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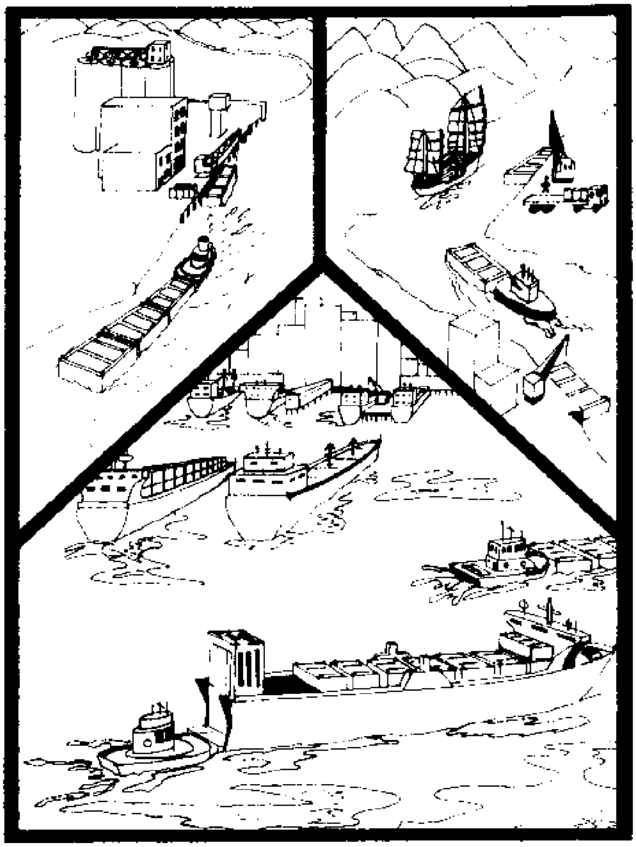

The Role of the Columbia/Snake Navigation System in Intermodal Ocean Transportation

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Summary

Columbia River ports serving ocean vessels have to some extent found their competitive position in general cargo trade suffering from the adoption of intermodal containerization in ocean transportation in the late 1960's and early 1970's. Ocean vessels equipped to carry containers are highly capital intensive and this has moved steamship companies to look to the loadcenter concept. Under this system, steamship lines restrict their ports of call to as few ports as possible. This minimizes the time the vessel spends idle in port. The high fixed costs of these vessels make it economic for the steamship line to divert cargo to a few major ports. Among the U.S. Northern Pacific Coast ports, Bay area and Puget Sound area ports have gained momentum at the expense of Columbia River ports. Seattle alone has enjoyed a larger annual increase in the number of containers handled in recent years than the total number of containers handled by the Port of Portland each year. The smaller Lower Columbia River deepwater ports have experienced even more of a decline in the number of general cargo vessels calling on them since the container revolution.

Nevertheless, grounds for optimism about the potential role of Lower Columbia River ports in intermodal ocean movement have been identified in this study. The inland navigation system that provides Lower Columbia River ports direct slackwater access to the interiors of Oregon, Washington and Idaho, and indirect access to regions further inland, adds a new dimension to the intermodal concept. Historically, cargo transported on inland waterways has consisted primarily of low value bulk commodities such as grain, fertilizer and petroleum. Two new modes of inland water barge transportation — container-on-barge and shipborne barge — have extended the scope of river transport to intermodal general cargo movements. Both systems integrate inland barge shipments with ocean vessel shipments.

The most promising in the near future is container-on-barge service. In this system, the physical commodity is placed in a standard container that can be shipped under one bill of lading via more than one mode of transportation. Container-on-barge service typically involves trucking cargo to an inland river terminal, transferring the container to a barge and transshipping the container to an ocean vessel for transoceanic or intercoastal movement. The contents remain in the container throughout shipment.

Most of the major barge lines servicing the Middle Columbia and Snake Rivers now offer container-on-barge service or plan to in the near future. Shore facilities to handle containers are now available at Pasco, Umatilla, Clarkston, Whitman County and Lewiston. Companion studies to this one at the University of Idaho indicate that peas, lentils and grass seed can feasibly and economically be shipped by container-on-barge. Forest products have been moving from Clarkston and Lewiston in substantial volume since slackwater navigation became available in 1975. Hay cubes and pellets, hides and skins and soybeans have been moving downriver at rapidly expanding rates from Umatilla and Pasco.

Columbia River ports also may be able to counteract the loadcenter challenge by developing a feeder service that would transship containers from river points to feeder container vessels which would in turn transship the containers to transoceanic vessels at Bay area and Puget Sound ports. This service potentially could counter the tendency to divert cargos overland from Columbia River ports to Bay area and Puget Sound ports.

The second concept in inland/ocean water transportation that could have strategic advantage for Columbia River commerce uses barge-carrying ocean vessels and shipborne barges. With this system, the barge and contents are loaded aboard an ocean vessel. This is not necessarily advantageous to Lower Columbia ports, since the concept is designed so that the mothership can anchor offshore to load and discharge its contents, allowing the vessel to avoid pier congestion and certain port charges. It could enhance the relative role of upriver ports, however.

Barge-carrying vessel service is currently available only on a limited basis on the U.S. Pacific Coast. Only one steamship line offers the service and it is restricted to New Zealand/Australia trade. If the system assumes a larger role in the future the major impetus will probably have to come from its potential value in Asia. One U.S. steamship line, operating from the Gulf of Mexico, is developing a barge feeder system to connect the islands and inland waterway systems of Southeast Asia. India is also reportedly considering the concept. The system could conceivably work well in the important Sino/U.S. trade.

