U.S. COMMERCIAL NAVIGATION ON THE GREAT LAKES: AN OVERVIEW

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ABSTRACT. U.S. transportation across the Great Lakes has declined in recent decades. Iron ore, coal, limestone, and grain are the dominant commodities transported across the lakes. Transportation of iron ore is crucial to the continued existence of the Great Lakes as a commercial navigation system. Probable implementation of direct reduction technology in the domestic steel industry in the near future portends poorly for the future of commercial navigation on the Great Lakes.

Shipments of intercity freight by water have grown since World War II, but the growth of water shipments has been substantially below that of shipments by land. Shipments of intercity freight on the Great Lakes have not grown; they have declined. While the Great Lakes accounted for about one-third of all waterborne intercity freight shipments in 1947-49, they only accounted for 10% to 11% in 1988-90 (Fig.1).

CONNECTING CHANNELS

The Great Lakes Waterway consists of the five Great Lakes and the four natural interconnections between them. The latter are termed "connecting channels"; they include the:

1. St. Marys River, which connects Lakes Superior and Huron;
2. Straits of Mackinac, which connects Lakes Michigan and Huron;
3. Detroit-St. Clair River System, including Lake St. Clair, which connects Lakes Huron and Erie; and
4. the Niagara River, which connects Lakes Erie and Ontario (Fig. 2).

All but the Niagara River are a connection for purposes of commercial navigation. Because of the presence of Niagara Falls, the Niagara River is not a navigable connection. The navigation link between Lakes Erie and Ontario is the Welland Canal.

Locks are required on two of the four connecting channels - the St. Marys River and the Welland Canal. The four locks on the St. Marys River, the Soo Locks, allow for a vertical drop of 23 ft. from Lake Superior to Lake Huron. The Welland Canal consists of eight locks with a total vertical drop of 326 ft. The Straits of Mackinac is a natural channel that requires minimal maintenance. The Detroit-St. Clair River System has to be extensively dredged in order to provide a navigable channel.

The navigable connecting channels are the major constraints to shipping on the Great Lakes. In order to pass from one lake to another, a vessel must pass through a minimum of one connecting channel. The dimensions of the locks through which a vessel must pass determines the maximum size vessel that can be used on that particular route. In general it is the Welland Canal that determines the maximum size vessel as largest lock at the Soo, the Poe Lock, is larger than the locks on the Welland Canal.

THE GREAT LAKES FLEET

In 1990 the commercial navigation fleet operating on the Great Lakes numbered 185 vessels of which 117 were of Canadian registry and 68 were of U.S. registry. This compares to 277 vessels in the aggregate fleet in 1973 and 302 in 1980. Currently the U.S. fleet consists mainly of self-unloading vessels - those that contain loading/unloading facilities on board. Fifty five of the 68 U.S. flagged vessels afloat on the lakes in 1990 were self-unloaders.

The U.S. fleet has become smaller but the average size of vessel in the fleet has increased. Excluding tankers, which on the Great Lakes are few in number, the average size of a Great Lakes carrier under U.S. registry increased from 15,989 tons in 1973 to 32,908 tons in 1990. The principal reason for this has been the retirement of small bulk carriers and the addition of large self-unloaders. At present all 14 of the large Class 9 and 10 vessels, the largest operating on the lakes, are of American registry. Thus while the size of the U.S. fleet has decreased since 1973, the total per trip carrying capacity of the fleet increased.

The significance of larger vessel size lies in the fact that ships are subject to significant economies of scale. With relatively large fixed costs, operating costs per ton of commodity transported decrease as vessel size increases. Assuming transportation of a single commodity between a particular O&D pair (port of origin and port of destination), the savings from use of a large vessel can be substantial.

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COMMODITY FLOWS

Bulk commodities comprise the great majority of total shipments transported on the Great Lakes. General cargo is estimated to account for about only three percent of all freight movements on the lakes. The principal bulk commodities shipped across the lakes are iron ore, coal, grain and limestone. They account for about 85% of all shipments across the lakes.

Iron Ore

The shipment of iron ore is the backbone of the commercial navigation industry on the Great lakes. In a non-recessionary year 60 to 70 million tons are shipped across the lakes. Most, about 80%, originates in the iron producing region of northeastern Minnesota and the western portion of the Upper Peninsula of Michigan. The ore is shipped to integrated steel mills in the United States that are situated at Great Lakes industrial centers and also at some nearby inland centers. The leading iron ore shipping harbor is Duluth-Superior, which ships about 20 million tons in a non-recessionary year.

About 20% of the iron ore transported on the lakes originates in eastern Canada, north of the St. Lawrence River. The ore is shipped south by rail from the mine sites to three Canadian harbors on the north shore of the St. Lawrence River. There the ore is loaded into Great Lakes freighters and shipped up the St. Lawrence River to Canadian and some U.S. integrated steel mills.

