely to be more troublesome in terms of delays than other ports. We would expect Ford to take more interest in these reliability factors.

Observation 3 – Ford does not request or use transit reliability in bidding

The third observation is that Ford requests that the carriers quote transit times in the bid but has no reliability information on which to judge these transit times. The quoted transit times often turn out to be a "best case scenario" which some carriers never achieve even once in practice. Carriers who grossly underestimate their transit times during the bidding suffer no penalty for such actions and seem to gain an unfair advantage over carriers who try to present realistic transit times.

Observation 4 – Ford does not treat unreliability causes the same

The fourth observation is that Ford appears to be more concerned about some forms of variability or delay than others. Ford appears to be less disturbed by (or perhaps more resigned to) the "normal" variability in ocean transit times. Until the capacity squeeze of Q1 2010 Ford did not track, measure, report, or score-card normal variability. Indeed even now that normalcy has returned, Ford does not appear to be greatly concerned about the late shipments that occur every day. They have learned to build a generous buffer into their CMMS scheduling systems to account for these normal delays.

However, Ford is aggravated by major delays caused by snafus (rejections, bump, skip, cut & run), and origin port delays. The discretionary nature of these delays (i.e. a person at the carrier makes a conscious decision that delay's Ford's freight) undoubtedly contributes to Ford's strong reaction. While Ford does not routinely measure or track ocean freight transit time reliability, it did begin to track the frequency of snafus into North America after Q1 2010. It should be noted that Ford is no longer doing this consistently.

Observation 5 – Ford does not collect data for nor utilize a performance scorecard

The fifth observation is that Ford does not create a scorecard to give feedback to carriers on transit time reliability – or any other dimension we have observed. This was a significant difference between Ford and the other customers of the carriers that we interviewed. Comments by Ford management indicated that they did not believe that measuring reliability and providing feedback would cause any change of behavior among the carriers.

Observation 6 – Ford has no single uniform or consistent definition of reliability

The last observation is that Ford has no standard definition of transit time reliability. The interviews with regional staffs while providing interesting and thoughtful definitions of reliability did not uncover any standards. Actual delivery times were compared alternatively to the bid (quote), recent history, or ship schedules. If Ford is to begin to measure and provide feedback to carriers on their reliability they will need to establish a consistent reliability metric.

4. Reliability Analysis

This section discusses how Ford defines reliability and compares the planned or contractual standards to actual performance. We examined as much transactional data for actual container movements as Ford could provide to better understand the actual performance.

4.1. Understanding what "Reliability" means to Ford

How to Define Reliability

Reliability has many definitions at Ford. We polled the regional ocean freight managers to understand how they think about reliability. The results are shown in Table A2 (appendix).

The poll revealed that reliability has two main facets: credibility and schedule consistency.

Credibility:

- Did the carrier actually do what they said they would do?
- Reserve the slots that they were supposed to? (no Rejections or Bumping)
- Stop at all the ports that they were supposed to? (no Skipping)
- Load the containers onto the ship that they committed to? (No Cut and Run)

Schedule Consistency:

- How close do they keep to the quoted schedule?
- How consistent is their transit time?

Each region has a different definition for the schedule consistency aspect of reliability. We found three general definitions for reliability:

1. Comparing actual transit times to the quoted transit time in the contract,

2. Comparing actual transit time to the carrier's recent (e.g. 6 months) transit time performance, and

3. Comparing actual transit time to the published ship schedules.

Based on these responses we categorized several candidate ways to define reliability, shown in Figure 4.1 below. We also suggest an additional metric that judges reliability on the "tightness" of the distribution of transit times.

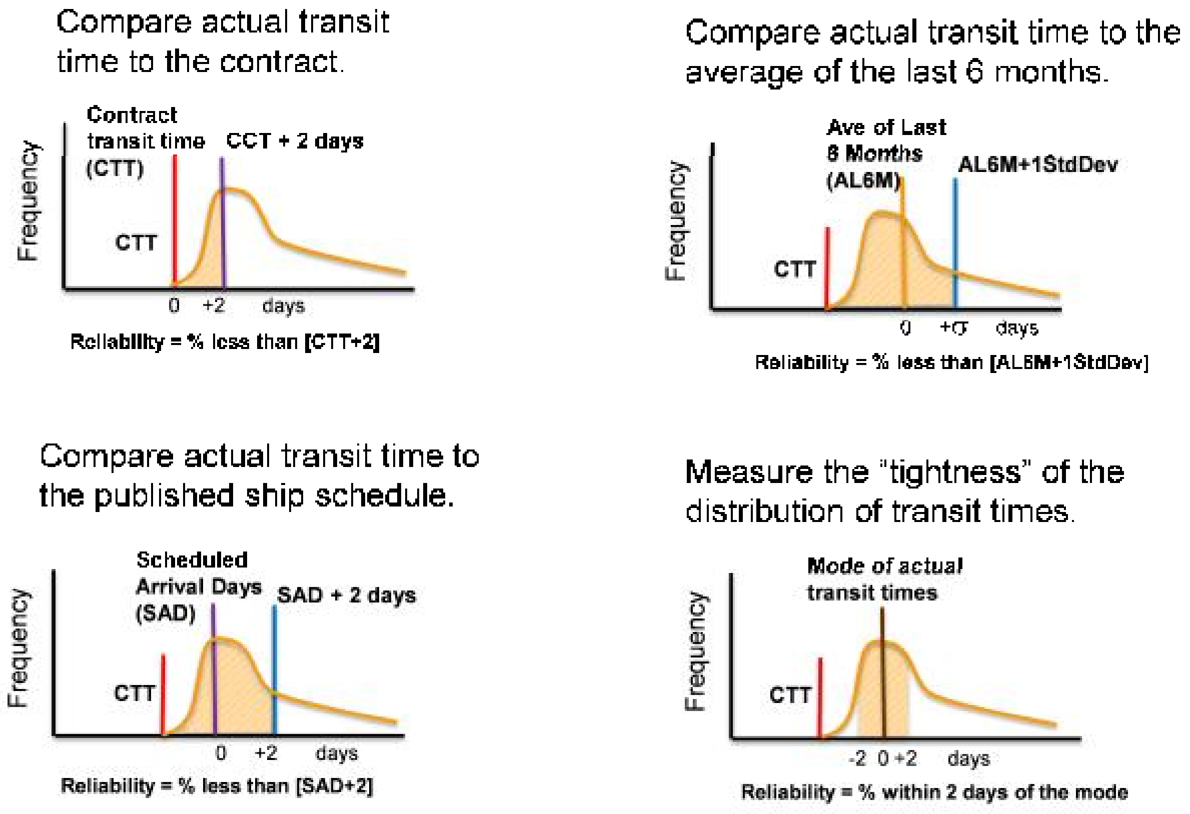


Figure 4.1. Alternative ways to define the "reliability" of ocean transportation.

However a region chooses to define reliability, the end result is a transit time value entered into each plant's CMMS system. This value is used to schedule the releases of shipments of parts from remote suppliers to the plant.

Types and Causes of Variability and Delay

Through discussions with Ford and later with its carriers, we are able to describe some of the types and causes of variability and delay (Table 4.1, below).

CATEGORY	NAME (Purported frequency)	DESCRIPTION	MOST LIKELY CAUSES
Discretionary (someone at the carrier makes a choice)	Rejection: Below Allocation (rare)	At booking Ford is limited to below its contracted allocation	Carrier has a severe capacity problem likely due to an operational problem. Carrier makes choice of whose loads to take.
	Rejection: Extras Refused (occasional)	At booking Ford is limited to its contracted allocation	Demand is heavy and carrier needs all/almost all its space to meet its contracted loads. Carrier makes choices as ship fills up of whose loads to take.
Operational Problems	Bumped or Left on the dock (occasional)	Container is booked, arrives on time, but is left on the dock.	Most often due to a "cut and run."(a) Could also be a mistake by the terminal operator or carrier. Most likely not a deliberate decision.
	Late Arrival (highest frequency)	Container gets on the ship but the ship arrives late.	Many causes – delays or re-routing (port skip) to avoid bad weather, congestion, berthing snafus, ship maintenance issues, etc.