Innovative measures are thus available to Columbia River ports to face the loadcenter challenge. At the same time, the smaller Lower Columbia ports need to recognize that each port cannot expect to invest in the container-handling facilities necessary to make each of them a full-fledged major calling point for deepwater container vessels. Over- tonnaging, which currently exists on the Pacific trade, will make it possible to attract certain lines, especially the independent third flag lines. Once this overcapacity of container vessels is absorbed, these lines will likely resist calling at many independent ports. The smaller ports will be abandoned first.

Introduction

This report focuses on the Columbia/Snake navigation system and its current and future status in the context of intermodal ocean shipping. It covers one phase of a research program at the University of Idaho to investigate the potential of the Columbia/Snake waterway in the Pacific Northwest export distribution system.

The purpose is to look at how developments in intermodal transportation encompassing ocean and inland waterway technologies that occurred in the late 1960's and early 1970's may affect waterborne commerce on the Columbia/Snake navigation system. Consideration is given to how the intermodal revolution and accompanying loadcenter concept has affected Columbia/Snake navigation. This includes examining the relative efficiencies offered by container-vessels, container-carrying river barges and barge-carrying vessels, and investigating the compatibility and adequacy of facilities and services available on the Columbia/Snake Rivers in general cargo ocean shipping. Such information is useful for policy makers, planners and industry affiliated with the river to better perceive how the Columbia/Snake River system can best be utilized as a part of Pacific Northwest transportation and commerce.

Intermodal Technologies and the Columbia/Snake

Containerization and Waterborne Shipping

Containerization of transoceanic general cargo[1] shipments was pioneered in 1966 when Sea-Land Service, Inc., initiated service from the U.S. Atlantic Coast to Europe. This ushered in a decade of revolution in seaborne shipping and handling techniques unmatched in the history of ocean shipping. The viability, or more correctly, dominance of containerized shipping in the world's general cargo trading routes was firmly established by the time Columbia River ports had begun to react to the concept.

Intermodal Container Technology

Modern containerization was described by Rath (1973) as "a technology devised to improve transportation methods by systematically passing a cargo from carrier to carrier, in the same container, without touching the cargo placed in the container by the original shipper for the consignee." Containerized shipments are usually moved intermodally. Truck, rail, ship and barge surface modes can be used jointly in the movement of the container. Certain containers also can be used by air as well so the container concept is truly intermodal. Originally the container was a closed, standard-size box, but over time several variations of container types have been developed to accommodate different cargo and shipper requirements (Figs. 1,2).

The intermodal container enables the shipper to pack his cargo into the container at his own premises, have it hauled by truck, rail or barge to a port to be transferred to an ocean vessel, and delivered overseas to the foreign consignee, without each individual unit of the consignment being handled at each intermediate stage of the journey. It is this door-to-door through-movement that allows the intermodal concept to reduce considerably the need for manpower (by using capital-intensive transfer equipment in lieu of stevedores, etc.), speeds cargo movements, reduces time at the port and diminishes the risk of damage and pilferage of cargo by keeping

[1]General cargo movements refer to commodities and products that do not lend themselves to bulk handling or move in consignments too small for full bulk shipment