This flow of Canadian iron ore up the St. Lawrence into the Great Lakes is tied to the shipment of Canadian grain out of the Great Lakes via the St. Lawrence Seaway. As the grain ships would otherwise have to return to the Great Lakes empty, they willingly transport the iron ore at a reduced rate (a back haul rate). Since at present the shipment of Canadian grain via the Great Lakes and the Seaway is greatly diminished from what it had been in previous years, there is considerable concern in the Province of Ontario that a resulting increase in transportation costs on the iron ore shipped to the integrated steel mills in the province (Hamilton and Nanticoke) threatens the competitive position of the industry.

A significant problem facing the integrated U.S. mills has been the growth of domestic mini-mills, which operate electric arc furnaces charged with scrap. In the past three decades mini-mills have been expanding while the integrated mills have been declining. Competition between the two recently has been exacerbated by the introduction of thin slab casting technology to the mini-mills. With this technology mini-mills are now able to produce plate steel at a cost substantially below that of the integrated mills. Since plate steel is the premium product of the integrated mills, the introduction of thin slab casting is a direct threat to the economic vitality of the integrated mills.

The possible implementation of new technology in steel production complicates an assessment of the volume of future iron ore shipments across the lakes. New technologies, direct reduction and iron carbide technology, will most probably be introduced into the domestic steel industry before the end of the decade. If widely implemented they would permit the use of iron ore, as opposed to steel scrap, as the metallic charge in electric arc furnaces. This, and increased competition from mini-mills, could significantly alter the locational pattern of the steel industry and thus affect the quantity of iron ore transported across the Great Lakes.

In the course of the research underlying this presentation, a number of sources knowledgeable of the U.S. steel industry were contacted. Based on discussions with these sources it has been concluded that from one to as many as five of the 20 integrated mills operating in the U.S. portion of the Great Lakes Basin in 1990 will not exist in 2000. The probability that one will close is extremely high; the probability declines as the number of mills projected to close increases. The most probable scenario would call for a closure of one mill with a consequential decline of about 1.3 million tons in shipments of raw material across the lakes by 2000. This would not significantly alter the magnitude or character of commercial navigation on the lakes. It should be noted, however, that other more pessimistic scenarios are possible.

Coal

In the past decade the volume of coal transported across the Great Lakes has fluctuated from about 35 to 40 million tons per year. Most coal shipped across the Great Lakes originates in the Appalachian states and in the states of the eastern Mid West; such coal is know as Eastern Coal. It is shipped by rail to varied U.S. harbors on the lakes and then by water to numerous Great Lakes harbors in the U.S. and in Ontario.

A second major producing region is the Powder River Basin of Wyoming and Montana; this coal is know as Western Coal. It is shipped in unit trains from the Powder River Basin to Duluth-Superior and then by water across the lakes to a limited number of Great Lakes harbors. Most is destined for two Detroit Edison thermal electric plants situated in southeastern Michigan.

Eastern Coal has a higher energy content than does Western Coal, but Eastern Coal has a higher sulfur content than Western Coal. Because of its higher energy content and lower transportation costs to market, Eastern Coal has been the preferred fuel for thermal electric generating plants located in the eastern U.S. and central Canada. With the passage of more stringent airborne emission standards, shipments of Western Coal have substantially increased.

It is difficult to predict the volume of coal that will be transported across the Great Lakes. Eastern Coal, even with its higher sulfur content, could continue to be utilized by thermal electric plants if modern "scrubber" technology were implemented by the electric utilities in the U.S. and Canada.

Grain

Shipments of grain across the Great Lakes in 1989 and 1990 are only slightly more than half what they were a decade earlier. Shipments of U.S. grain amounted to 15.0 and 15.8 million tons in 1989 and 1990 respectively. Duluth-Superior is the principal U.S. grain shipping harbor but it is a distant second to Thunder Bay, Ontario. Barring catastrophic crop failures in traditional grain exporting nations, grain shipments will be maintained at about current levels or lower unless: 1) there is a successful resolution of the agricultural subsidy conflict between the U.S. and the European Economic Community (EEC) or 2) the U.S. provides substantial volumes of grain on a continuing basis to the states of the former Soviet Union. Of the two the latter is more probable.

Limestone

The volume of limestone (and dolomite) transported across the lakes currently exceeds the volume of grain transported across the lakes. Most limestone shipments originate at three private harbors in northern Michigan.

The demand for limestone is very sensitive to economic conditions. The rise of limestone from fourth to third in the list of commodities transported on the lakes is more a result of the decline in grain shipments than an increase in limestone shipments. The recent trend to mix flux stone (a mixture of limestone and dolomite) with the iron ore at taconite pellet producing plants represents a new market for transportation of limestone on the Great Lakes. Largely as a result of increased demand for flux stone, a modest increase in the volume of limestone shipped across the lakes is predicted.