Table 4.1. Types and Causes of "Un-Reliability."

Ford staff realizes that ocean transportation is inherently unpredictable and builds in buffers of inventory and transit time to prevent the factories from being disrupted. But delays that go beyond their buffering capacity are troublesome. Normal operational delays can be large but delays that are in some part discretionary by the carrier hurt the carrier's credibility and are particularly irritating to Ford:

Rejected – booking is refused
Bumped – container is booked but then bumped off the ship

Skip – ship skips a port to get back on schedule
Cut & Run – ship leaves before Ford's containers are loaded

In addition to these discretionary delays, Ford is also very concerned about delays at the origin land legs and origin port – because Ford cannot easily expedite the shipment at these locations.

4.2. Data Summary and Methodology

In this section, we review our data analysis methodology and objectives to better understand the reliability problem and to provide suggestions.

Data Description

To examine the reliability problem, we sent out requests to the four regions for all shipment data on all lanes of 2010. Unfortunately, after a prolonged effort, we were able to obtain shipment data for some fraction of the lanes only. Table 4.2 lays out the number of lanes for which we received container shipment information (in parenthesis) and the total number of lanes for each origin-destination pair. Unfortunately, we were not able to receive any container shipment data from the South America region; we have only been able to receive partial vehicle shipment data from this region. The amount of information available after the data collection process and the amount of time spent to retrieve the information suggested that the shipment data are actually not collected or reviewed extensively by Ford.

		To				
		North America	APA	South America	Europe	Total
From	North America	2	44 (1)	48	79 (24)	173 (25)
	APA	74 (42)	126 (18)	20	53	273 (60)
	South America	19 (7)	15 (1)	11	14	59 (8)
	Europe	141 (30)	77 (7)	24	1	243 (37)
	Total	236 (79)	262 (27)	103	147 (24)	

Table 4.2 Number of lanes in different regions.
(Number of lanes in the container shipment data set is shown in parenthesis.)

We have received the following data sets on ocean container shipment transactions:

- Partial information on container shipments into North America, Europe and APA
- Delayed shipments into North America (March-December 2010)

- Refused bookings from Asia and South America into North America (January-May 2010)

The North America and Europe container shipment data sets were quite similar in format and they included the following information for each shipment:

- Characteristics of the shipment: Shipment ID, Supplier (Name and Location), Plant (Name and Location), Conveyance, Consolidation Center GSDB, Consolidation Location (City, State, Country), Deconsolidation Center GSDB, Deconsolidation Location (City, State, Country)
- Dates that the shipment reaches each step of the route: Ship Date, Arrival Date to the Consolidation Center, Departure Date from the Consolidation Center, Arrival Date to the Load Port, Departure Date from the Load Port, Arrival Date to the Destination Port, The Date that the container is available at the Destination Port, Departure Date from the Destination Port, Arrival Date to the Deconsolidation Center, Departure Date from the Deconsolidation Center, Arrival Date to the Consignee
- Characteristics of the Shipment Route: Ford Route ID Number (O Lane), Ocean Carrier's name, Port of Exit, Port of Entry

APA data had a different format and provided a summary of lane-by-month container moves from many origins into APA. Specifically, it included the following information:

- Lane number, carrier, origin/destination, service agreement
- Number of sailing, number of containers, contract transit time, containers arrived on time/+1 to 2 days delayed/+3 to 7 days delayed/+8 to 13 days delayed/ more than 14 days delayed
- Causes of delay

We have also received data on Ford's contracts with ocean carriers, which provided information on the following elements for each lane:

- Carrier
- Service agreement (P/P, P/D, D/P, D/D)
- 2010 Estimated TEUs
- Annual buy (total amount to be paid)
- Transit time estimates provided by the carrier at the time of the bid
- Origin, destination, entry and exit ports

Data Analysis Objective

Our initial efforts have been focused on eliminating the inconsistencies and cleaning the data sets received on North America and Europe shipments. Moreover, since the shipment level data has shipment of boxes and containers all listed as different entries, we have consolidated the shipment level data into container level data.

After the cleaning process, our effort on data analysis has been focused on addressing the following issues:

1. What is the operational reliability of Ford's carriers?
   a. How do the carriers perform with respect to the transit times specified in the contract?
   b. How variable are the actual transit times for different lanes and regions? How is the variability distributed across different legs of the transit?

2. What are the impacts of the major transit delays documented in delayed shipments data?
   a. How often do the major delays occur? How are they reflected in the shipment transactions data?
   b. What are the main causes of these delays?

To answer the first question, we have analyzed the variability in the container shipment data from North America and Europe regions. We have made comparisons between the actual transit data with the contract transit time estimates as well.

To answer the second question, we have analyzed the delayed shipments into North America. Specifically, we identified the main causes of these delays as well as their effect on the estimated arrival of the vessel and total transit time.

4.3. Operational Reliability of Ford's Carriers

Contract Reliability of Ocean Carriers

The ocean carriers provide estimates on the transit times at the time they bid for Ford's business. This estimate provides a benchmark for the reliability performance of the ocean carriers. If their estimate is accurate, Ford can use it during their internal planning. Otherwise, Ford has to use their own resources to estimate the transit duration when planning their operations. Hence, how the ocean carrier perform compared to their estimate is important for Ford.

To understand the contract reliability, we calculate the percentage of containers that were delivered to Ford on time (i.e., either at or below the transit duration estimated by the carrier in the contract) for each lane. We call this metric as on-time contract reliability and it provides a conservative measure of contract reliability since the container is considered as late even if it takes an extra day over the contract transit time estimate. To provide more flexibility to the contract reliability definition and to better capture the duration that the container is late, we also calculate the percentage of containers that were delivered to Ford up to 7 days delayed. This metric is referred as 7-day contract reliability. The calculated reliability values are given in Table 4.3.

First of all, the reliability values for lanes into North America are quite low: the on-time contract reliability, on average, is 12% across different lanes. The delays are quite significant as suggested by the 7-day contract reliability. This metric shows us that, on average, around 45% of containers arrive with a delay of more than 7 days. From the reliability numbers, we realize that there is a clear mismatch with what the carriers estimate beforehand and how they perform throughout the year for the North America lanes.

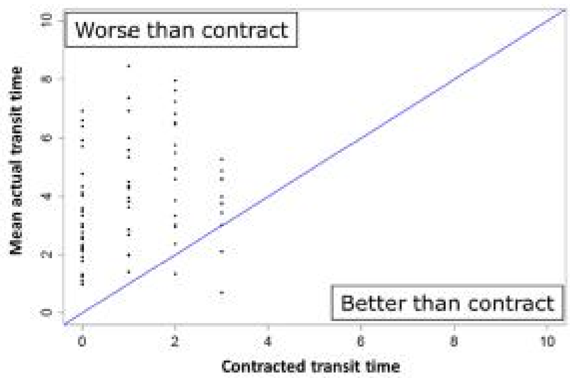
We observe an improved reliability performance for the lanes into Europe: the on-time contract reliability, on average, is 69% across different lanes in this region. 7-day contract reliability reaches 94% which suggests that most of the delays are less than 7 days. A comparison of the on-time reliability values between Europe and North America shows that the Europe lanes are significantly more reliable (supported by Wilcoxon test with a significance level of 5%). Therefore, contract reliability performance of the carriers is considerably affected by the region they operate in. Note that this observation is possibly driven by the accuracy of the transit time estimates in different regions rather than a difference in the distribution of the actual transit times.