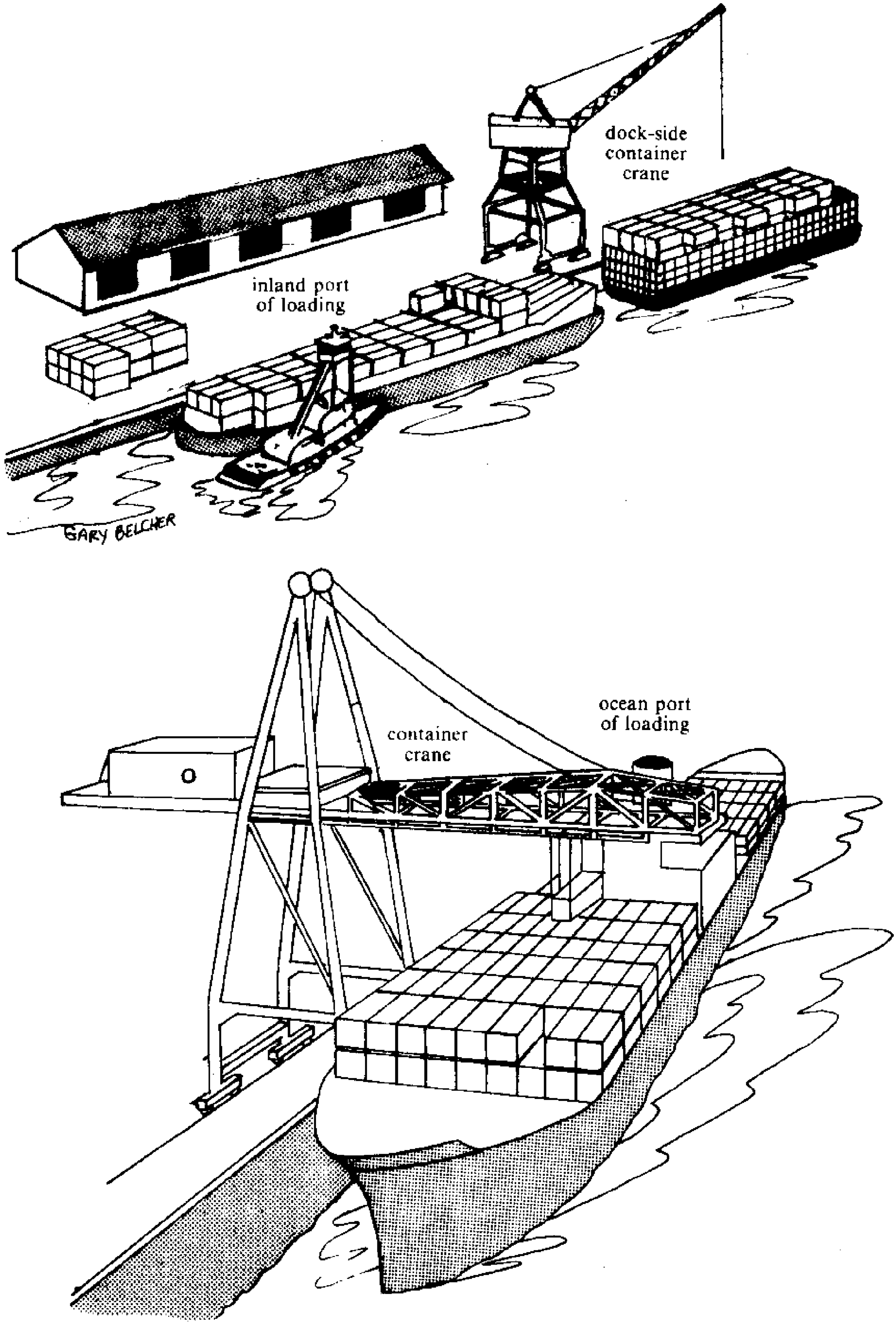


Fig. 1. Container-on-barge and container ship methods of loading containerized cargo onto oceanvessels.

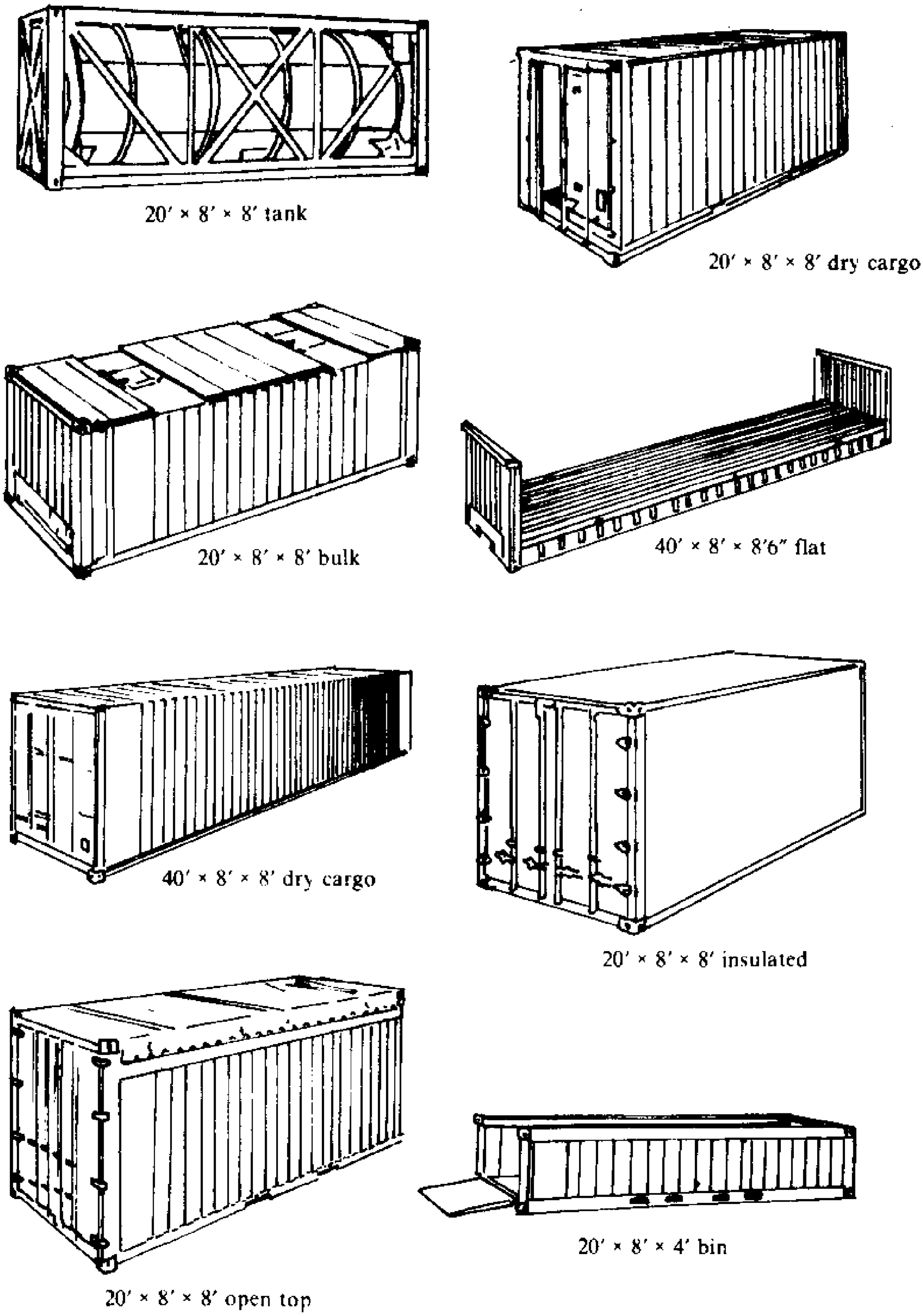


Fig. 2. Selected varieties of intermodal containers.

the contents secured in a sealed container throughout the trip.

Containerships have rapidly been displacing the conventional breakbulk liners. Major shipping lines have largely abandoned breakbulk shipping methods to circumvent two main drawbacks associated with traditional handling and shipping methods: excessive time spent by the vessel in port, and high labor costs associated with manual handling. Conventional breakbulk cargo vessels typically spend only about 40% of their time at sea and 60% in port (Whittaker, 1975). About half the time spent in port is attributed to delays incurred while waiting for labor and handling equipment and making hatches ready to receive or discharge cargo. By divorcing the ship loading operation from the cargo-handling operation, intermodal ocean shipping technologies afford substantial reductions in transportation costs. Packing the cargo in the container is performed separately from stowing it in the hold of the vessel so that the ship is not delayed as much. Additionally, economies are realized via mechanized vessel-loading procedures. When containerization initially began, the cargo-loading rate rose from 15 tons per gang-hour to 200 tons per gang-hour (Rath, 1973). These savings were effected in large part by substituting capital-intensive operations for labor. Efficiency is also presumably enhanced by coordinating or integrating many subsystems into one unified transit system providing door-to-door physical distribution.

