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THE TUMULTUOUS WORLD OF GLOBAL MARITIME TRANSPORTATION: A CAUTIONARY TALE FOR SUPPLY CHAIN MANAGERS

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ABSTRACT

The past five years have seen unprecedented changes transform the way goods are moved around the world. The expanded Panama Canal now permits larger vessels as well as simultaneous transits in each direction. Coincidentally, steamship lines began purchasing a new generation of bigger ships, forcing ports in the United States to make very large investments in new infrastructure. When examined within the context of other environmental events impacting global trade, the total effect has been to put the maritime industry into a state of flux. This paper will examine these and other important issues before offering conclusions intended to help managers develop successful supply chain strategies in today's uncertain post-Panamax world.

INTRODUCTION

The past five years have seen unprecedented changes transform the way goods are moved around the world. The expanded Panama Canal opened for business on June 27, 2016. Widely hailed as a game changer on the scale of the original, the increased capacity of the new locks now permits larger vessels as well as simultaneous transits in each direction, both serious limitations of the pre-existing canal. Coincidentally, steamship lines began purchasing a new generation of ships that are too big even for the larger locks. In order to handle these large vessels, ports in the United States have been forced to make significant investments in new infrastructure. When examined within the context of other environmental events impacting global trade, the total effect has been to put the maritime industry into a state of disarray that has made managing the transportation element of the firm's global supply chain especially challenging. This paper will examine these and other important issues before offering conclusions intended to help managers develop successful supply chain strategies in today's uncertain post-Panamax world.

THE EXPANSION OF THE PANAMA CANAL

The Panama Canal expansion officially began on October 22, 2006 with the passage of a national referendum in Panama approving the project. Work actually commenced on September 7 the following year with an estimated completion date of October 2014. From the outset, the Panama Canal Authority (ACP) stated that the purpose of the expansion was to double the Canal's capacity in order to accommodate much larger container vessels, an issue discussed in more detail in a subsequent section (Panama Canal Authority, 2018). However, most U.S. ports were ill prepared to handle such large ships on a regular basis, either because of water depth issues, landside shortcomings, or both, and immediately initiated steps to remedy deficiencies so as to take advantage of the anticipated boon. On the Atlantic Coast, the major ports of New York, New Jersey, Baltimore, and Virginia have all recently completed or nearly completed post-Panamax expansions.

Charleston is poised to begin a dredging project that will deepen its harbor to 52 feet at mean low water (MLW) by 2020 (South Carolina State Ports Authority, 2016), while the Port of Savannah is

planning to increase its depth to 47 feet at roughly the same time (Georgia State Ports Authority, 2018a). PortMiami recently completed \$1.3 billion in infrastructure upgrades that will improve vessel, truck, and rail access to its container facility (Klulisch E., 2017). The Gulf Coast's major ports, despite facing much shallower water because of the coastal profile, are planning similar upgrades. At Bayport, the Gulf's largest and newest container facility, port authorities are dredging deeper channels, expanding berthing space, adding container yard acreage, and installing post-Panamax cranes (Port of Houston, 2018). The major West Coast ports of Oakland and LA/Long Beach already enjoy sufficient water depth and are focusing their improvement efforts on systems to speed ship loading/unloading and expedite the movement of cargo into and out of the respective terminals.

Clearly, U.S. ports, regardless of size, expect to benefit from the expansion and are, at great cost, proceeding accordingly. Whether or not they should be, remains to be seen. No port wants to be left out, because the risk of "missing the boat" by doing nothing is simply too high. That said, these projects are expensive and complex, leading to costs which are often underestimated at the outset. Once begun, the work must be completed regardless of the extra funds required. Because long-term benefits are very difficult to know and quantify, they tend to be overstated at the beginning to justify the work. Sometimes the port/bridge/waterway is built only to discover twenty years later that it probably shouldn't have been.

THE CURRENT SITUATION

Unfortunately, as is often the case, the world has changed in unexpected ways since expansion work began. First, the present state of the global container shipping industry will be scrutinized with respect to the growth in ship size and the reduction

in the number of carriers. Then, containerized cargo flows into and out of U.S. ports will be discussed, followed by a closer look at critical problems affecting some domestic ports. Finally, something that cannot be ignored is the ongoing uncertainty surrounding the Trump administration's handling of foreign trade issues and in what ways their policies might affect global maritime transportation.