HARBORS

A commercial harbor is defined as any harbor for which the U.S. Army Corps of Engineers publishes commercial navigation statistics. So defined there are 96 commercial harbors on the Great Lakes in the territorial waters of the United States.

Nineteen of the 96 commercial harbors have been constructed, operated, and maintained by private entities; they are termed private harbors. The remaining 77 harbors have been constructed, operated and maintained by the Federal government (by the U.S. Army Corps of Engineers); they are termed Federal harbors. In 1989 private harbors handled 18.4% (53.1 million tons) of all freight transported to/from commercial harbors in the U.S. on the Great Lakes.

A cumulative distribution of the harbors ranked in terms of the amount of traffic processed in 1989 indicates an interesting insight; a relatively small number of harbors process most of the traffic on the lakes. The top 10 harbors, all with more than 10.0 million tons of traffic, handled 61% of all commercial traffic. The top 18 harbors, all with more than 5.0 tons of traffic, handled 83.6% of all traffic and the top 33 harbors, all with more than 1 million tons, handled 95.9% of the traffic.

CONCLUSIONS

The near term future (to the year 2000) of the Great Lakes commercial navigation industry is secure. Depending upon national and international economic conditions, the volume of freight that will be transported across the Great Lakes during the remainder of the current decade will fluctuate, but the industry in 2000 should be much the same as that in 1991.

The existence of the Great Lakes as an integrated waterway system is dependent upon the continued flow of iron ore. Though the movement of iron ore (and associated limestone) appears secure through the end of the current decade, the probable introduction of direct reduction technology in the steel industry raises the possibility that the volume of such flows may well decline substantially after the turn of the century. The first decade of the 21st century may well prove to be critical to the continued viability of the Great Lakes as an integrated commercial navigation system.

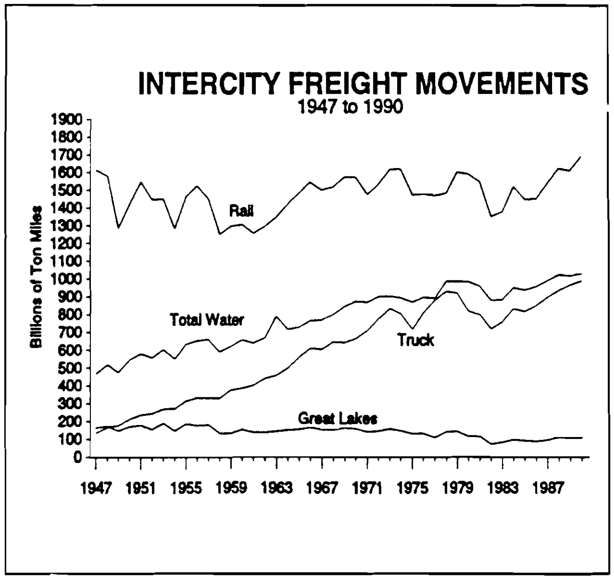

Figure 1

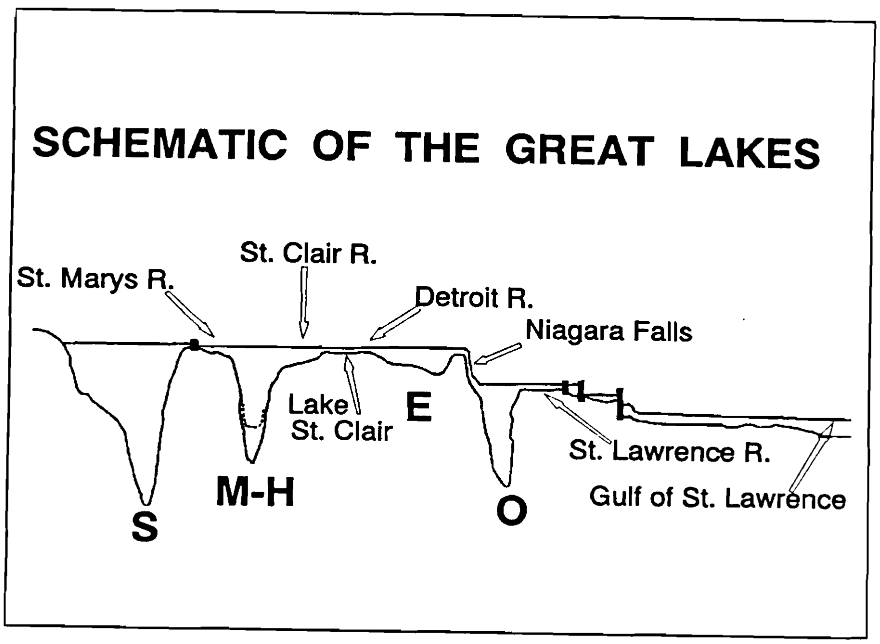

Figure 2

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