DIGITALCOMMONS
@WAYNESTATE

Journal of Transportation Management

Volume 28 | Issue 2 Article 6

1-1-2018

Container shipping in the Great Lakes: current situation and future potential

John Floyd
Wayne State University, fx2236@wayne.edu

James L. Roach
JL Roach, Inc.

John C. Taylor
Wayne State University, taylorjohn@wayne.edu

Follow this and additional works at: https://digitalcommons.wayne.edu/jotm

Part of the Operations and Supply Chain Management Commons, and the Transportation Commons

Recommended Citation
Floyd, John, Roach, James L. & Taylor, John C. (2018). Container shipping in the Great Lakes: current situation and future potential. Journal of Transportation Management, 28(2), 49-59. doi: 10.22237/jotm/1541030700

This Article is brought to you for free and open access by the Open Access Journals at DigitalCommons@WayneState. It has been accepted for inclusion in Journal of Transportation Management by an authorized editor of DigitalCommons@WayneState.

CONTAINER SHIPPING IN THE GREAT LAKES: CURRENT SITUATION AND FUTURE POTENTIAL

John Floyd
Wayne State University

James L Roach
JL Roach, Inc.

John C. Taylor
Wayne State University

ABSTRACT

Containerization has had an outsized impact on the growth of global trade over the past 60 years. The Great Lakes-St. Lawrence Seaway is an important bi-national waterway. Since the advent of containerization in the 1950's there has been much excitement about the prospects of scheduled container shipping in the Great Lakes. There is a perception that direct container service will add value to the economy of the Great Lakes-St. Lawrence Basin (GLSLB). However, due to unique shipping constraints in the Great Lakes-St. Lawrence Seaway, significant container service has not materialized. This research seeks to explain the current state of container shipping in the Great Lakes, as well as provide an analysis of the feasibility of future container shipping in the Great Lakes. It is very important for policymakers to understand both the opportunities for container shipping, and the barriers and issues with such services. A lack of understanding of these points can lead to missed opportunities and/or the potential for significant expenditures of time and money on unrealistic projects.

INTRODUCTION

Container shipping has become synonymous with the rise of global supply chains. The movement of shipping containers on the world's oceans is growing, and the economies of many parts of the world are tied to the efficiencies associated with a single box moving from a producer in one country to a consumer in another country. The rapid growth of global trade has lowered the cost of goods in many parts of the world. Subsequently, it has placed unprecedented demands on container ports and the surface systems that serve these ports.

The Great Lakes and St. Lawrence Seaway has a rich history of being an economic driver for Eastern Canada and the U.S. Midwest. As the Great Lakes Region has attempted to strengthen its role in global commerce, the potential for increased waterborne movement of containers into the Great Lakes has long been of interest to port agencies and their municipalities. There is a perception that the direct movement of containers by ship into a Great Lakes community will be beneficial to the local economy and allow it to more effectively participate in global trade.

However, it is very important for policymakers to have an understanding of both the opportunities for container shipping, and the barriers and issues with such services. A lack of understanding of these points can lead to missed opportunities and/or the potential for significant expenditures of time and money on unrealistic projects. Over the last 40 years or so many ports and local government entities have expended large sums of money and resources on consulting studies, service subsidies and other efforts to attract container services to the

Lakes. This paper seeks to clarify the opportunities and obstacles for such services so as to provide for more informed decisions by policymakers and political leadership.

This research examines the current state of container shipping in the Great Lakes, and its potential for growth. First, a background on containerization, commerce on the Great Lakes, and container shipping on the Great Lakes is presented. This section is followed by a review of Great Lakes container shipping traffic levels and an analysis of this traffic. Then, an analysis of various issues that are likely to impede scheduled container services is reviewed. The next section then suggests what services might be viable. The paper then offers some conclusions on the state of container shipping and the potential for direct scheduled international container services.