Global Maritime Industry

Two of the most significant and recent changes to the container shipping industry have been the rapid growth in vessel sizes and the unprecedented consolidation of carriers.

Vessel Sizes

Containerized shipping actually began in the mid-1950s with the movement of truck-trailers. The inefficiencies associated with transporting what are essentially boxes with wheels quickly became apparent, and the modern container was created and standardized in either twenty-foot or forty-foot lengths. In fact, the twenty-foot equivalent unit, or TEU, is the global standard unit of measure for containerized freight transportation. One TEU represents a single twenty-foot long container while two TEUs could refer to two twenty-foot containers or one forty-foot container. Thus, while ship capacity is commonly quoted in TEUs, the number of actual containers on the vessel represents a mix of twenty-foot and forty-foot boxes that, theoretically, will always be lower than its quoted capacity. By the mid-1960s, ships specifically designed and built to transport nothing but containers began to appear, and the rest is history. As shown in Figure 1, growth in ship size and carrying capacity has continued ever since. Given the dimensions of the original Panama Canal locks, vessels were broadly categorized at that time as being either Panamax (roughly 5,000 TEU, the largest size able to use the canal) or Post-Panamax (too big to use the canal). Those classifications remain, but are different for the expanded locks

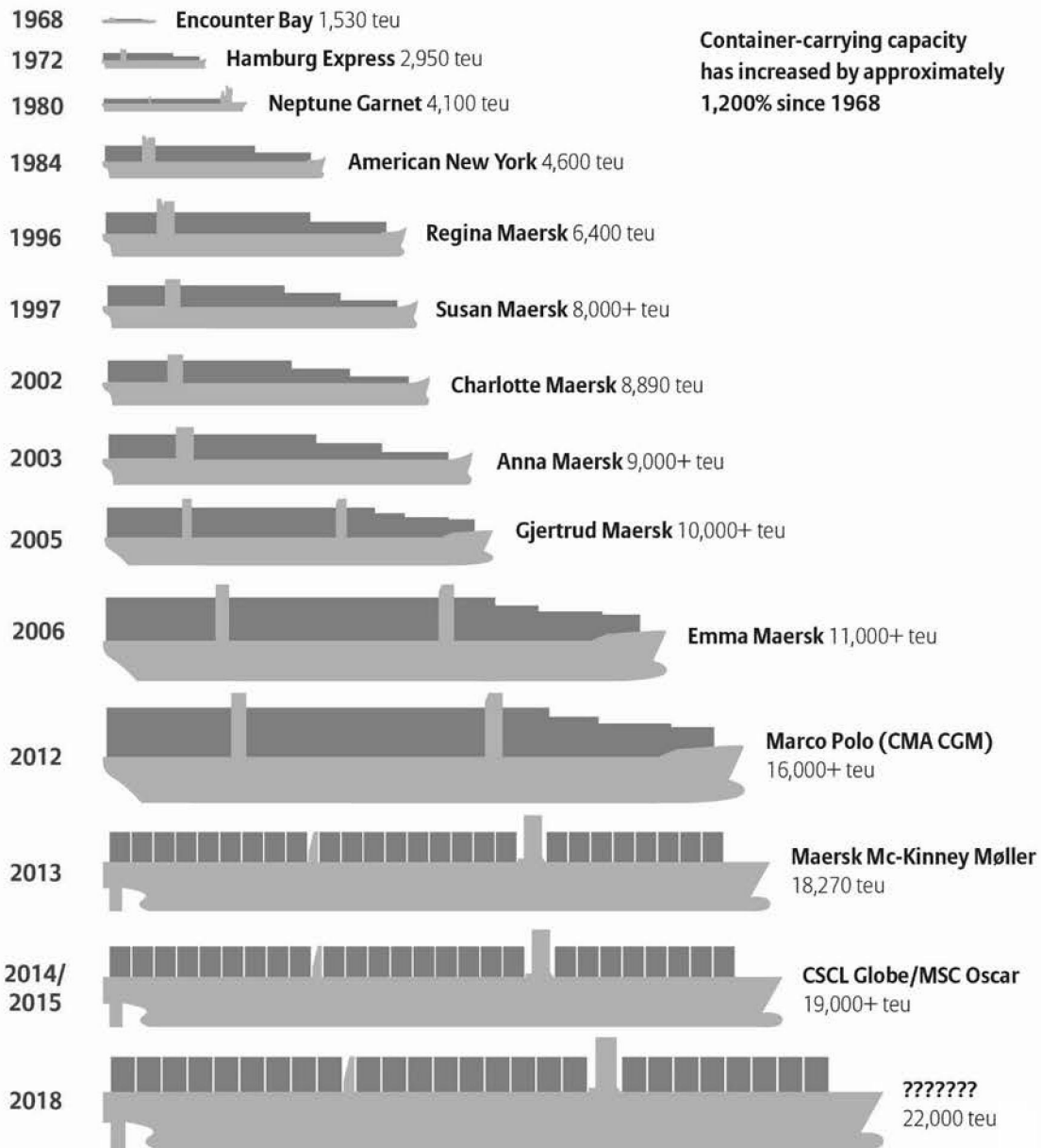
where Panamax now refers to vessels of approximately 13,000 TEU capacity or higher.