Three major types of ocean vessels carry containers. Cellular containerships carry containers exclusively and are designed with cells within which the containers are stacked vertically upon each other. The combination container/breakbulk vessel or partial containership is equipped with holds to contain breakbulk cargo and also has space on deck to accommodate containers. Containers are loaded onto both of these types of vessels by cranes positioned near berths, or in some instances, on the vessel itself. The third container-carrying vessel is designed on the principle of the ferry. Containers are left on the trailer chassis and driven directly on board the vessel. These vessels are referred to variously as roll on/roll off (ro-ro) ships, trailerships or vanships.

The ro-ro vessel is well suited to handling heavy equipment that can be driven on the vessel and it can serve ports that lack container cranes as long as a berth is available to extend a ramp from vessel to shore to drive the cargo on and off. The ro-ro vessel has proven to be especially well designed for congested, underequipped ports receiving and shipping containers such as in the Middle East and Nigeria. However, as port congestion lessens, cellular container carrying vessels have an immediate advantage in providing more efficient space utilization. They are also much less expensive to build than ro-ro vessels. All three types of container vessels call on the Port of Portland and occasionally on some of the other Lower Columbia River ports.

While containerized shipping is already the most important method employed in general cargo shipping, it is expected to continue expanding as additional shipping routes become containerized. These routes will serve such areas as South America and Africa. Also, more and more commodities are now being shipped by container, and the feasibility of expanded trade volumes will continue to be enhanced by reduced transportation costs in certain instances. Marcus et al. (1976) forecast that by the year 2000 the number of full-containerships in U.S. international trade will nearly quadruple from the number in 1975. Another study (U.S. Department of Commerce, 1978) projects that for the same period the number of partial or combination containerships (vessels equipped to carry both breakbulk and containers) will increase nearly eightfold while the number of full containerships including ro-ro vessels will nearly triple (Table 1). Because of an expected continuation in the already present move to larger vessels, deadweight tonnage figures amplify the significance of the shift to container carrying vessels. At the same time breakbulk vessels are expected to decline in absolute as well as relative numbers over this period.

The Loadcenter Concept

Containerization has stimulated major changes in transportation and cargo handling techniques and concepts. These changes have in turn had enormous implications for the competitive environment within which port authorities, transportation interests and cargo shippers operate. Efficient containership operation relies heavily on ports providing the services and suiting the needs of the ocean vessel operator. Vessels designed for containerized trades cost much more than traditional breakbulk vessels. This increases the need to minimize the time the vessel spends in port. Containership operators consequently minimize the number of ports they call on to reduce the amount of time that the vessel is not carrying cargo at sea. This spreads the high fixed costs of the vessels over greater amounts of cargo. This "loadcenter" concept of restricting vessel calls to a few major ports has caused many smaller ports, overshadowed by larger neighboring ports, to experience difficulty in maintaining adequate steamship service.

Smaller ports find their position further complicated because port facilities which handle containers are extremely capital-intensive, thus requiring that they make large capital outlays too. Therefore, ports also require large volumes of cargo to spread the high capital outlays associated with procuring such facilities. Many existing ports do not have enough cargo to sustain these requirements. Certain major steamship operators have found it advantageous to absorb the costs of diverting cargo by land away from smaller ports to their larger neighbors.

This perhaps has been the major problem that the container era has presented to Columbia River ports. Puget Sound and Bay-area ports have been selected as loadcenter ports by certain steamship lines, at the expense of Columbia River ports. Sea-Land, the world's largest steamship operating company, does not call on any Columbia River ports. American President Lines has also restricted its calls on those ports. If the size of containerships continues to increase as some expect there could be even more incentive to divert cargo to loadcenter ports in the future, accelerating a trend that is favorable to Puget Sound and Bay-area ports. This trend threatens the competitive ability of the deep sea ports on the Lower Columbia River to attract adequate vessel service. The competitive position of upper river ports is endangered in turn, since they must rely on steamship service downriver.

Container-on-Barge Transportation

Partly because of their access to inland river navigation, Columbia River ports have historically dominated the U.S. Pacific Coast bulk grain shipping business. The future may demonstrate that access to barge shipping will also enhance the ability of these ports to compete in the general cargo trade and withstand the pressures presented by the loadcenter concept.

One of the most recent phases in the development of intermodal container transportation has been the adaptation of barges to carry containerized cargo. Containers are transferred to and from barges by crane (lift on/lift off) or driven on and off the barge (roll on/roll off). Roll on/roll off container-on-barge service was initiated on the Snake River in 1975. For two years, only two carriers had Interstate Commerce Commission authority to operate in this trade. More recently, operating authority has been extended to several other carriers. Weekly service is now available up to Lewiston, where paperboard and other forest product items are being shipped by Potlatch Forest Industries, one of the largest shippers in the inland Pacific Northwest. Peas, lentils, hay cubes and pellets, hides and skins, seeds, soybeans, groceries, furniture and glass are also shipped on the river in containers.

Other University of Idaho research related to this project analyzed the economies offered by barge

Table 1. Merchant fleet forecast summary.