BACKGROUND

Containerization

In 1956, American businessman Malcom Mclean loaded the first standardized containership in the Port of Newark, NJ bound for Houston, TX. The event was met with criticism at the time but would later come to mark the beginning of a revolution in global trade (Donovan, 2004). The advent of the containership has been credited as a catalyst for the growth in global trade that the world has seen in the last 60 years. In an empirical analysis of containerized shipping data from 1970-1992, Bernhofen, El-Sahli, and Kneller found that containerization had a statistically significant impact on the growth in trade amongst industrialized nations (2015). While containerization has allowed for more cargo to fit onto ships, much of the gain in efficiency has been from shorter loading and unloading times. A study done by McKinsey found that before containerization, a dock worker could load 1.7 tons of cargo per hour onto ships. Five years after containerization, this number rose to 30 tons per hour, a tremendous increase in productivity. (McKinsey, 1972). While not all ports have been able to reap the benefits of containerization, it has helped to expand global commerce through a reduction in prices and increases in efficiency (Notteboom, Rodrigue, 2008).

Throughout the 21st century, containerization and container ports have continued to grow throughout the world. Table 1 shows the volume of traffic moving through the fifteen largest ports in North America. Also shown is Halifax, which is #24 on the list. The largest container port in the world is Shanghai, which set a world record moving more than 40 million TEUs[1] in 2017. In addition, Singapore and Shenzen each handle more than 25 million TEU's annually.

Commerce on the Great Lakes

The Great Lakes have a storied history of transportation stretching back hundreds of years. From the fur trade to the lumber trade, to the iron and copper booms of the 19th century, the St. Lawrence and the Great Lakes have played an important part in the development of the region. (Taylor, Roach, 2007). Stretching from Montreal, QC in the east, to Duluth, MN in the west, the waterway spans 2,342 miles (Figure 1) (Dimitrascu, Higginson, 2007). Historically, the Great Lakes have primarily transported bulk commodities such as iron ore, grain, coal, and aggregates. These trends have held true to the present day with the primary commodities transported during the 2016-2017 shipping season being grain, iron ore, coal, and dry bulk (SLSMC/DC, 2017). These commodities are carried by a combination of Laker vessels, and ocean going ships. The inter-lakes shipping industry is highly reliant upon the domestic steel industry (Dimitrascu, Higginson, 2007). The decline in the domestic steel industry is a contributing factor for the overall decline in inter-lake traffic since the mid-twentieth century. Laker traffic in the Montreal-Lake Ontario portion of the Great Lakes system peaked in 1977 with 38.3 million metric tons, with oceangoing traffic peaking in 1978 at 23.1 million metric tons (Taylor, Roach, 2007, SLSMC/DC, 1992). This compares to 17.6 million metric tons of Laker traffic, and 11.2 million metric tons of ocean traffic in 2017.

Despite an overall decline in traffic, the Great Lakes-St. Lawrence Seaway still has a major bi-

TABLE 1
NORTH AMERICAN CONTAINER TRAFFIC

2016	Port	2016 TEU's
1	Los Angeles	8,856,783
2	Long Beach	6,775,170
3	New York/New Jersey	6,251,953
4	Savannah	3,644,521
5	Seattle/Tacoma Alliance	3,615,752
6	Vancouver	2,929,585
7	Hampton Roads	2,655,707
8	Manzanillo	2,580,660
9	Oakland	2,369,641
10	Houston	2,182,720
11	Charleston	1,996,276
12	Montreal	1,447,566
13	Honolulu (FY)	1,211,997
14	San Juan (FY) fy 2015-16	1,200,000
15	Lazaro Cardenas	1,115,452
24	Halifax	480,722

Source: American Association of Port Authorities.

FIGURE 1
THE GREAT LAKES ST. LAWRENCE SEAWAY SYSTEM

national economic impact. The waterway serves a significant portion of both the United States and Canada, with the GLSLB containing 27% of the population of the United States, and 62% of the population of Canada (Stewart, 2012). A 2011 study found that the waterway generates $35 billion dollars in business revenues (Martin, 2011).

Container Services in the St. Lawrence Seaway and Great Lakes Region

The St. Lawrence Seaway enjoys the geographical advantage of having the shortest trans-Atlantic route to Western Europe (Hull, 2015). Given that during the 1960s, 70% of international maritime trade was conducted on the Northern Atlantic trade route, the St. Lawrence Seaway was positioned to benefit from the advent of containerization (Guy, Alix, 2007). Manchester Liners was the first company to establish a Europe to Montreal container route in 1968. They were then followed by companies such as CAST, CanMar, and CP Ships. (Alix, Comtois, Slick, 1999). Early on, companies experimented with container shipping out of Quebec City. However, due to the size of the port and market, these operations soon moved to Montreal (Alix, Comtois, Slick, 1999). Before long, Montreal had established itself as the container shipping center of the St. Lawrence Seaway.