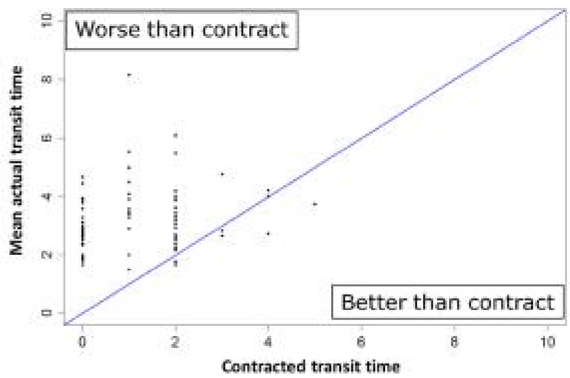
NORTH AMERICA												EUROPE			
Ford Route Number	On-Time Contract Reliability	7-Day Contract Reliability	Number of Containers	Ford Route Number	On-Time Contract Reliability	7-Day Contract Reliability	Number of Containers	Ford Route Number	On-Time Contract Reliability	7-Day Contract Reliability	Number of Containers	Ford Route Number	On-Time Contract Reliability	7-Day Contract Reliability	Number of Containers
0030A	14%	84%	245	1333A	8%	41%	387	1769A	22%	77%	226	0421A	100%	100%	24
0032A	15%	61%	252	1334A	33%	76%	95	1783A	22%	89%	9	0697A	91%	96%	56
0058A	17%	76%	585	1337A	0%	49%	87	1794A	0%	9%	55	0699A	100%	100%	57
0060A	1%	23%	328	1339A	10%	71%	42	1799A	5%	35%	37	0701A	77%	100%	44
0309A	30%	85%	40	1352A	0%	18%	44	1805A	0%	62%	77	0703A	98%	100%	43
0454A	0%	89%	46	1367A	0%	75%	4	1844A	41%	83%	59	0710A	86%	96%	49
0455A	0%	94%	17	1451A	0%	24%	208	1952A	60%	93%	243	0731A	75%	100%	20
0748A	7%	77%	30	1452A	2%	27%	341	1957A	2%	39%	44	0976A	11%	57%	82
0838A	0%	27%	550	1466A	0%	76%	32	1958A	0%	6%	32	1179A	0%	79%	24
0839A	7%	83%	46	1596A	8%	45%	74	1972A	2%	46%	54	1329A	61%	97%	66
0842A	0%	100%	6	1597A	21%	66%	233	2000A	0%	28%	72	1504A	68%	97%	41
1098A	26%	77%	112	1601A	0%	32%	212	2025A	14%	60%	696	1611A	95%	100%	109
1101A	54%	95%	59	1604A	0%	0%	3	2029A	52%	100%	23	1621A	39%	93%	59
1107A	33%	83%	6	1607A	0%	12%	49	2069A	12%	90%	51	1624A	61%	93%	76
1109A	0%	82%	57	1618A	14%	62%	66	2070A	6%	48%	33	1658A	31%	95%	61
1111A	52%	86%	21	1626A	32%	66%	47	2071A	0%	50%	8	1660A	92%	100%	100
1114A	5%	72%	39	1628A	17%	79%	77	2074A	0%	27%	30	1705A	87%	96%	118
1118A	7%	76%	135	1631A	13%	62%	110	2075A	0%	18%	130	1896A	89%	100%	104
1121A	0%	32%	241	1645A	0%	58%	212	2078A	14%	54%	654	1965A	64%	94%	130
1207A	30%	100%	10	1652A	7%	59%	54	2083A	0%	35%	37	1998A	41%	100%	97
1227A	53%	95%	40	1654A	0%	36%	36	2121A	27%	82%	11	2024A	63%	83%	8
1230A	17%	100%	6	1684A	0%	68%	19	2218A	0%	50%	2	2199A	0%	0%	2
1232A	30%	92%	89	1696A	26%	93%	46	2258A	0%	100%	2	2203A	33%	64%	12
1242A	0%	15%	85	1697A	0%	53%	47	2259A	0%	50%	2				
1250A	0%	29%	116	1710A	18%	61%	61	2267A	100%	100%	1				
1255A	1%	62%	85	1721A	56%	94%	87								
1304A	9%	52%	23	1722A	31%	90%	42								

Table 4.3 Contract Reliability of North America and Europe Ocean Lanes

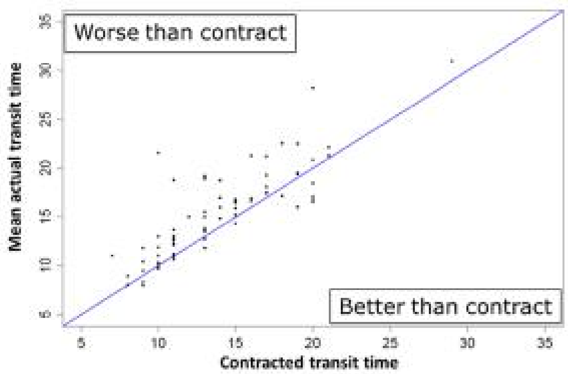
Our analysis of contract reliability provides an aggregate view of how the carrier performs up to the contract. However, it does not provide information on which part of the transit may hurt the reliability performance the most. Since the North America reliability values are quite low, we analyzed these lanes further to identify the problematic parts of the transit. Note that the carriers provide transit time estimates of different legs of the route. To better assess the causes of the low reliability values for lanes into America, we compared these estimates with the actual transit times of different legs in our data. This analysis helps us to identify the legs of the route that deviates most from the contract.

We find striking differences between the reliability performances of the different legs: for example, the carriers can, in fact, provide quite accurate estimates of the port-to-port transit times. However, they cannot provide reliable estimates of the port dwell times, as evidenced by Figure 4.2. Therefore, Ford can use some parts of the carrier's estimate and may find it useful to increase visibility on others. For example, Ford can benefit from acquiring information on the port dwell times and incorporate this information during internal planning.





(a) Load port dwell contract reliability (b) Destination port dwell contract reliability



(c) Port-to-port transit time contract reliability

Figure 4.2 Contract reliability of load/destination port dwells and port-to-port transit for North America lanes (each point represents a lane in the data set)

Another question of interest is whether the contract reliability is affected by the service agreement between the carrier and Ford. In our North America data set, 58 lanes had D/D service and 21 lanes had P/D service while all lanes for which we have the information in Europe had D/D service. We did not find any significant difference between the on-time contract reliability performances of D/D and P/D lanes in North America. Therefore, service agreement was not identified as a highly significant factor in contract reliability in our analysis.

To increase the visibility over the performance of different ocean carriers, we also calculated the on-time contract reliability of each carrier by aggregating the container shipments into North America and Europe (provided in Table 4.4). The values in this table provide a measure of how reliable a particular carrier is with respect to the contract. We observe significant variability in the performance of different carriers: for example, ZIM has the highest contract reliability percentage with 38% of containers meeting the transit time estimate in the contract. Conversely, MOL can only meet the contract estimate 9% of the time. HAPAG, the carrier with the highest number of traffic in our data, had an on-time reliability performance of 20%. Note that these values are different from Appendix 2.1 since they are based on contract reliability and our data set is limited.

Carrier	On-Time Contract Reliability	Number of Containers
HAPAG	20%	7336
APL	18%	1352
Hamburg Sud	12%	548
ZIM	38%	367
NYK Line	23%	237
MAERSK	17%	77
MOL	9%	45

Table 4.4 On-Time Contract Reliability of Different Carriers

1.1 Variability in the Transit Times

As another measure of operational reliability, we also consider the variability in the transit times of lanes. If a particular lane has a consistent transit time, then Ford can use the historical performance of the lane as an estimate in planning. However, a high variability also makes the internal planning more difficult. Therefore, in this section, we examine the variability in the transit times of different lanes for container shipments as well as the sources of variability.