As shown in Figure 2, beginning in 2010, the average size of the global container fleet surged as lines began buying megaships, a term loosely

referring to vessels capable of moving 18,000 TEU or higher. In fact, orders for 50 such vessels of between 18,000 and 22,000 TEU were placed in 2015. Mediterranean Shipping Company (MSC) deploys the largest number (90) of what are sometimes referred to as Ultra Large Container

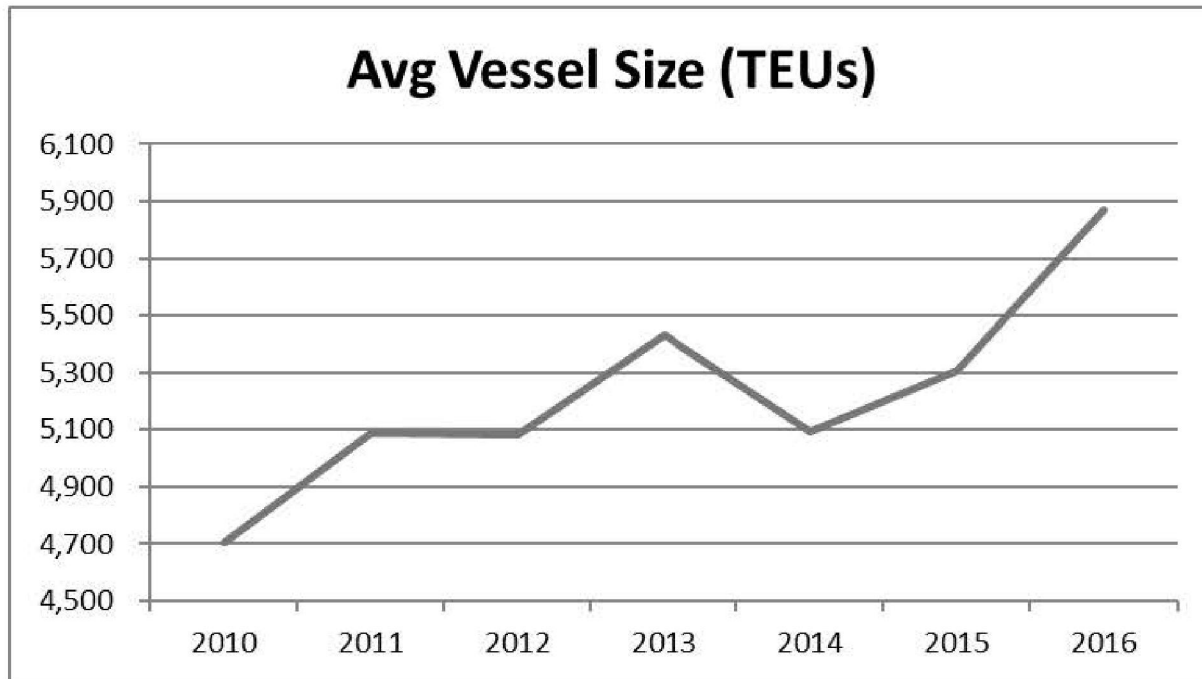
**FIGURE 1
FIFTY YEARS OF CONTAINER SHIP GROWTH**

50 years of Container Ship Growth



Graphic: Allianz Global Corporate & Specialty.
Approximate ship capacity data: Container-transportation.com

**FIGURE 2
AVERAGE VESSEL SIZE IN TEUS**



Source: South Carolina State Ports Authority

Ships (ULCS) and has 11 on order that can each accommodate 23,350 TEU (Visser, 2018).