As Montreal established itself as a major container shipping center other communities began to explore how they could extend containerization into the Great Lakes region via feeder services to Montreal or with scheduled direct container services with European ports. This posed certain challenges, including a shipping season of 9 months, as well as constraints on ship size due to the lock and dam system used on the St. Lawrence Seaway System (Hull, 2015). Nevertheless, companies such as Manchester Liners established feeder service to and from other Great Lakes cities and Montreal (Hull, 2015). As late as 1979, Manchester Liners was running a container feeder service from Montreal to Cleveland, Detroit, Chicago, Milwaukee, and Toledo (Globe and Mail, 1979). However, as Mayer (1978) noted, this service went bankrupt only a couple of years later. These ships faced stiff competition from trucks and railroads that also transported containers from the Midwest to Montreal and other east coast ports. It was the intermodal connections that made Montreal a great container port, and at the same time limited container shipping by water west of Montreal (Guy, Alix, 2007). However, the combination of comparatively low container traffic, limitations on ship size, and intermodal competition kept larger Lakes waterborne container operations from developing in the latter half of the 20th century (Mayer, 1978).

Despite this, ports around the Great Lakes have been interested in scheduled container services, which potentially could offset the loss of traffic from domestic cargo. Over the years, news of potential container service has made headlines in cities including Milwaukee (Connole, 1987), Duluth (Belz, 2014), Chicago (New York Times, 1979), and Muskegon (Watson, 2017). Reports on Great Lakes port studies of direct international scheduled container services go back many years. For instance, in 1989, James Kellow, Director of the Detroit/Wayne County Port Authority at the time, said that "we believe we need regularly scheduled liner services," and that the "economics are there" (Markiewicz, 1989). In the mid 80's, a study by DeWin, a joint Detroit/Windsor port promotional agency, outlined the potential for a Northern Europe to Detroit/Windsor scheduled direct container service using 500-600 TEU vessels (DeWin, 1989). Like many other such efforts nothing developed. A similar 1989 report commissioned for DeWin suggested a liner service that would generate large profits.

More recently, in 2010, the Port of Toledo went as far as to install two container cranes to try and attract feeder service (Lavigne, 2013). Currently, the Port of Cleveland has invested time and resources ($3.1 million in subsidies for 2500 containers over the season) in a scheduled container service using the decks of bulk carriers, however this service has recently seen significant drops in its very limited volumes (Miller, 2018). As of January, 2018 the Cleveland Port was working at negotiating an extension of its contract with the carrier. In addition, in the 2015-2018 period, the Port of

Muskegon has been working to develop cross-lakes and linked international container services (Stephen Kloosterman, Watson, 2017), although the stated goal of services starting in 2017 has not materialized.

GREAT LAKES CONTAINER TRAFFIC TRENDS AND SERVICES

In order to understand trends in Great Lakes container traffic over the years the authors obtained traffic data from two principal sources—the US Army Corps of Engineers (USACE) Navigation Data Center and the Great Lakes-St. Lawrence Seaway's Annual Traffic Reports. The USACE data provides information on the number of TEU's at major ports in the U.S. These ports, in 2016, handled over 36 million TEU's with the Port of Los Angeles being the busiest with almost 6 million TEU's handled. (See Table 1 for other large ports). By contrast, all of the U.S. Great Lakes ports are lumped together and typically are at or near the bottom of the TEU Table. For instance, in 2016, all U.S. Great Lakes ports combined handled only 1,328 TEU's—about 5 TEU's per day on average for the typical 280 day sailing season. This compares to 15-20,000 TEU's per day for Los Angeles and 4,000 TEU's per day for the Port of Montreal.