Following the data and the feedback from Ford, we segmented each container movement into the same five segments as identified in Chapter 2. These segments are origin-to-port, load port dwell, port-to-port, destination port dwell, port-to-destination. Table 4.5 also provides the means and standard deviations of the duration of each of these segments. Our key observations can be listed as follows:

North America:

- Total transit from various regions into North America takes approximately 30 days. There is considerable variability since the standard deviation is 5-6 days for all origin regions.

- Port-to-port segment is relatively stable compared to the other segments (i.e, this segment has the lowest variability compared to the average).
- There is significant amount of dwell time in the ports (approximately 3-4 days). The dwell times are very significant for lanes from South America: we observe an average of 6 days and the standard deviation is 4.8 days.
- For all origin regions, the highest variability compared to the average transit time is observed in the origin-to-port segment.

Europe:

- The total transit time is, on average, 22 days. This is lower than the North America transit times, but there is high variability as evidenced by a standard deviation of 8 days.
- Port dwell times are once again significant and take approximately 3 days.
- Port-to-port segment is relatively stable compared to the other segments (i.e, this segment has the lowest variability compared to the average). Compared to North America region, port-to-port duration is lower, but variability is higher, which may be due to changes in the number of stops at the route.
- The highest variability compared to the average transit time is observed in the destination port-to-destination segment.

	Origin Landside Transit	Origin Port Dwell	Ocean Transit	Destination Port Dwell	Destination Landside Transit	Total Transit
APA to North America	2.1 (2.5)	3.2 (3)	14.4 (5.1)	4.1 (4)	6 (4.8)	29.9 (6.4)
South America to North America	2.4 (3)	6 (4.8)	17.2 (3)	3 (2.4)	3.2 (2.9)	31.8 (5.3)
Europe to North America	4.2 (3.1)	4.4 (3)	12.6 (3.5)	2.7 (1.8)	4.3 (3.1)	28.3 (5.5)
North America to Europe	3.1 (2.4)	3.1 (2.8)	11.2 (5.6)	3.1 (2.6)	1.9 (2.5)	22.4 (7.8)

Table 4.5 Means and standard deviations of the transit times in days (standard deviations are shown in parenthesis).
Bold values indicate a coefficient of variation > 1.0 – high variability.

1.2 Major Delays

We received data on the major delays that occurred between March and December 2010 for a subset of lanes into North America. The delays mostly occurred for shipments originating from APA and South America: the data set included mostly 93 container shipments from APA, 161 container shipments from South America, and only one container shipment from Europe.

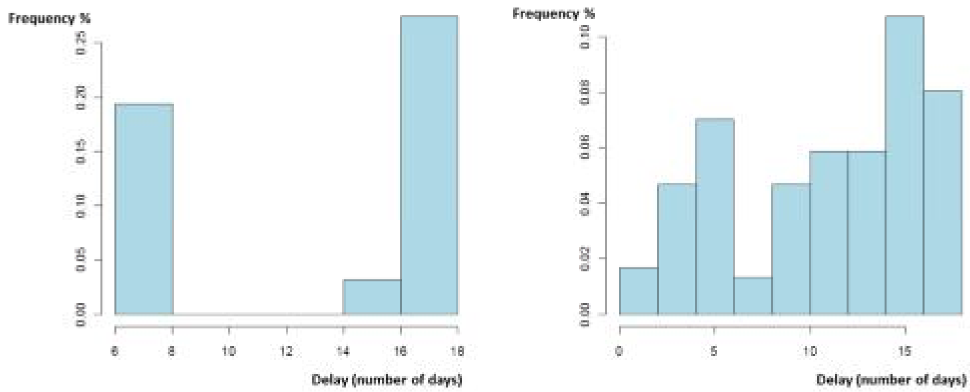
As a first step, we examined the common causes of the major delays. Since the data set included comments on the causes of delays, we used them to classify the data. We identified nine common causes for delay, which are listed in the table below along with their frequency of occurrences in the major delays data:

Causes of Delay	Frequency of Occurrence	Median Delay in the Arrival Date
Vessel Schedule Delays	25%	2
Port Congestion	22%	5
Weather Issues	13%	3
Vessel Operational Delays	11%	7
Vessel Skipping Port	10%	2
Cut-and-Run	9%	7
Customs Inspection	8%	7
Strike	1%	31
Port Congestion and Weather Issues	1%	2

Table 4.6 Documented Reasons for Delay (March-December 2010)

In this table, vessel schedule delays correspond to cases where the carrier updates the shipping schedule and postpones the delivery times due to delays in the route while vessel operational delays imply the delays due to operational problems such as mechanical issues. As can be seen from the table, vessel schedule delays, port congestions, and weather issues are the leading factors for major delays. Cut-and-runs, which were often mentioned in the interviews with Ford, are cited 9% of the time among the major delays data. 94 percent of the shipments delayed by cut-and-runs were originating from Brazil, were carried by Hapag, and occurred in July and August 2010.

To assess the impact of the documented reasons above, we examined the amount of delay caused by each of these factors. The delay is reflected in the change in the estimated arrival time of the vessel to the destination port, which was available to us in the major delays data. Histograms below show the distribution of delays caused by (a) cut-and-runs and (b) other factors. We observe that although the cut-and-runs may have a lower frequency than some of the other factors, they contribute to a higher amount of delay, which can also be statistically verified.



(a) Amount of delay caused by cut-and-runs

(b) Amount of delay caused by other factors

Figure 4.3 Amount of delay in the arrival time of the vessel.

Next, we checked the significance of the documented delays on the total transit time. Since the delays data only had the changes in the arrival and departure dates of the vessel, we calculated the total transit times of the documented delays by finding the corresponding entries in the shipment data. We then compared the total transit times of the documented delays with the rest of the shipments in the same lane from the shipment data. First of all, we were only able to locate 66 documented delays in our shipment data. This may be due to the partial tracking of the shipment information. Among the delays we located, the impact of the major delays in the total transit times was not as high as we anticipated. Particularly, among the 16 lanes for which we had documented delays information, only three lanes (0838A, 1645A, 2025A) had a significantly higher median total transit time than the rest of the shipments in the same lane from the shipment data. Therefore, although we observed quite significant changes in the vessel schedules in the delays data, the effect of these delays on the total transit time were not as high and possibly reduced by other legs of the route.

5. Findings and Recommendations

This chapter summarizes the key findings and lays out recommendations for Ford to take in order to improve their global ocean transportation operations.

5.1. Overall Findings

This project consisted of both qualitative and quantitative analysis. We interviewed over two-dozen executives from Ford as well as experts from across the industry. We did NOT survey or interview other shippers for general practices. Movement by movement transactional analysis was completed for all regions that could provide us data.

Interestingly, we found great consistency in the findings across the different analyses. The top nine findings from our joint analysis are listed below.

1. Delivery reliability within the ocean transportation industry is appalling, with an average 50-55% on-time port-to-port delivery. This needs to be put in the context of overall door-to-door delivery reliability, where shipping accounts for a small (5-6%) part of the overall variation across a string.

2. The industry has responded to the recession and afterwards by widespread adoption of slow steaming, centralizing functions and a greater focus on profitability. However, the introduction of new capacity has ensured a downward pressure on prices over the rest of 2011.

3. Focusing on door-to-door total transit time is important, but so is analysis on each of the five segments that comprise these movements: Origin landside transit, Origin port dwell, Ocean transit, Destination port dwell, and Destination landside transit.