Unfortunately, the arrival of these new ships coincided with a flattening of global trade, resulting in a glut of capacity chasing smaller amounts of cargo. Beginning May 1, 2016, contract rates fell to historic lows, some as low as \$700 per 40-foot container moving eastbound across the Pacific where they remain to this day. Unless these rates cover break-even costs of approximately \$1500, the carrier will lose money (Paris and Walker, 2018). While an in-depth examination of slot costs (i.e. costs incurred to move one container) is beyond the scope of this paper, suffice to say that empirical data do not support the hypothesis that unit costs necessarily decrease with increments of vessel size, especially beyond 8,000 TEU, nor that TEU-mile cost decreases as ship size increases. Because fuel makes up roughly 40% of these costs, the savings are greater when the price of oil is high.

A 2015 comparison of slot cost savings per round trip voyage on a typical Asia-North Europe service of an 18,000 TEU ship versus one with 14,000 TEUs showed that savings had reduced from \$76 per slot to \$38 per slot based a reduction in fuel costs (Knowler G., 2015). Instead, the economies of container ship voyages appear to depend on many factors unrelated to size. For example, larger vessels are also faster and can, therefore, provide better service and utilization of assets. On the other hand, they are often harder to handle necessitating more demanding requests, in terms of both money and time, related to navigating channels along rivers/canals, port berthing, port access channels, and cargo handling facilities. In other words, because there is a tradeoff between the positive returns earned at sea and the negative returns while in port, the overall efficiency of a ship may depend ultimately on the total time taken to complete a voyage dock to dock (Gkonis and Harilaos, 2009).

Even before the August 31, 2016 Hanjin collapse (more about that later), spot rates were trending higher. In November of that year, the spot rate for a forty-foot container was \$1843 versus \$623 the previous April. In response, carrier managers began to reduce capacity by selling or scrapping smaller, relatively new vessels that are able to move through both the old and new sets of locks on the Panama Canal (Tirschwell, 2016). In April of 2018, the spot rate for a forty-foot container from Shanghai to the West Coast was \$1127, up 19.3% over the previous week. Negotiations for transpacific trade lane contract rates normally begin with the largest customers signing contracts in late March or early April. These accounts, in turn, set the floor for service contract rates that run from May 1 through April 30 the next year. Contract negotiations are then concluded with small and mid-size beneficial cargo owners who generally pay several hundred dollars more per forty-foot equivalent unit (FEU) than do the largest shippers (Mongelluzzo, 2018). However, if the market remains firm after the Chinese New Year holiday, then there can be a pressure from shippers to tie down their yearly rate agreements earlier (Wackett, 2017). However, the level of uncertainty is illustrated by the fact that some industry experts feel the overhaul of the market could help prevent excess capacity and problems on freight rates, while others fear that shipping lines might cut their rates to pursue market share for their new alliances or order ships to beef up services. Finally, idle ships could be put back into service relatively quickly, further driving rates down (Wright, 2017).

Industry Consolidation

For most of the carriers, the damage resulting from falling rates has already been done. Of the largest 12 shipping companies that published financial results in 2016, 11 announced huge losses. A.P. Moller-Maersk, the industry leader, lost \$1.9 billion, their largest negative result ever (A.P. Møller-Maersk A/S Annual Report, 2016) while CMA CGM went from a \$567 million profit in 2015 to a

\$325 million net lost in 2016 (Barnard, 2017). Perhaps the most shocking event was the sudden collapse of Hanjin Shipping that stranded ships, crews, and cargo around the world for months. In addition, other mergers were announced in 2016. CMA CGM acquired Singapore's NOL and its APL brand; Hapag-Lloyd bought United Arab Shipping Company (USAC); China Ocean Shipping Company (COSCO) combined with China Shipping Container Line (CSCL); and Maersk purchased Hamburg Süd (Hand, 2016).