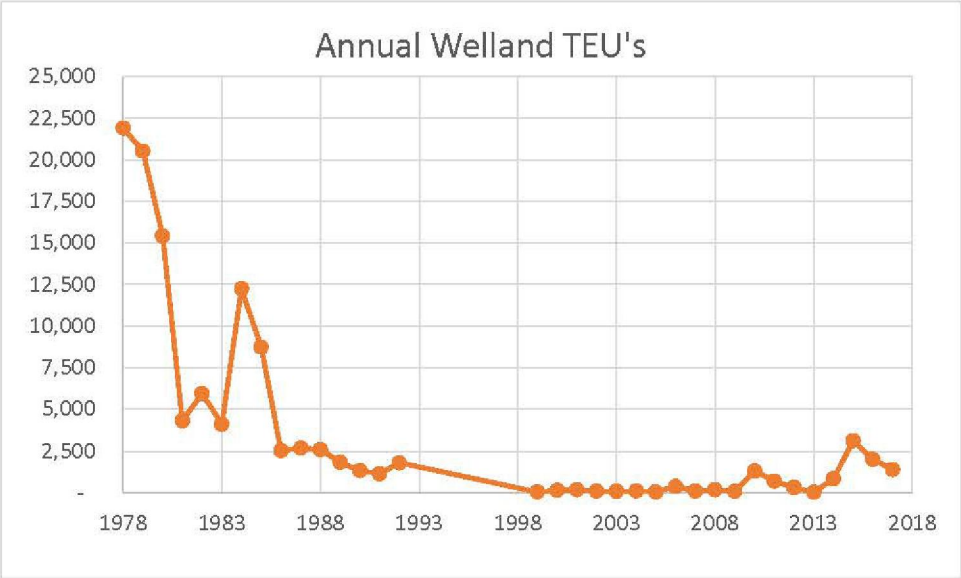
All waterborne containers entering or exiting the Great Lakes must pass through the St. Lawrence Seaway. The St. Lawrence Seaway publishes an annual report that shows the tonnage carried in containers passing through both the Montreal-Lake Ontario (MLO) Section of the Seaway and the Welland Canal Section of the Seaway. The MLO Section has much higher container tonnage due to the location of container ports located near the Montreal terminal area. As noted previously, Montreal is a major container center ranked as 12th busiest in North America. The MLO Section of the SLS handled 58,605 metric container tons in 2017 whereas the Welland Section handled 12,557 metric tons. Much of the above traffic originates and terminates in the Montreal-Lake Ontario Section of the Seaway which means that it never makes it to the Upper Lakes.

The graph in Figure 2 shows long term container trends for the Welland Canal Section of the Seaway. This provides evidence of the earlier attempts to develop container traffic in the Great Lakes. In the 1978-80 period, there were 15,000-22,000 TEU's each year passing through the Welland Canal Section into the upper Great Lakes. These levels generally declined to year 1999 when only 40 TEU's were counted. The 21st Century continued with extremely low levels of traffic with most years less than 500 TEU's and many years less than 100 TEU's. This changed in 2014 due to initiatives by the Port of Cleveland to develop regular sailing schedules for containers and other traffic to and from the Cleveland area.

The Cleveland port efforts mentioned earlier provide an interesting study on traffic prospects for direct scheduled container services in the Lakes. Based on the SLS Annual Traffic Tonnage reports for Cleveland, the authors calculated that the port handled 825 TEU's in 2014, 2,934 in 2015, 1,615 in 2016 and 1,256 in 2017.[2] These values may differ somewhat from local sources because they assumed each TEU contained ten tons of cargo. Overall, the Cleveland traffic declined 57.2% between 2015 and 2017 despite substantial subsidies to get the business started. Additional perspective on the volumes involved can be gained by looking at the number of trains it would take to move this traffic between Cleveland and the Atlantic Coast. For comparison purposes, about two 600 TEU trains (one each direction) could carry the 2017 combined full year traffic of 1,256 TEU.

The Cleveland traffic was in large part due to the establishment of a monthly chartered ship between Cleveland, Ohio and Antwerp, Belgium (Lavigne, 2013). The service, operated by Spliethoff, is marketed as a niche shipping solution that can save up to 4 days in transit time to Europe vs East Coast ports (SeeNews North America, 2013). While it is billed as the only container service in the Great Lakes, it does not exclusively carry containers. Spliethoff utilizes multi-purpose ships that can carry bulk cargo as well as containers. The same ship that operates on the Cleveland to Antwerp route

FIGURE 2
ANNUAL WELLAND TEU'S



delivered 20 containers of bulk equipment to the port of Detroit in 2015 (Bonney, 2015).