4. Ford does not appear as “One Ford” to its carriers. The movement lanes are often duplicated from the carrier’s perspective and there are multiple layers of decision making within Ford that make the firm look like a collection of fiefdoms instead of a single entity. Additionally, each regional area has different processes, practices, and priorities – there does not appear to be a single Ford approach.

5. Ford procurement forces all carriers into a lane-by-lane analysis. This discourages economies of scope or scale in the bidding process. But, to be fair, we are unsure how much the carriers can actually utilize global bidding capabilities.

6. Ford’s procurement process seems to take too long for a one-year contract. Ford’s multiple layers of approval for procurement adds months to the time and reduces likelihood of a “One Ford” global strategy.

7. Ford does not appear to really care about transit reliability or other carrier performance metrics. This is reflected in the lack of data collection on carrier performance – data only collected after a problem is found (reactively) not used proactively. Ford's carrier management seems to be based more on "Management by Anecdote" than on any data analysis.

8. Reliability seems to be viewed as important at the top management level, but is not included in any procurement or management decisions that we found at the operational level.

9. The definition of reliability is not consistent across Ford's regions or groups.

5.2. Recommendations

Based off our analysis, we recommend five general actions for Ford to take:

Recommendation 1 – Capture and measure both Door-to-Door and segment statistics

While our focus has been - as requested - on the ocean transit segment of the global movement, we believe that it is critical for Ford to focus on capturing and measuring total door to door costing, timing and variability management (See Figure 2.2). As a second tier of metrics, the individual five transit and dwell segments should also be measured. Second tier of metrics can help in the identification of causes of delays.

Managing and controlling GOT as a commodity that is subjected to lane-specific pressures for rate reduction needs to be placed in the context of overall door-to-door improvement objectives. Door-to-door management and control could be coordinated by a partnership of freight forwarders (shipping) and associated 3PL's (freight).

Recommendation 2 – Create a Single Consistent Definition of Reliability

As noted in Chapter 4, each region seems to have a different way of measuring reliability of ocean transit – if they measure it at all. We recommend that just as Ford centralized and standardized the bidding process, it should standardize the definition of reliability.

We recommend that Ford adopt "Contract Reliability" as its formal reliability metric. This would technically be defined as the actual number of transit days less the number of days specified in the contract at the time of procurement. The coefficient of variation (CV) could also be used as a comparative measure between carriers and lanes. Both of these metrics can be applied at the five segment levels (Figure 2.3) as well as the overall door-to-door transit time. In turn, causes of delay and lack of reliability (such as landside dwell times and ocean transit port delays) can be identified and improved.

The main benefit of this definition is that it ties together both the procurement and the operational management of reliability. The values that the carriers promise during the bid will be used to judge how well they perform over the course of the contract.

Recommendation 3 – Standardize and Require Data Collection Across All Regions

A good indicator of the lack of importance of a metric (such as reliability) is the effort required to collect the data to be able to calculate it. While we requested data for individual shipment movements from all regions, we were ultimately only able to collect 17% of the total lanes constituting just 6% of the forecasted container volume over the course of the year! Only two regions could provide us any data of real detailed analytical value.

We adhere to the adage that you can only manage what you measure and you can only measure what you collect. Just as Ford should standardize the definition of reliability, it should also standardize the manner and form of the data collection needed to create these metrics. These should be collected and coordinated across the entire 'door to door' process, not just the ocean transit segment. Because Ford uses third parties for the management of these movements, we envision that this should be easily accomplished – and part of any negotiation with forwarders or third parties.

Recommendation 4 – Implement a Carrier Performance Scorecard Process

We recommend that once the performance metrics are clearly defined and the data is collected in a standardized manner, the results should be utilized in the carrier management process. Carrier reliability metrics could be used during the procurement cycle to validate (invalidate) the carrier's promised future performance. If a carrier is not an incumbent or there is no historical reliability data to report, then a proxy for reliability could be the number of intermediate ports on a string. This data should be captured during the bidding process.

Recommendation 5 – Encourage Innovative Global Bundled Bids

We recommend that Ford continue to push the leading edge to open itself up to more innovative and global bids from its carriers. There are parallels to truckload procurement in that the carrier market needs to evolve in order to fully leverage these processes. But, Ford should be a leader here in allowing carriers to be creative in how they respond to bids – to include global offers.

5.3. Proposed Next Steps for Research

We anticipate that the next steps for our research will emerge from the workshop scheduled for June 6 in Dearborn. This could include positioning GOT in the context of overall door to door times.

6. APPENDIX

6.1. Appendix 1.1: Shipping Industry Reliability

Reliability by carrier

Carrier	Percentage of on Time Vessel Arrivals (Previous Quarter)	Overall on Time Vessel Reliability Ranking (Previous Quarter)	Average Deviation from ETA in Days (Previous Quarter)	Overall Transit Time Deviation Ranking (Previous Quarter)
Maersk Line	76.5% (69.2%)	5 (6)	0.6 (0.7)	6 (4)
Hyundai Merchant Marine	64.0% (54.2%)	11 (17)	0.8 (0.9)	8 (6)
APL	63.2% (55.5%)	12 (15)	0.9 (0.9)	9 (6)
CMA CGM	59.6% (55.6%)	13 (14)	1.1 (1.2)	11 (9)
UASC	59.5% (50.6%)	14 (19)	1.0 (1.1)	10 (8)
OOCL	56.9% (42.2%)	16 (24)	0.9 (1.3)	9 (10)
Hamburg Süd	55.7% (56.3%)	17 (13)	1.3 (1.1)	13 (8)
Hapag-Lloyd	55.3% (46.9%)	19 (20)	1.0 (1.2)	10 (9)
NYK	54.0% (39.7%)	20 (26)	1.3 (1.5)	13 (13)
MOL	50.0% (44.7%)	21 (23)	1.3 (1.1)	13 (8)
Hanjin Shipping	47.1% (34.7%)	22 (29)	1.2 (1.5)	12 (13)
Zim	46.6% (34.1%)	23 (30)	1.2 (1.7)	12 (14)
Evergreen Line	43.6% (45.1%)	24 (21)	1.5 (1.4)	15 (11)
Cosco Container Lines	41.2% (30.2%)	26 (33)	1.7 (1.8)	17 (15)
Yang Ming	41.0% (32.0%)	27 (32)	1.6 (1.7)	16 (14)
CSAV	40.4% (61.8%)	28 (8)	2.1 (1.0)	19 (7)
K Line	39.7% (28.9%)	29 (34)	1.6 (1.9)	16 (16)
MSC	38.6% (40.6%)	32 (25)	1.9 (1.8)	18 (15)
CSCL	28.4% (33.1%)	36 (31)	2.1 (2.0)	19 (17)
PIL	14.3% (24.4%)	41 (37)	3.5 (2.7)	26 (19)

Note: Top 20 refers to leading operators' containership fleets measured in teu

Source: Drewry Research tracking of 1,792 vessel calls (expected arrival versus actual arrival)