Clearly, 2016 was a disastrous year for container shipping and did not bode well for the ability of smaller lines to compete with the behemoths. In fact, consolidation activities continued through 2017 and into the follow year. COSCO hopes to complete their acquisition of OOCL in June 2018 (Goh, 2018), while Japan's big three shipping groups ("K" Line, Mitsui O.S.K. Lines (MOL), and NYK) are spinning off their respective container shipping businesses into a new joint-venture company called Ocean Network Express (ONE). The new entity will have a total capacity of 1.4 million TEU, which would rank as the sixth largest in the world and have a global market share of approximately 7% (Paris and Tsuneoka, 2018). There have also been unconfirmed rumors the Taiwanese lines Evergreen and Yang Ming will combine (<https://fairplay.ihs.com>, 2018). The result of all this activity is that 90% of total container capacity on major trades routes will be controlled by three carrier alliances made up of the following companies (Paris, 2017): 2M (Maersk, MSC), Ocean Alliance (CMA CGM, COSCO, Evergreen, OOCL); THE Alliance (Hapag Lloyd, ONE, Yang Ming).

Containerized Cargo Flows through U.S. Ports

As shown in Table 1, while the ports on the U.S. West Coast are perceived to occupy a very high profile position in U.S. container trades, the U.S. East and Gulf Coasts actually handle more freight.

TABLE 1
U.S. CONTAINERIZED CARGO FLOWS BY COAST IN MILLION TEUs

Year	West Coast	Atlantic and Gulf Coasts	Total
2015	14.3	17.3	31.6
2014	14.9	16.7	31.6
2013	14.8	15.9	30.7
2012	14.5	15.4	29.9
2011	14.5	15.0	29.5
2010	14.1	14.3	28.4
2009	12.4	12.9	25.3
2008	14.3	14.7	29.0
2007	15.0	14.7	29.7
2006	14.6	13.7	28.3
2005	13.5	13.1	26.6
2004	12.3	12.2	24.5
2003	11.1	10.9	22.0
2002	10.1	10.1	20.2
2001	9.3	9.3	18.6
2000	9.4	9.2	18.6

Source: South Carolina State Ports Authority

There are several reasons for this change. First, the gradual shift of off-shore manufacturing from China to Southeast and Southern Asia has made the choice of reaching U.S. markets via the Suez Canal more competitive (Prozzi and Overmyer, 2018). Second, congestion on and off the West Coast terminals can seriously impede the flow of goods into and out of the ports even on the best of days. Third, contentious labor relations keep the specter of slowdowns and strikes there on the West Coast an ever-present threat, especially at peak shipping times. Fourth, many of the eastern ports are extremely efficient, making them an attractive option for shippers and carriers alike. The long term effect of these West Coast limitations has been to pull the center of gravity for U.S. distribution activities farther east. In sum, these obstacles to efficient cargo handling on the West Coast, combined with problematic intermodal services for the remainder of

the eastbound journey, and emerging global production centers, make using Eastern and Gulf Ports an appealing alternative even if the ocean portion of the total move is longer and/or costlier (Conway, 2017).

In the short term, the demand for global transportation will remain flat as growth in global trade volumes have slowed in recent years, thanks to a tepid economic recovery from the financial crisis of 2008 and the changing structure of the Chinese economy. Also, the Trans-Pacific Partnership (TPP), a trade agreement between twelve Pacific Rim countries originally including the United States, was intended to jump start global trade among the signatories, however it has not been implemented further harming global trade. Among other things, the TPP contained measures to

lower trade barriers and establish an investor-state dispute settlement mechanism. Though signed in February of 2016, President Trump promptly cancelled the agreement shortly after taking office, opening the door for China to assume the leadership position abrogated by the U.S (Mui, 2017). However the Agreement was not signed as noted, and trade has not increased as much as one would have expected while the Agreement was being negotiated. Longer term, there is little doubt that global trade will increase, although by how much and when remains in question.