ISSUES LIMITING IMPACTING FUTURE GREAT LAKES CONTAINER SERVICES

Absent major changes in the geopolitical and economic climate, a number of issues stand in the way of increased container shipping into and out of the Great Lakes. While no one obstacle is necessarily insurmountable, taken together these factors make it very difficult for scheduled container services to operate. These issues have been well known to academics and policymakers for many years. For instance, Dr. John L. Hazard of Michigan State University, a noted authority on Great Lakes shipping, and a mid' 60's Assistant secretary of Transportation for Policy, summarized a number of issues in various mid 70's-80's presentations and reports (Hazard, 1987; Hazard, 1988). He mentioned Seaway problems for container shipping related to augmented overland competition (rail and truck), lock and canal size limitations, the limited nine month shipping season, and a move towards shippers favoring speed and reliability of service with smaller shipment sizes and inventories. These issues are also well known to more recent analysts of Great Lakes shipping. For instance, James K. Higginson and Tudorita Dumitrascu (2007), in their article on Great Lakes shipping, note many of the issues mentioned above, and which we review below.

Following are some of the key issues:

Small Seaway Size Ships Could Not Compete in the Trans-Atlantic Market

A major issue deals with ship size and the Seaway size limitations. Containerships continue to increase in size and efficiency. OOCL recently completed the OOCL Hong Kong, which can carry over 21,000 TEU's. This ship is over 1300 feet long, has a beam of 193 feet and draft of 45 feet.[3] There are many other ships being built, or recently built, in the 18,000-21,000 TEU range. By comparison, the larger ships coming into the Port of Montreal are in the 4,400 TEU range. A containership moving west of Montreal would need to be much smaller because of the dimensional constraints of the Seaway. A container ship passing through the Seaway into the Great Lakes would likely be in the 1000-1500 TEU range. The international shipping community would classify this size ship as a feeder ship.

It would be difficult or impossible for these small vessels to effectively compete in Trans-Atlantic trade against the large ships that will serve the Port of Halifax or the Port of New York/New Jersey, or the medium size ships serving the Port of Montreal. A small vessel requires a crew similar to a larger vessel yet the larger vessel can carry 3-10 times the number of TEU's. There has been discussion over the years regarding expansion and deepening of the St. Lawrence Seaway locks and channels. However, that does not currently appear to be on the horizon, and current efforts are being directed towards funding to maintain Seaway infrastructure in its present configuration.

Viable Trading Routes into the Great Lakes are Limited

Another issue is that any container waterborne movement into the Great Lakes would have to capture traffic from the ports of Halifax, Montreal, and New York/New Jersey. A container route into the lakes could be most effective in capturing traffic between these ports and European or Mediterranean ports since it could provide a direct movement into the North American heartland. In fact, Halifax often markets its port as being at least a day closer sailing distance to Europe then the Port of New York/New Jersey. However, the adverse distance associated with traffic from other parts of the world (i.e., ships from southern points have to travel far north around New Brunswick and the Gaspe Peninsula to gain access to the St. Lawrence River) appears to make this an unlikely move.

More Ships Are Required to Service Great Lakes Ports

Due to the high fixed costs of today's containerships, owners prefer an operating plan that gets as many trips as possible from a given vessel in a given service. A service from Northern Europe (e.g., Hamburg, Antwerp etc.) to Montreal takes about 7-8 days—depending on the number of stops. Cycle time including port time is about 21-days—that is, a given ship will be able to depart Montreal for Northern Europe every 3-weeks. Weekly service would thus require three ships. If a ship went beyond Montreal to Detroit or Chicago additional time would be required given the longer distances and sailing times — about one additional week to Detroit and two additional weeks for Chicago service.

- o Three ships can provide a weekly service between Montreal and N. Europe
- o Four ships would be required to provide a weekly service to/from Detroit
- o Five ships would be required to provide a weekly service to/from Chicago

These ships would have to be much smaller than the ships serving only Montreal and all five ships would have less capacity than just two larger ships leaving Montreal. Twice weekly service would require respectively 8 and 10 ships.

Service Levels Would Be Less Than Currently at Montreal

Montreal currently is able to generate sufficient traffic to offer very high levels of service to Northern Europe with ships departing at least 3-5 times each week. Close to daily departure opportunities make this very attractive for companies involved in closely timed low inventory supply chain operations. Weekly or bi-weekly service would be much less desirable and would increase inventory and other carrying costs. Further, it is difficult to see how such a service could be competitive with Montreal, Halifax, or the Port of New York/New Jersey given the well-developed rail and truck networks designed to service these ports.