Vessel classification	Total ships required to serve the U.S.-foreign trade (Vessels and thousands of deadweight tons)					
	1975	1980	1985	1990	1995	2000
Vessels						
General cargo ships (breakbulk)	2,043	1,867	1,647	1,346	1,044	795
Partial containerships	132	247	373	555	754	1,043
Full containerships*	181	259	303	365	429	511
Barge carriers	27	23	29	33	37	40
Neobulk carriers	80	101	126	153	176	205
Total	2,463	2,497	2,478	2,452	2,440	2,594
Deadweight						
General cargo ships (breakbulk)	18,241	18,288	16,634	14,496	11,754	9,387
Partial containerships	1,387	3,011	4,950	7,860	11,468	16,365
Full containerships*	2,766	4,198	5,086	6,307	8,058	10,180
Barge carriers	1,015	896	1,160	1,336	1,520	1,721
Neobulk carriers	1,730	2,193	2,779	3,487	4,298	5,428
Total	25,139	28,586	30,609	33,486	37,098	43,080

*Includes Ro-Ro vessels.

Source: U.S. Department of Commerce Maritime Administration. 1978. Merchant fleet forecast of vessels in U.S.-foreign trade: executive summary.

shipments of dry peas, lentils and grass seed (Bahn and Jones, 1978; Belcher, Jones and Lindeborg, 1979). Using a mathematical programming model that simultaneously considered the various modes, routes, origins, destinations and rate structures available or potentially available to shippers, the studies indicated that container-on-barge offers significant rate savings for peas, lentils and grass seed. These case studies, and actual experience with shipments, suggest that it is feasible to move general cargo in containers loaded on barges. The transportation industry recognized that low-value commodities shipped in bulk can be economically shipped by barge, but until the advent of the container, did not think general cargo shipments by barge were feasible.

Feeder Services and Their Advantages To Columbia/Snake Waterborne Transportation

Water feeder service could possibly alleviate some of the pressures placed upon Columbia River ports by the loadcenter concept. With such a service, containers would be collected at smaller ports on the Lower Columbia and elsewhere on the U.S. Pacific Coast and transferred by a feeder vessel to loadcenter points. There the containers would be loaded on large vessels for shipment to overseas markets. Such a feeder vessel operation would permit full implementation of the loadcenter concept without freight being diverted overland to ports such as Seattle and Oakland at the expense of Portland and other Lower Columbia River ports.

This type of feeder service could also be integrated with a river-barge feeder service. If the feeder services were integrated with a terminal at Astoria, barge river service would possibly become more attractive on the middle Columbia/Snake navigation system because a longer haul by river would allow the costs of transferring from truck to the barge to be spread over a greater distance.

A U.S. Pacific Coast container feeder service has recently been implemented. The economic viability of such a system is still to be proved. Will the major steamship companies save enough by avoiding short hauls and numerous small port calls to make the system profitable?

Containers have also been brought to Astoria from inland river points on an experimental basis but no full-scale river barge container feeder service has been implemented to date.

Table 2. Worldwide BCV fleet in 1975.

Company	No. of vessels	Type	Flag	Barge capacity	Trade area
Vessels					
Central Gulf	3	LASH	U.S.	89	Atlantic and Gulf to Southeast Asia
Moslash	2	LASH	Norway	83	U.S. Gulf to Northern Europe
Combi-line	2	LASH	1 Germany 1 Holland	83	Gulf and South Atlantic to Northern Europe
Delta Lines	3	LASH	U.S.	89	U.S. Gulf to east coast of South America
Lykes Lines	3	SEABEE	U.S.	38	Gulf to United Kingdom and continent
Pacific Far East Line*	6	LASH	U.S.	73	U.S. West Coast to Far East U.S. West Coast to Australia
Prudential Lines	5	LASH	U.S.	73	Atlantic to Mediterranean
Waterman Steamship Co.	3	LASH	U.S.	89	Atlantic and Gulf to east coast of Africa, India and Pakistan
Total	27				
Feeder ships					
Central Gulf	3	FLASH**		8	Southeast Asia
Central Gulf	1	FLASH		15	
Total	4				

Barges	No. (app.)	Length	Beam	Depth	Draft	Deadweight (long tons)
LASH	4,000	61′ 6″	31′ 2″	13″	8′ 11½″	369
SEABEE	300	97′ 6″	35′	14′ 7″	10′ 7″	833

*PFEL has since sold two of its vessels serving Australia to Farrel Lines and converted the other four serving the Far East to containervessels.

**Feeder LASH lighter transporters.

Source: Webb Institute of Naval Architecture. 1976. Market penetration and potential for barge-carrying vessels (BCV's). U.S. Department of Commerce Nat. Tech. Inf. Ser. PB-258947.

Still another alternative may be offered by a new class of containervessel, designed by a New Orleans-based company, that would have a draft of only 14 feet and be 217 feet long. This type of vessel could travel the Columbia/Snake Rivers all the way to Lewiston. The economic viability of such an operation has not been considered, however.

Barge Carrier Vessel Intermodal Service

The barge carrier vessel (BCV) concept is a relatively recent innovation in intermodal ocean transportation. It is unique because it directly bridges inland and ocean water cargo transportation. Specially designed shallow draft barges are directly loaded and discharged by an ocean-going mothership specifically equipped for this purpose. This concept has had limited use on the Columbia/Snake navigation system. However, since BCV is specifically intended to exploit the advantages of trade routes involving inland waterway navigation, the concept is potentially significant for future Columbia/Snake waterborne commerce. The concept has natural appeal to operators and users of inland river ports since theoretically these ports would assume the final interfacing role between land and ocean movements. Barges could be loaded at inland river ports, towed downriver and loaded directly aboard the ocean vessel rather than first being transferred to shore at an ocean port.

BCV Technology

The two major BCV design concepts employed to date are LASH (lighter aboard ship) and SEABEE. In 1975 the worldwide fleet of barge-carrying vessels comprised 24 LASH and 3 SEABEE barge ships plus 4 feeder LASH vessels (Table 2). The fleet also included 4,000 LASH lighter barges and 300 SEABEE barges.