Reliability by trade route

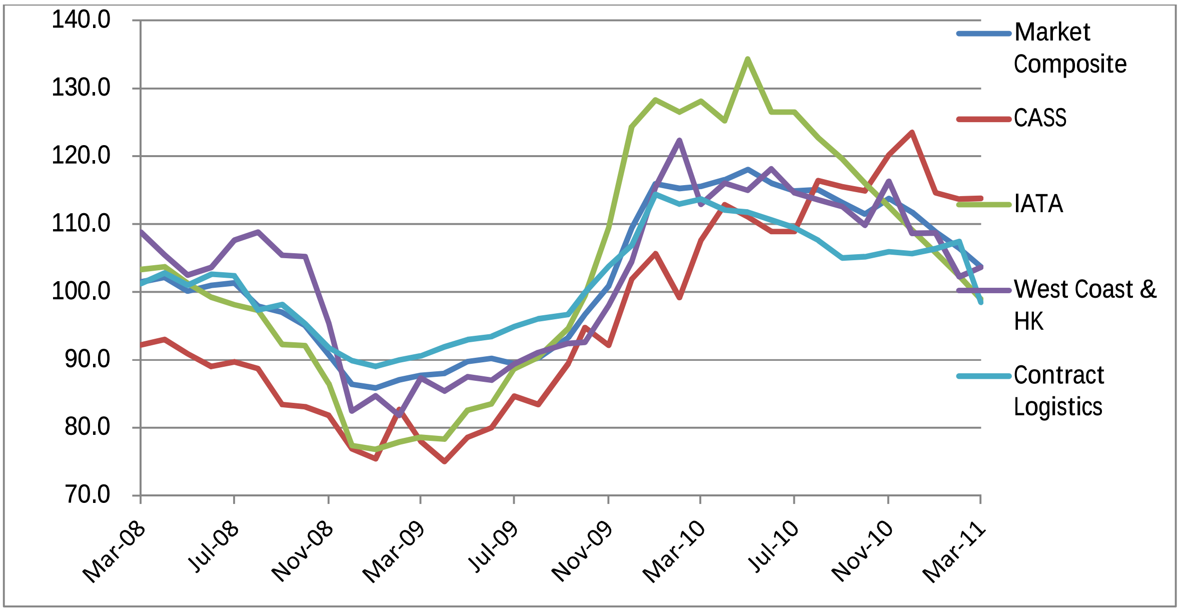
Trade Route Name, Service Name & Carriers Operating the Service	Total Vessel Arrivals Tracked by Service	No. of Vessels on Time	% of on Time Arrivals	Average Time Deviation in Days from ETA
Asia/Aus/NZ/South Pacific				
APL/Evergreen/Hamburg Süd/Hapag-Lloyd/HMM/Maersk/MSC - AAS/CAS	14	10	71%	1.1
Cosco/PIL/Gold Star Line/NYK/MOL/K Line - CAS	9	3	33%	4.3
ANL/CSCL/OOCL/NYK/MOL/K Line/Cosco - AANA/NACA/AUS2/AU2	12	3	25%	2.5
CSCL/OOCL/ANL - ACE	12	2	17%	1.2
Cosco/MOL/NYK/Hamburg Süd/Maersk Line/Hapag-Lloyd - NZ3	12	1	8%	2.3
Asia/ECSA				
MOL - CSW	12	7	58%	1.3
CMA CGM/CSCL - SEAS	11	4	36%	1.8
Maersk/Hamburg Süd/Safmarine - ASAS/NGX	12	4	33%	2.0
Evergreen Line/Cosco - ESA	13	2	15%	3.0
Asia/Europe/Med				
Maersk Line - AE6	13	13	100%	0.0
Cosco/K Line/Yang Ming/Hanjin/UASC - NE1	12	11	92%	0.2
Maersk Line/CMA CGM - AE7	12	11	92%	0.1
Maersk Line - AE2	13	11	85%	0.2
New World Alliance/Grand Alliance/CMA CGM - AEX	13	11	85%	0.2
New World Alliance/Grand Alliance/CMA CGM - SCX	13	11	85%	0.6
UASC/Hanjin - AEC2	13	10	77%	0.5
Maersk Line/CMA CGM - AE9	13	9	69%	0.4
CMA CGM/ANL/HMM/Maersk/APL/MOL/CSCL/Evergreen - FAL1	13	8	62%	0.6
Cosco/K Line/Yang Ming/Hanjin/UASC - NE2	12	7	58%	0.6
Grand Alliance/Evergreen/Zim - Loop A	13	7	54%	0.5
Grand Alliance/Zim - Loop C	13	7	54%	0.9
Cosco/K Line/Yang Ming/Hanjin/UASC - NE4	13	6	46%	1.0
Grand Alliance/APL/Zim - Loop B	13	6	46%	0.9
Cosco/K Line/Yang Ming/Hanjin/CSCL - MD1	13	5	38%	3.5
New World Alliance/CMA CGM - JEX	11	3	27%	1.3
Cosco/K Line/Yang Ming/Hanjin/UASC - NE3	13	3	23%	0.8
Grand Alliance/New World Alliance/Zim - EUM/MED	10	2	20%	2.2
MSC - Silk Express	10	2	20%	3.4
CMA CGM/CSCL/ANL - FAL2/AEX7	13	2	15%	3.0
MSC - Dragon Express	7	1	14%	3.3
Evergreen/CSCL/CMA CGM/Zim/HDS Lines - CEM/AEX1	13	0	0%	2.2
Asia/Indian Sub/Mideast/Red Sea				
Maersk Line/HMM - FM1	13	12	92%	0.3
APL/MOL/HMM - WAX/CMI	11	9	82%	0.3
Grand Alliance/T.S.K. Line/RCL/Emirates/HMM - MAX	13	9	69%	0.3
Yang Ming - CGX	12	8	67%	0.6
Emirates/OOCL/CMA CGM - Hyper Galex/AIM7	13	7	54%	0.5
APL/CMA CGM - REX	9	3	33%	2.6
CSAV Norasia - Super Galex	12	3	25%	1.8
CSCL/CMA CGM/UASC/CSAV Norasia/Emirates/Seacon - AMA/CIMEX	12	3	25%	2.3
Evergreen Line - APG	11	2	18%	2.3
Evergreen Line/Cosco - FRS	6	1	17%	5.3
HMM/NYK/Maersk Line/MOL/Hapag-Lloyd - KMS	13	1	8%	1.8
Wan Hai/PIL/K Line - CMS/CSG	12	0	0%	2.6

Trade Route Name, Service Name & Carriers Operating the Service	Total Vessel Arrivals Tracked by Service	No. of Vessels on Time	% of on Time Arrivals	Average Time Deviation in Days from ETA
Asia/WCSA				
NYK - ALEX-NEO	9	9	100%	0.0
K Line/MOL - New Andes	9	4	44%	1.6
CCNI/Hamburg Süd/MSC/MOL - China Express Service/ASPA 1	11	4	36%	1.5
CMA CGM/CSCL/CCNI - ACSA	6	2	33%	2.0
CSAV - ANDEX	24	8	33%	2.6
MSC/CCNI/Hamburg Süd - Andes Express/North Asia Express	11	1	9%	4.1
Asia /Africa				
Maersk Line/Safmarine - FEW 1	12	8	67%	0.3
Maersk Line/Safmarine - Safari 1	9	6	67%	1.7
CSAV - ASAX	8	2	25%	3.8
MSC - Cheetah service	5	0	0%	2.8
Europe/Med/Africa				
OPDR - Tangier and Andalusia Service	10	7	70%	0.7
Safmarine/DAL/MOL/Maersk Line - SAECS Main String	12	7	58%	1.7
Grimaldi Lines - Central Express	14	8	57%	0.9
MSC/Stinnes/Hapag-Lloyd - South Africa/N Europe	7	1	14%	1.3
Maritime Carrier Shipping - South Africa/Europe MPP	9	1	11%	3.9
Europe/Med/Carib/Central Am				
Maersk Line - CRX	13	13	100%	0.2
CMA CGM/Hapag-Lloyd/Hamburg Süd/CSAV - ECS	7	4	57%	1.0
Europe/Med/ECSA				
Hamburg Sud/Alianca/Hapag-Lloyd/CSAV/CMA CGM - River Plate Express	13	12	92%	0.8
CMA CGM/Hapag-Lloyd/Hanjin/Hamburg Süd - Safran/Brazil Express	13	7	54%	1.3
CSAV/MSC - EuroAtlan 2/SAEC 2	22	6	27%	1.9
Grimaldi Lines - Europe/Northern W Af/ECSA	9	1	11%	2.6
Europe/Med/Indian Sub/Mideast/Red Sea				
Hapag-Lloyd/Hamburg Süd/UASC - Indian Ocean Service	11	11	100%	0.2
Maersk Line/Safmarine/UASC - ME1	13	13	100%	0.0
CMA CGM - EPIC	12	10	83%	0.5
Maersk Line/Safmarine - ME3	7	4	57%	0.4
CSAV Norasia - IMEX	12	5	42%	2.0
SCI/MSC/Credo Shipping - India Subcontinent Europe Service-ISES	14	1	7%	2.5
Europe/Med/WCSA				
Maersk Line - A1 Andean	13	12	92%	0.2
CCNI - North Europe Service/Condor Express	5	3	60%	0.8
Hapag-Lloyd/Hamburg Sud/CMA CGM - Eurosal 1	11	2	18%	1.8