THE IMPACT OF BIGGER CONTAINER SHIPS ON U.S. PORTS

Congestion

Congestion can occur on both the shipside and the landside. In LA/Long Beach, for example, mega-ships generate between 5,000 to more than 10,000 extra container moves per call. Assume one crane can average 40 lifts per hour and 10,000 TEU are coming off. If four cranes are utilized, the off load will require almost 3 days, with the same amount of time needed to load outbound containers. Obviously using more cranes will speed the process but may require that other vessels wait. Once the containers are landed, they have to go somewhere. As mentioned earlier, most carriers operate in vessel-sharing alliances, which distribute containers from as many as six individual lines each using a different terminal with its own policies and procedures. The model of carrier-owned chassis has also changed and added complexity, with three large chassis-leasing companies now providing them. The interface between the port and the intermodal transportation system also contributes to the problem. Drayage industry issues such as a shortage of drivers or long waits at terminal gates can slow the flow of containers into and out of the port. In fact, the simultaneous arrival of multiple large ships can simply overwhelm the port and swamp the long-distance rail system essential for

moving the containers to their final destination (Mongelluzzo, 2016). Similar problems have bedeviled the Port of New York and New Jersey in recent years as well (Morley, 2016).

Labor Strife

Larger ships with many more containers exacerbate the impact of work stoppages because the sheer volumes that build up during a slowdown or strike can overwhelm the system. Work stoppages affected port operations on both sides of the country in 2016, with the expected impacts from larger ships making it difficult for ports to recover. Though none were as disruptive as the West Coast strike in 2002 (which lasted for 11 days) or the 8-day action there in 2012, just the thought of a similar shutdown is enough to send ship operators scurrying for alternative ports, a disruption in its own right. However, the aftermath is arguably more disruptive to supply chains than the strike itself. Port operations alone can take weeks and even months to return to normal. The big railroads suffer as well because the flow of containers on their way to affected ports must be stopped as soon as possible, either at origin or some intermediate spot. Once the dispute is resolved, the floodgates are opened and transporting cargo out of the port becomes the problem. During the strike, the companies lose a massive amount of revenue because nothing is moving; once the port reopens, the sheer volume of outgoing containers overwhelms the rail system leading to additional delays, lost cargo, and poor service.

Because the upheaval in supply chains is so severe and the potential for strikes on the West Coast is ever present, retailers and direct shippers have indicated in surveys that they are increasingly likely to shift some of their cargo volume to East Coast ports. Southeast ports like Charleston and Savannah, which typically experience little to no labor disruption, saw significant increases in volumes in the second half of 2014 due to diversions. A

permanent loss of some cargo for the West Coast may be inevitable as shippers increasingly look at the potential labor actions as a serious threat to the security of their supply chains (<http://actlogisticsinc.com>, 2015). Two-thirds of the U.S. population lives east of the Mississippi River. Many of the large retailers that dominate U.S. containerized imports are based there as well and have extensive retail store networks in the eastern half of the country, resulting in the “distribution pull” discussed earlier.

PORT INFRASTRUCTURE PROJECTS

Ports are businesses like any other and must remain competitive if they are to remain attractive to both shippers and steamship lines. To that end, ports in the United States have started on, or recently completed, vary large infrastructure projects intended to keep them viable in today’s environment with these much larger ships. A few of these are discussed below.

Dredging

The West Coast ports enjoy sufficient harbor depth to handle the large ships, so much of their investment has been in procuring larger cranes and other equipment to service those vessels. While the ports on the East Coast are making similar purchases, they face other challenges as well due to larger ships. As mentioned earlier, both Charleston and Savannah are actively dredging their ports. The Savannah project is especially daunting because it requires deepening the entire 40-mile-long shipping channel: the 18.5-mile outer harbor to 49 feet and the Savannah River channel to 47 feet MLW (2018). In each location, work only started after completing planning and approval processes that stretched across two decades. Miami has already deepened its channel to 50 feet, while the Port of Jacksonville and Port Everglades are pushing to do the same thing (Kitchen, 2016).

Development of Inland Ports

Again, in order to disperse the large numbers of containers flowing as a result of larger ships, ports have sought to spread the volume around to more locations. For instance, in October 2013, the South Carolina State Ports Authority (SCSPA) opened an inland port in Greer, South Carolina, 212 miles inland. This facility connects with port facilities in Charleston via a dedicated daily rail service that facilitates the rapid movement of containers out of and into the port itself, effectively extending the Port’s reach well beyond the borders of South Carolina. The facility was so successful that the SCSPA opened a similar facility in Dillon, South Carolina in 2018 (SCSPA, 2018). The Georgia Ports Authority is also planning to open their second site, the Appalachian Regional Port in Chatsworth, Georgia in October 2018 (Georgia Ports Authority, 2018b).