The original LASH system involved a barge-carrying mother vessel equipped with a 500-ton shipboard gantry crane designed for loading and off-loading LASH barges or lighters over the stern. Barges are marshalled and delivered to or from the vessel by shallow draft tugs. The barges are approximately 60 feet long, 30 feet wide and 13 feet high. Each can carry approximately 400 tons. Fully loaded, the barges require approximately 9 feet of draft. The original LASH motherships were designed to handle up to 89 loaded barges. The first vessel to go into service was 893 feet long with a beam of approximately 100 feet. The vessel's service speed was 22 knots and it was rated at about 40,000 d.w.t. capacity. This LASH design is still by far the most prevalent in sea routes today.

Two new LASH designs recently introduced are smaller than the original versions and purportedly cost no more to construct than conventional ships (Wade, 1978). The LASH-19 version of the barge-carrying ship is capable of carrying 19 barges and 108 20-foot containers. This version operates on the float on/float off (FO/FO) principle and thus dispenses with the expensive gantry crane required on the older and larger vessels. The vessel has an overall length of 492 feet and a draft of 16 feet. Its construction cost in European or Japanese yards is estimated at $8 million. The second version is an intermediate size that can carry about 48 barges. The vessel loads and discharges barges with an on-deck crane as in the original design. Cost is estimated at around $35 million when built in overseas yards.

The SEABEE concept differs from LASH in that the lighters are designed differently and the method of loading, off-loading and stowing barges on the vessel is different. The barges have nearly twice the carrying capacity of LASH barges and are more durable because of a double hull construction. The fully loaded draft required for these barges is 11 feet which exceeds the capacity of much of the Mississippi navigation complex where the system is presently employed. However, this draft is well within the capacity of the Snake/Columbia system which can service barges requiring 14 feet draft all the way up to the Idaho terminus of the system. The mothership uses an elevator to load and off-load barges. The barges are stowed in three levels in the hold of the vessel as opposed to being stacked in a cellular configuration in the LASH vessel.

Other versions of barge-carrying vessels have been proposed, differing principally in the methods used for loading and discharging barges on the ocean vessel. One proposed design would use the air cushion principle (Whittaker, 1975). An air cushion is created between the side walls of the carrying vessel and curtains at the bow and stern, through which the barges pass. The carrying vessel settles deeply in the water while the barges are floated in and out, then the air cushion is created to lift the vessel out of the water. A plan to employ special BCV's to haul liquified gas from Indonesia to the Columbia River illustrates the diversity of BCV systems. The ship would be sunk near Astoria to discharge three barges, each capable of carrying liquified gas. The barges would be 260 feet by 105 feet with a draft of 25 to 29 feet which would limit their use to the lower portion of the Columbia. Another concept called FLASH, designed as a feeder system, has been used in Southeast Asia. Barges are marshalled from various points and towed within this craft to a central location to be transferred to the transoceanic mothership.

The Maritime Administration has projected that BCV vessels will decline to 23 in 1980 and increase to 40 by the end of the century (Table 1). However, developments since 1975, the base year for these projections, suggest they may be conservative. Four BCV's have been converted to containerships by Pacific Far East Lines but Waterman Steamship Agency has contracted construction of 2 new LASH type vessels. Central Gulf has two new, smaller versions of the LASH vessel. Moreover, Russia is completing two SEABEE-type vessels for its Black Sea/Mediterranean/Middle East routes and 3 LASH-type vessels reportedly for the Siberian/Far Eastern trades (Wade, 1978). A consortium of West German owners is building a container/barge carrier also. Thus, it would appear that 33 vessels will be on line by 1980.

Barge Carrier Vessel Economies

The barge-carrying vessel concept claims several advantages. The three most notable are (1) reduction of in-port time and increased turnaround; (2) versatility of the system; and (3) improved integration of inland waterway/ocean, inter-island/and inter-coastal waterborne transportation services.

These and other advantages principally accrue from the special characteristics of barge transport and the possible separation of the ocean vessel's schedule from cargo handling operations. Of course, a containership also divorces the cargo-handling operation from the ship schedule, but the BCV can be loaded without coming into a pier, thus enabling it to avoid the delays associated with port congestion. This is the BCV's unique feature. While other cargo ships await in roadstead for berths, the barge ship can discharge and load its cargo and continue in transit without the expense and delay of coming into dock (Fig. 3).

Port congestion and delays are prevalent in ocean waterborne commerce. A report issued by the United Nations Conference on Trade and Development (1975) identified 30 important ports where congestion results in an average ship delay of approximately 40 days (Container News, 1976). Delays of around 180 days were not atypical in Persian Gulf ports until recently. BCV vessels consequently can claim an advantage over containerships as well as conventional breakbulk vessels in terms of turnaround time efficiency because of reduced in-port time. Even when severe port congestion does not exist, the LASH version of BCV can be loaded or unloaded at the rate of 1,100 tons per hour compared to 360 to 720 tons per hour for a containership, depending on whether one or two cranes are used to load and unload the containervessel (Laing, 1973). The advantage of the BCV system over conventional breakbulk shipping is even more pronounced with in-port time being cut by as much as 90%. Thus, the BCV concept permits the ocean vessel to achieve maximum turnaround and spend more time at sea and less time in port.

The dimensions of barges used in BCV systems coupled with the ability of the system to accommodate containers, either in or on the barges, or in addition to barges, give the barge-ship concept tremendous versatility in terms of cargo that it can accommodate (Fig. 4). The system can handle palletized, baled, bagged, breakbulk, mini-bulk, heavy lift and liquid cargo. Containers can be accommodated in the barge or separately, either on deck or, in the case of SEABEE, on top of the barge. Reefer capacity can be provided either through specially designed barges or standard containers.