Alternative Modes of Transportation Provide Good Levels of Service

Railroads and trucking companies have developed extensive intermodal service networks serving Montreal, Halifax, and New York. Both CN and CP provide multiple daily train services from Detroit and Chicago to dockside in Montreal. A container loaded in these cities can be transported and loaded on a ship in Montreal in 2-3 days and then be on the way to Europe. This level of service and the frequent sailings from Montreal offer shippers from the Midwest the ability to regularly ship and receive containers. There are similar intermodal rail services from Chicago to the East Coast where again sailings

are very frequent. The most time sensitive freight could be trucked from Chicago to one of these ports in less than a day if necessary and be on its way to Europe. Weekly or twice weekly sailings from Great Lakes ports would incur both longer transit times and longer wait times for a ship.

Nine Month Season Makes Competition Difficult

A very difficult problem is the three months in the winter when the Seaway is closed. Shippers will have to make alternative arrangements for this time period and the other modes will be reluctant to offer attractive rates for this type of seasonal service. The railroads and truckers will not maintain an inventory of locomotives, railcars, and trucks that cannot be utilized fully throughout the year. As such, they will try to convince the shippers that they would be better off by contracting year-round with them to take the traffic to Montreal or another port. Any new service proposed for the Great Lakes will likely find significant resistance from the railroads and truckers to prevent them from switching a portion of their traffic to ocean vessels coming to a Great Lakes port. This could include initiatives to raise rates on traffic on other routes.

The Harbor Maintenance Tax Would Add Costs for U.S. Bound Containers

The U.S. imposes a .125% Harbor Maintenance Tax (HMT) on the value of goods imported into the U.S. by water. This Harbor Maintenance Tax is used to provide dredging and other maintenance activities at U.S. ports, channels, and harbors. This tax is also used to pay for the operation of the St. Lawrence Seaway Development Corporation —the entity responsible for the operation of the two U.S. locks on the Seaway. This tax would apply to the value of any containerized goods imported into a U.S. Great Lakes port. For example, the owner of a container containing $100,000 of merchandise would have to pay U.S. Customs $125 for that container. This tax only applies to goods entering the U.S. by water—it does not apply to goods landed in Montreal and trucked or railed into the U.S. It would however apply to any goods landed at an east coast U.S. port. The HMT gives the ports of Montreal or Halifax and the surface modes that serve them a cost advantage over east coast U.S. ports or container ships coming into the lakes to service U.S. ports. Containers tend to have higher value products compared to the other traffic and the HMT would affect them more than other types of cargo.

POTENTIAL CONTAINER SERVICES

Given the above barriers, aside from niche shipping services, conventional container services do not appear to be viable in the Great Lakes because of size constraints and the difficulty in competing in the trans-Atlantic market with much larger ships. However, it may be possible to trans-load containers from a larger vessel to a smaller Seaway size vessel at Halifax or Montreal. This type of "short sea shipping" is common in Europe and may have some application in North America. However, rail and truck services are much more efficient in North America and whether feeder type services could compete is not clear. Another issue relates to whether trans-loading costs at the transfer port could be kept low enough to make the concept viable. None-the-less, this is where there may be some possibility of services that can compete. But many of the above issues also create problems for cross-lake feeder services. For instance, the nine month season is a very large impediment to a viable commercial operation.

CONCLUSION

With the exception of niche shipping services serving specific markets, the authors do not believe there is significant potential for conventional container ship service into the Great Lakes. The smaller vessels that could fit through the Seaway could not compete in the trans-Atlantic trade with the much larger ships serving Montreal, Halifax, and New York. Further, the extra time involved in serving ports such as Detroit and Chicago and the infrequent service from these ports would not be attractive to shippers. They are accustomed to almost daily service between major eastern ports and Northern Europe as well as efficient rail and trucking services to and from these ports. The three-month winter closure of the Seaway would be a major problem for shippers

and the high rates they would pay the railroads or truckers during this period would further negate any economic advantage. The Harbor Maintenance Tax is a further economic obstacle for containers landing at U.S. ports especially as compared to containers landing at Montreal and moving by rail or truck to the Great Lakes Region.