Trade Route Name, Service Name & Carriers Operating the Service	Total Vessel Arrivals Tracked by Service	No. of Vessels on Time	% of on Time Arrivals	Average Time Deviation in Days from ETA
Intra-Europe				
Maersk Line - EuroMed	13	13	100%	0.1
Hamburg Süd - Europe-Mediterranean (Southern Route)	14	12	86%	0.5
Borchard Lines - North European Service	13	9	69%	0.3
CMA CGM - FEMEX	13	9	69%	1.2
OOCL - SBX2	13	9	69%	0.5
Delta Shipping Lines - UK/Continent Service	8	5	63%	0.6
CMA CGM - FAS Baltic Poland	13	5	38%	1.3
Hamburg Süd/Zim - N.Europe-East Med/NEC	6	2	33%	1.2
K Line - IBESCO A	10	3	30%	0.8
Swan Container Line - Hamburg, Rotterdam, St. Petersburg service	11	3	27%	2.2
Delta Shipping Lines/WEC Lines - European Service	10	2	20%	2.7
CMA CGM - FAS Baltic Poland	13	5	38%	1.3
Hamburg Süd/Zim - N.Europe-East Med/NEC	6	2	33%	1.2
K Line - IBESCO A	10	3	30%	0.8
Swan Container Line - Hamburg, Rotterdam, St. Petersburg service	11	3	27%	2.2
Delta Shipping Lines/WEC Lines - European Service	10	2	20%	2.7
CMA CGM - FAS Kaliningrad	12	1	8%	2.5
Evergreen Line - BAL1	27	2	7%	3.6
MSC/Hapag-Lloyd - EEX1	11	0	0%	3.4
OOCL - SBX1	8	0	0%	3.1
Turkon Line - N.Europe-Med Line	10	0	0%	3.4
North America/Africa				
MSC/Safmarine/Maersk Line - AMEX	8	5	63%	2.0
North America/Aus/NZ/South Pacific				
Hamburg Sud/Maersk/Hapag-Lloyd/ANL/U.S. Lines - PSW	12	8	67%	0.4
Hamburg Sud/Maersk/Hapag-Lloyd/ANL/U.S. Lines - PNW	6	3	50%	0.8
Hamburg Sud/Polynesia Line - South Seas Islands	5	1	20%	1.6
North America/Carib/Central Am				
Maersk Line - SAE	13	12	92%	0.3
North America/ECSA				
Hamburg Sud/Alianca/CSAV - New Tango	12	7	58%	1.7
MSC/CSAV/MOL/Hapag-Lloyd - US-ECSA String 1	18	3	17%	2.7
NYK/Yang Ming - ANS	13	0	0%	5.9

6.2. Appendix 1.2: Tracking the Contract Logistics market

Tracking the Contract Logistics market over the last 3 years



Jan 2008 = 100 © CEVA Logistics and Cranfield

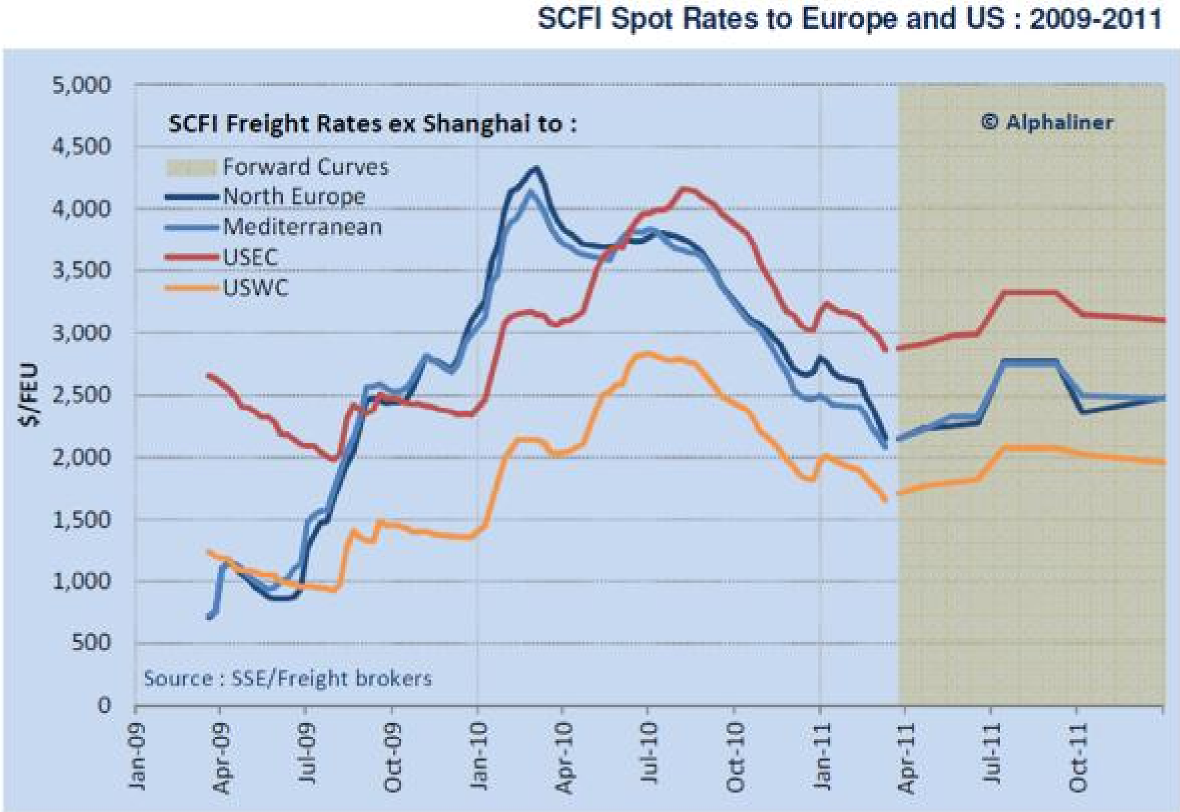
CASS Index of US domestic Freight Volumes: North American shipment volume increased 6.9% in March 2011, a gain of 13.8% from March 2010. Increased volumes in shipping, as well as positive news on other economic indicators, continues to provide evidence that the U.S. economic recovery is continuing to be positive.

IATA air freight volumes: continues to show a marked downward trend. Political unrest in the Middle East and North Africa during February is estimated to have cut international traffic by about 1%.

Containers handled in Hong Kong and US West Coast: February and March are typically slower months for Port traffic. For instance, Long Beach Port traffic as trade lags behind decreased manufacturing activity in Asia due to the Chinese New Year. All the ports experienced this decrease and on year on year base, the overall activity is higher by 2.2%. The figure is positive but lower than the previous months, stable around a growth around 10%. The disaster in Japan will not be apparent in this index until later in the year.