The shipbound barge system permits greater integration of inland, coastal and inter-island waterborne commerce. As a result, direct door-to-door overseas ocean transit is available to inland river ports and other shallow water ports where cargo would otherwise have to be transshipped at considerable expense to the ocean vessel at a major deepwater port. LASH, SEABEE or other BCV systems would permit cargo to be loaded at upriver points on the Snake and Columbia and then loaded directly on the ocean vessel, thereby circumventing Portland or other Lower Columbia River ports. This is important since the handling charges at these ports can be as much as, or more than, the costs of moving cargo on the river. With BCV service the inland port effectively becomes the seaport, thus eliminating the stevedoring and terminal charges incurred at the deepwater port. Moreover, the system is ideal where smaller shipments can be assembled at or dispersed to smaller island ports, as in trade involving island nations such as Indonesia and the Philippines.

Other advantages of the BCV system are cited as well. Barges, as opposed to ocean vessels, have little impact on the spotting, loading and unloading functions of a port so barge use minimizes the amount of expensive equipment that is required for a port to accommodate such a system (Kearney, 1976). Unless the cargo itself is extremely heavy (heavy equipment, etc.), the only requirement is that a crane be available to remove and attach the hatch cover on the barge before and after loading cargo. Pilferage is also minimized if the hatches are sealed once the cargo is loaded and then not opened again until the barge reaches its overseas destination. However, this protection from pilferage is not as comprehensive as for containers in cases where the cargo originates or ends up at a point requiring overland transport. Identity-preserved bulk shipments of grains could also be ac-

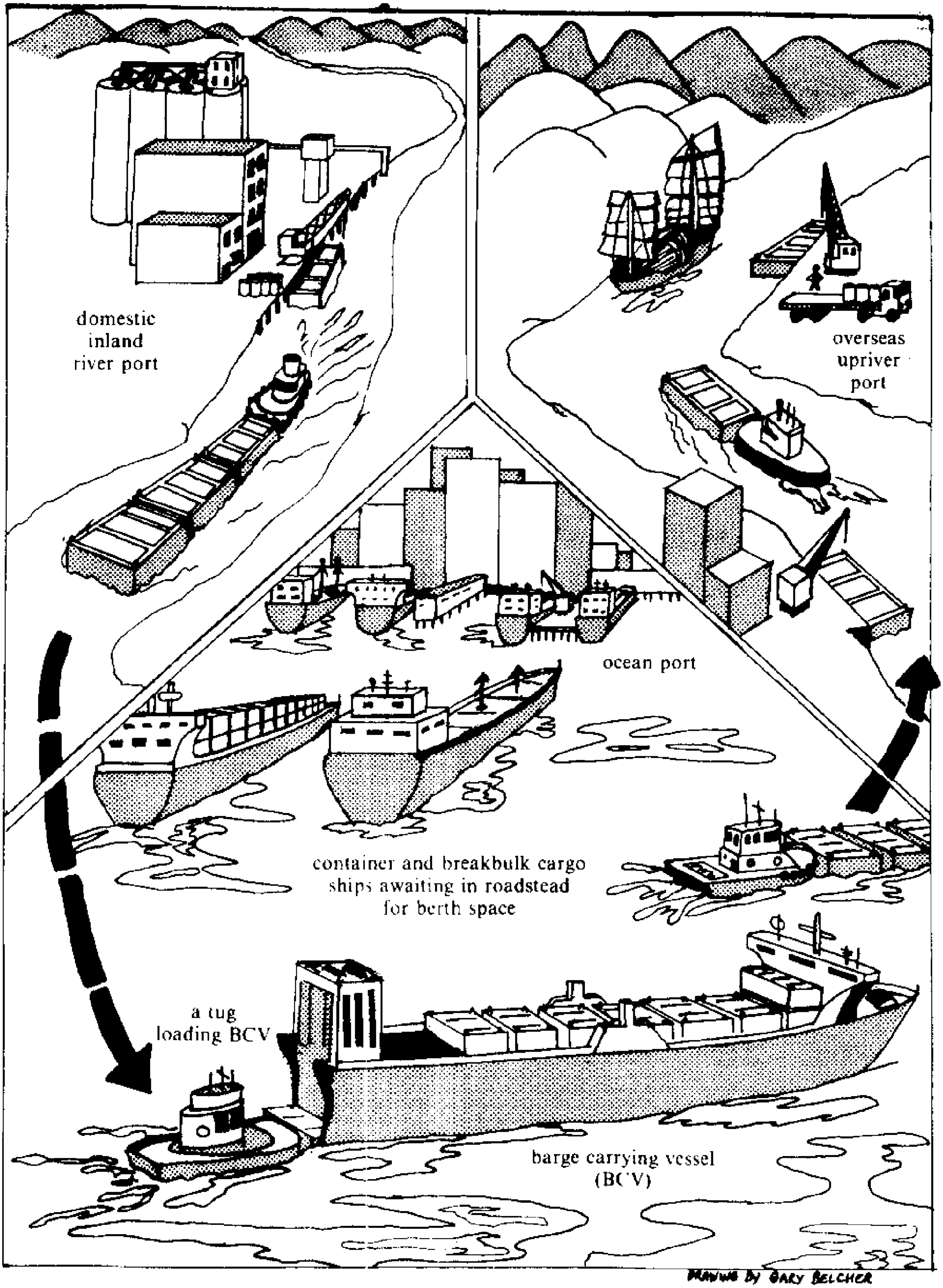
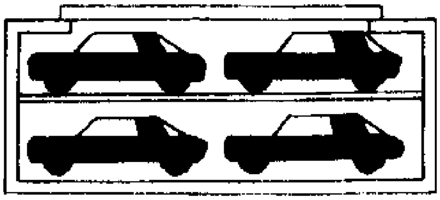
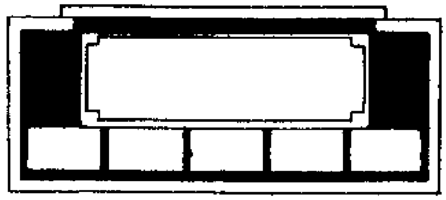


Fig. 3. Operation of barge-carrying vessel and lighter barges.