There will always be containers moving on the Great Lakes as incidental or project related cargo. There may in fact be an opportunity to increase this business particularly in certain specialty or low volume areas where containerization makes sense. There may also be the potential for certain types of short sea feeder services for containers moving up-bound from Halifax or Montreal into Lake Ontario or possibly Lake Erie. A Canadian port would have an advantage since it would be exempt from the HMT. These feeder services, if economically viable, would likely be low volume compared to existing volumes currently moving by rail and truck.

However, regularly scheduled transatlantic container services face many challenges that make them very unlikely given the cost structure and service dimensions offered. Even with subsidies, these services are unlikely to succeed. While there have been many studies and efforts over the last 50 years to initiate scheduled container services none have been proven viable. While the current Cleveland service continues, traffic levels have declined from earlier years even with subsidized operations. Given this record, it is critical that policymakers have an objective analysis of the current traffic levels, competition, obstacles, and potential for such services. Otherwise there is a risk of significant expenditures of time and effort on proposals that are not viable.

REFERENCES

Alix, Yann., Slack, Brian., & Comtois, Claude (1999), "Alliance or Acquisition? Strategies for Growth in the Container Shipping Industry: The Case of CP Ships," *Journal of Transport Geography*, *7*(3): 203-208.

Belz, Adam (2014), "Sails Up For Duluth's New Option Of Europe-Bound Shipping," *TCA Regional News,* Retrieved from http://search.proquest.com.proxy.lib.wayne.edu/docview/1613255428?accountid=14925

Bernhofen, Daniel M., El-Sahli, Zouheir, Kneller, Richard (2016), "Estimating the Effects of the Container Revolution on World Trade," *Journal of International Economics, 98*: 36-50.

Bonney, Joseph (2015), "Cleveland-Antwerp Container Service Takes Wing," *Journal of Commerce,* Retrieved from http://search.proquest.com.proxy.lib.wayne.edu/docview/1695888578?accountid=14925

Bonney, Joseph (2015), "Rare Sight in Great Lakes Ports – Containers," *Journal of Commerce,* Retrieved from http://search.proquest.com.proxy.lib.wayne.edu/docview/1703503871?accountid=14925

Connole, Jon (1987), "Container Service May Lead to Revival of Port of Milwaukee," *The Business Journal, 4*(50): 6.

DeWin (1989), *MPD Liner Service Feasibility Assessment*, III1-13.

Donovan, Arthur, (2004), "The Impact of Containerization: From Adam Smith to the 21st Century," *Review of Business, 25*(3): 10.

Guy, Emmanuel., & Alix, Yann (2007), "A Successful Upriver Port? Container Shipping in Montreal," *Journal of Transport Geography, 15*(1): 46-55.

Hazard, John L. (1987), *Revitalization of Great Lakes-St. Lawrence Seaway Commerce*, report for an MSU – All University Research Initiation Grant, 71-4629, March 2, 1987, 1-20.

Hazard, John L. (1988), *Revitalization of Great Lakes-St. Lawrence Seaway*, presentation to the American Water Resources Association Symposium, November 9-10, 1988, Milwaukee, Wisconsin,

Hull, Bradley (2015), "Containerization on the Great Lakes: Why It Declined," [On-Line], Available: http://ctrf.ca/wp-content/uploads/2015/05/CTRF2015HullMarineTransportation.pdf. Accessed: 1/31/2018.

Higginson, James K., & Dumitrascu, Tudorita (2007), "Great Lakes Short Sea Shipping and the Domestic Cargo-Carrying Fleet," *Transportation Journal, 46*(1): 38-50.

Kloosterman, Stephen (2015), "Port of Muskegon Container Shipping Could Start As Early As 2016, Officials Say," Muskegon News, October 1, 2015.

Lavigne, Grace M. (2013), "Port of Cleveland Plans Great Lakes-Europe Container Service," *Journal of Commerce,* [Online]. Available: https://www.joc.com/port-news/us-ports/port-cleveland-plans-great-lakes-europe-container-service_20131029.html. Created: 10/28/2013, Accessed: 2/6/2018

Martin Associates (2011), "The Economic Impacts of the Great Lakes – St. Lawrence Seaway System," [On-line], Available: http://www.greatlakes-seaway.com/en/pdf/eco_impact_full.pdf. Created: 10/18/2011, Accessed: 2/10/2018

Markiewicz, David A. (1989), "Port of Detroit Expansion Proposal Stirs Controversy," *Detroit News*, December 24, 1989: C1.