Synthetic Contract Logistics Indicator: was kept strong by US, EU and China markets, all of which revealed a stable situation on a year on year base in Q4 2010. While January and February data continued this trend, there was a marked drop in March. The figures were constrained by Japanese performance, which stalled after the earthquake. Q1 results for the automotive sector show a continuing 6-8% growth, slightly better than Q4 of 2010. Q3 and Q2 of 2010 showed double digit growth, but this can be explained by the comparative dip in 2009. While growth rates in China have eased somewhat (from >11% in Q3, Q4 2010 to 9.6% Q1 2011), we are not seeing a marked effect on this indicator because growth is still high, and from a higher base.

6.3. Appendix 1.3: Freight rates from Shanghai (SCFI)



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Freight rates from Shanghai sink to 16 month low Freight rates out of Asia have dropped to their lowest levels since September 2009, with further rate weakness expected in the next few months until the peak season starts to kick in. The SCFI dropped below 1,000 points last week to 994 points - the lowest level recorded since the freight rate index was formally introduced in October 2009.

A significant flow of new vessel deliveries and new service launches over the next three months could thwart carriers' attempts to raise rates. Much of the capacity increase is targeted at the Transpacific trade this year, with eight new strings currently confirmed. The increase in supply will comfortably exceed TSA forecasts of 7-8% growth in demand this year. Alphaliner estimates that the capacity growth on the Transpacific routes could reach 14% on an annualised basis, higher than the global fleet growth which is estimated at 8.7%.

Despite the carriers' predictions that the effective capacity growth in 2011 will be mitigated by the impact of delays in vessel deliveries, additional slow steaming and container shortages, these three factors are not expected to have a significant impact on the overall supply growth. A large part of the capacity due to be delivered this year has already been delayed from the last two years. Many of these ships are already fully completed and could be commissioned at any time.

6.4. Appendix 2

Table A2.1 Statements by Ford's ocean carriers during the interviews.

Topic	Aspect	Comments (frequency if more than once)
Bidding	Mechanics of how run	Very well run. (5)
	Boilerplate	Very aggressive, especially the air freight clause. Free time requirement too big and unclear (2)
	Length of time	About right. Not enough time. Takes too long.
	Time delay till effective	Too long between bid and effective date (2)
	Timing of Bidding	Fine (3), Out of synch with Pacific trades results in carrier hedging & higher rates (3)
	Regional meetings	Don't need them (2), Regional meetings are desirable & would result in better relationship / better rates for Ford(2).
	Duplicate Lanes	Same O-D pairs shows up multiple times, adds undesired complexity (2)
	Transit Time	Is very important to Ford. Not important compared to price (2).
	Price	Most important aspect in bid by far (2), Ford seeks the cheapest carriers (2)
	Reliability	Does not appear at all in the bidding (2)
	Bundling	Ford allows carriers to offer bundles(4), Carriers struggle to collaborate across the "trades" so multi-regional bundles are limited (3), Tried submitting bundles but turned into lane by lane anyhow (3)
Performance Measures	Shipment Reporting	Not asked to provide this information. We provide this information to the forwarder (2)
	Scorecard	No such process by Ford(4)
	Periodic Reviews	No such process by Ford (4), Ford calls us when there is a problem (4)
Relationship	Different Kind and Better	No, Ford has best relationship already (4) Not happy, want to be primary global carrier. Ford should have more of a partnership mentality (2)
	Longer Term Contract	We would prefer a longer term contract with price reviews (2) Really like the bunker fuel adjustment (3) Indexed rates are worrisome – index is usually to coarse
	Risk Sharing	There is no effective penalty to Ford for shipping fewer containers, no effective MCQ (2) There is an effective MCQ. (minimum commitment quantity)
	Paying On Time	Ford does not pay its bills on time
	Reduced	Ford never tells us if they are going to need fewer slots (4)

	Volumes	
Reliability	Refused Allocated Slots	We did not do this in the last year (3) Only do this when there is an operational problem.
	Refused Extra Slots	WE did not do this last year. We try not to ever refuse Ford's containers. This will happen when capacity is tight (2)
	Define Bumping Strategy	No, have not made a plan for this (2), Will bump non-contract customers first (2). Will bump NVOCC containers first (2), Will bump lower paying freight first.
	Peak Load Pricing/Bumping	No, have not thought about this (3), Yes bulk customers get low price but know they will get bumped first (3)
	Include in Bidding Process	Yes we would like to have reliability included somehow (3), Very hard but important to get apples to apples reliability data on carriers (4)
	Data base of Reliability Data	Forwarders would have to collect this from all carriers (4) Probably need data from other shippers and forwarders to be comprehensive (2)

Table A2.2 Statements by Carriers regarding ship schedules and bid information.

Carriers Questions	Hamburg Sud	SAF Marine	Maersk	Hapag-Lloyd	NYK Line
When you complete the bid package for Ford including specifying transit times, do you know what the ship schedules will be for Feb – May of the contract year?	No	Not really – schedules may change.	Not always – schedules do change.	Not really because the schedules may change.	No because the schedules can change – Jan-May is a slack season
When you specify the cost and transit time in your bid for a lane, are you basing that on a specific actual ship schedule or are you approximating it based on general recent experience on that lane?	Transit time is based on the present schedule at time of quote.	Transit time is based on the present schedule at time of quote.	Transit based on current schedule pro-forma.	It is based on current schedules and market conditions for that particular trade, not necessary per ship.	Transit times are based on the current schedule in place while preparing the bid

During the bidding, do you provide Ford with the ship schedules or provide Ford with the number of other stops the ship will make along the way? (for the lanes that you are bidding on)	No schedules to Ford. No info on stops to Ford.	No schedules to Ford. No info on stops to Ford	No schedules to Ford. No info on stops to Ford	Not at the time of bidding, we provide our transit days as the service currently stands.	No - Ford's bid asks for the transit time and the transship port, but does not ask for the full schedule details.
During a year, how often do your ship schedules and routings change? Do these changes affect the transit times on contracted lanes?	Schedules change in-frequently but it could impact transit times.	Schedules do change but he did not know how often. Yes they affect transit times.	They do change, more frequently when supply & demand are out of balance.	Some have slight changes a couple times per year, others have dramatic changes that affect transit times.	Our schedules and transits do change, even port rotations change during the year.

Table A2.3 Statements by Ford regional staff concerning reliability.

	North America	Europe	South America	Asia Pacific Africa
How do you define reliability? Reliability is when:	- A container actually goes on the ship it is booked on. - The carrier actually holds the agree-upon slot for us - Transit time matches the average of the last 6 months	- Complying with expected route - Meet the expected transit time (make efforts to catch up) - Carrier resolves delays at terminals - Identify & fix issues on timely basis - Not leaving booked loads on the quay	Actual transit time matches the quoted (bid) transit time.	Reliability is defined as how well the actual transit time matches the Contract (bid) transit time.
What target do you compare an actual transit time to determine if it is "on-time?"	Compare to history of last 6 months	Compare to a mix of both recent experience and published schedule arrival date.	Compare actual port to port transit time to the quoted (bid) transit time but also looks at the ship schedule.	The actual port to port transit time and the door to door transit times are compared to the same transit times in the Contract.
How is your expectation of arrival date set?	Based on the last 6 months history	Combination of recent experience, chat with forwarder, and published ship schedules	The expectation is set by the quoted (bid) lead time.	The expectation is set by the Contract. They will also look at the ship schedules for clarification if needed.
What value do you put in the CMMS system?	Average of last 6 months plus one standard deviation.	Recent average transit time plus buffer of about 5 days (more in winter)	This calculation considers the total transit time, supplier dock to plant dock, and sea transit time is part of it.	Quoted transit time plus a buffer designed for each lane