Raising the Bayonne Bridge in NY/NJ

Another reaction to larger ships involves the need to provide higher vertical bridge clearances. The project to raise the navigational height of the 151-foot-tall bridge to 215 feet was completed in mid-2017 (McDonald, 2017). Prior to that time, the largest ships that could dock at the terminals in Newark and Elizabeth, N.J., carried between 8,500 and 9,000 TEUs. However, the largest vessel ever to call the port, the CMA-CGM Theodore Roosevelt with a capacity of 14,400 TEU, made its way to New Jersey in September after transiting the Panama Canal (Villanova 2017).

Jasper Ocean Terminal

Perhaps the most ambitious project, in order to deal with the larger ships, is the on-again/off-again effort by the states of Georgia and South Carolina in the southeastern part of the United States to develop a new terminal on the South Carolina side of the Savannah River that would be jointly-operated by

the port authorities in each state. The \$4.5 billion, bi-state project, is on again after more than two decades of discussions and a series of lawsuits. Once complete, it will handle seven million units of shipping cargo that the ports in Savannah and Charleston wouldn't be able to process when they reach capacity within the next 15 years. By 2040, with the complete build out of the terminal, the Port has the potential to create one million jobs and \$9 billion in tax revenue between Georgia and South Carolina, according to a 2010 study by the University of Georgia and Wilbur Smith & Associates. If/when the project is completed; it would be the largest single land port in the United States (Murdock, 2015).

OTHER TRADE AND CONTAINER SHIPPING ISSUES

Political Instability in the United States

Political uncertainty will continue to characterize the near term for managers of global logistics and supply chain systems. The U.S. withdrawal from the TPP was mentioned earlier. In April, President Trump announced plans to impose a 25% tariff on \$50 billion worth of Chinese-made products and followed up in late May with a decision to impose tariffs on steel and aluminum imported from the European Union (EU) (Zumbrun and Salama, 2018). Until a clear direction has been established for U.S. international trade policies by the present administration, strategic business decisions will need to be made with care and include the ability to quickly pivot in response to the winds of change. However, the reality is that global trade will continue growing in response to the booming e-commerce demand, the shift of the Chinese market from a focus on production to one of consumption, and, for the time being, lower fuel prices.

Volatility in the Price of Oil

As alluded to earlier, petroleum prices rose steadily during early 2018, but quickly fell late in May as

Saudi Arabia announced plans to increase production (Petrov, 2018). The drop in oil prices is welcome news for drivers, as well as transportation companies and oil-importing countries like India that buy a lot of energy. Unfortunately, the nation's producing the oil prefer higher prices which generate the revenue upon which those governments depend to fund their political agendas (Ibid). This dichotomy virtually guarantees continued instability in the world's oil markets.

CONCLUSIONS AND IMPLICATIONS FOR SUPPLY CHAIN MANAGERS

While the completion of the Panama Canal expansion was touted as a "game changer," the term could be applied to many other issues discussed in this paper. In essence, the game itself has changed which in no way should minimize the accomplishment of the construction of the Panama Canal or its potential impact on the supply chain. Given the immediate sense of unease, however, supply chain managers must deal with simultaneous, unprecedented, and perhaps more pressing changes to their environment.

The introduction of mega-ships at a time of stagnant global trade led to a consolidation of maritime carriers into alliances that will undoubtedly leverage their size and market power to negotiate higher rates from shippers which will, in turn, make port efficiencies a bigger factor in distribution decision making. To expedite door-to-door delivery times and mitigate the risk of shipment disruptions, managers will opt for using ports where the chances of congestion and labor issues are small, most of which are on the Southeast or Gulf Coasts of the U.S. In fact, a 2016 National Real Estate Investor study confirmed that the East and Gulf Coasts are currently experiencing the highest traffic growth, and listed Savannah, Charleston, and Houston among the five top performing non-West Coast Ports (Carr, 2016). With the demand for prime warehouse and distribution space expected to

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