Mayer, Harold M. (1978), *Current Trends in Great Lakes Shipping* (the University of Wisconsin Contribution No. 167), *Geojournal, 2*(2): 117-122.

McKinsey (1972), *Containerization: A 5-year Balance Sheet: A Presentation to the Hamburg Intertraffic*, 72: 1-78.

Miller, Jay, "After Robust 2017, Port Authority Anxiously Awaits U.S. Decision on Tariffs," *Crain's Cleveland*, January 28, 2018, http://Crainscleveland.com/article/20180128/news/150011/after-robust .....

Notteboom, Theo., & Rodrigue, Jean-Paul (2008), "Containerization, Box Logistics and Global Supply Chains: The Integration of Ports and Liner Shipping Networks," *Maritime Economics & Logistics, 10*(1-2): 152-174.

SeeNews North America (2013), "Port of Cleveland Unveils Container Service to Europe," *SeeNews North America*, Retrieved from http://search.proquest.com.proxy.lib.wayne.edu/docview/1460474709?accountid=14925

The Globe and Mail (1979), "Manchester Increasing Capacity for Containers into Great Lakes," *The Globe and Mail (1936-Current)*

SLSMC/DC (1959-1992), *St. Lawrence Seaway Traffic Report: 1959-1992 Navigation Seasons*, 1-41, and Web updates. SLSMC/DC Web page, http://www.greatlakes-seaway.com/en/pdf/traffic_report_hist.pdf

SLSMC/DC (2016), *St. Lawrence Seaway Traffic Report: 2016 Navigation Season*, pp. 1-49, and Web updates. SLSMC/DC Web Page, http://www.greatlakesseaway.com/en/pdf/traffic_report_2016_en.pdf

The New York Times (1979), "Chicago Port Investing to Regain Cargo Trade," *New York Times (1923-Current File)*

Stewart, R. D., National Research Council (U.S.), National Cooperative Freight Research Program., United States., CPCS Transcom Limited., University of Toledo., Prime Focus, LLC., ... Great Lakes Maritime Research Institute (2012), *Multimodal Freight Transportation Within The Great Lakes-Saint Lawrence Basin*, Washington, D.C: Transportation Research Board.

Taylor, John C., & Roach, James L. (2009), "Ocean Shipping in the Great Lakes: An Analysis of Industry Transportation Cost Savings," *Transportation Journal, 48*(1): 53-67.

Watson, Rachel (2017), "Cross-Lake Shipping Route to Launch Soon," *Grand Rapids Business Journal,* [On-line]. Available: http://www.grbj.com/articles/88339-cross-lake-shipping-route-to-launch-soon. Accessed: 2/05/2018.

BIOGRAPHIES

John Floyd is an Undergraduate Research Assistant within the Department of Marketing and Supply Chain Management in the Mike Ilitch School of Business at Wayne State University. He will be graduating in August 2018 with a B.S. in Global Supply Chain Management Honors. His research interests include various transportation and logistics topics. He can be reached at fx2236@wayne.edu.

James L Roach is President of JLRoach, Inc., a transportation consulting firm. He also serves on the Boards of Directors of several businesses. He was formally Manager of the Intermodal Planning Section of the Michigan Department of Transportation.

John Taylor is Chair of the Department of Marketing and Supply Chain Management in the Mike Ilitch School of Business at Wayne State University. He holds a PHD in Marketing and Logistics from Michigan State University. His research focus is on automotive industry supply chain management. He has also conducted numerous research reports on a variety of transportation policy issues. He can be reached at taylorjohn@wayne.edu.

(Footnotes)

[1] TEU means a "Twenty-foot Equivalent Unit" and is the common way of measuring cargo activity at a given port even though some containers may be longer than twenty feet. For example, a 40 foot container would be counted as two TEU's. A 20 foot container (TEU) has a maximum gross weight of 52,910 pounds per international standards. This results in a tare maximum weight of 48,000 pounds. Most containers weigh considerably less.

[2]

The SLS Traffic Reports report metric tons in containers. The authors converted this to short tons, and assumed ten tons per container. This process allows comparisons with USACE and other U.S. sources that use short tons.

[3] The Seaway can accommodate ships with a maximum dimension of 225.5 meters long (740 feet), 23.8 meters in breadth (78feet) and 9.1 meters draft (30 feet).