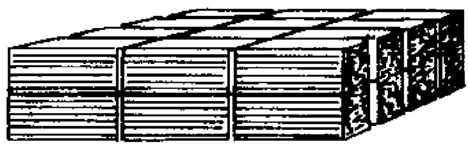


automobiles



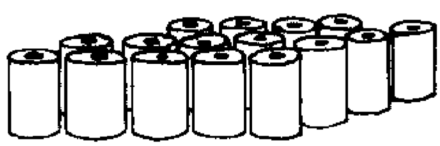
20′ container and boxes

bundles



lumber

bulk product



paper rolls

Fig. 4. Illustration of cargos carried by barge-carrying vessel.

commodated by this system since upriver elevators could ship directly to overseas customers. In instances involving grain shipments to destinations not equipped to handle grain by bulk methods, the grain could be bagged and moved in BCV type barges.

BCV vs. Containerized Shipping

The debate in the late 1960's and early 1970's concerning the advantages of intermodal systems over conventional breakbulk shipping has been largely resolved in favor of the former. Still not resolved, however, is the question of the relative roles of BCV and container-vessel operations. Comparisons of estimated costs in Table 3 show the initial capital outlay costs of the LASH version of BCV are greater than those of the containership (Laing, 1973). However, in general the costs per cubic meter are the same for both systems for one leg of a 20,000 mile round trip average under the assumptions of these calculations. The higher capital outlay required for BCV can be more than offset by savings from the reduced time in port. Nevertheless, most BCV's in operation today are combination container/barge-carrying vessels so steamship companies apparently concede certain advantages to the container carrier concept. The recent failure of Pacific Far East Lines (PFEL), the major steamship line providing BCV service on the U.S. Pacific Coast, has contributed to doubts of the advantages of the barge-ship concept vis-a-vis containerization.

Table 3. Comparison of BCV and container vessel costs.

Specifications	BCV[1]	Containership
Capacity	22,500 dwt	21,600 dwt
Vessel price (1970)	$21 million[6]	$16.5 million
Barge[1], container costs:		
2½ sets	23 million	5.4 million
@ $40,000 per barge		
3 sets 20 ft. containers		
@ $1,500		
Speed: knots	23	22
Annual operating costs		
Capital charge[2]	$2,466,500	$1,938,800
Crew	390,000	310,000
Barge costs[2]	716,500	--
Container costs[3]	--	1,240,000
Daily costs		
In port:	$ 11,850	$ 11,260
Fuel	2,730	2,730
At sea	14,580	13,990
Costs per cubic meter		
Over round voyage of 20,000 miles[5]	$ 13	$ 13

[1]LASH version (The SEABEE version is more expensive because it has more expensive barge loading discharging mechanism).

[2]10% over 20 years.

[3]10% over 6 years.

[4]Assuming 350 days service per year.

[5]For one leg of the voyage (10,000 miles).

[6]In October 1977, Waterman Steamship Co. received a builder's bid of $71,307,000 for one LASH ship and $63,709,000 for each of two (The Journal of Commerce, Thursday, Oct. 27, 1977). However, container costs have probably gone up similarly. Also, this figure represents the cost in a U.S. shipyard. Experience indicates that both containerships and BCV's can be built at considerably less expense in overseas shipyards.

Source: E. T. Laing. 1973. Containers, pallets or LASH: the economics of general cargo shipping. The Economist Intelligence Unit Limited, London

Containerization undoubtedly offers certain advantages over BCV. Containers allow a more efficient use of a vessel's space. LASH vessels converted to full containerships by PFEL resulted in a 40% increase in total capacity from 1,559,000 cubic feet to 2,189,000 cubic feet (Daily Shipping News, 1977). Containers also offer more likelihood of door-to-door transit. The BCV provides an integrated transportation system that minimizes handling when inland waterways or waterfront origins and destinations are involved. But for cargo that neither originates nor ends up at a point having direct water access, integration is less complete with the BCV than with containers that can be shipped overland.

A cost comparison of LASH barge service vs. container-on-barge service for dry pea and lentil movements on the Columbia/Snake navigation system shows that LASH barge shipments could reduce handling expenses at the ocean port by 54 to 57 cents per hundredweight (Table 4). However, loading and palletization costs of transferring the commodity from trucks to the barge at the river were estimated to be as much as 59 to 63 cents per hundredweight more than if the cargo had been shipped by container. Neither LASH nor container-on-barge demonstrates an obvious advantage over the other on the Columbia/Snake River system. Since both LASH barge and container-on-barge rates have only recently been established on the river system, additional adjustments in one or both will have to be made before they accurately reflect the economies of the two types of service.

The BCV concept has encountered inertia and outright resistance from various sources. In consequence these obstructions have complicated BCV's successful implementation and clouded the issue of the actual economies or diseconomies of the system.

Table 4. Cost and handling comparison between LASH and container-on-barge modes, Moscow, ID, to Portland via Snake-Columbia River.

Activity	Container-on-barge	LASH
Delivery of empty container and LASH barge	**Activity:** an empty container is delivered to the shipper via barge to the river terminal and truck to the shipping point. **Cost:** the cost is incorporated into the barge and truck rates below. **Cumulative subtotal:** not applicable	**Activity:** an empty LASH barge(s) is towed to Lewiston from the LASH vessel. **Cost:** this cost is incorporated into the LASH barge rate below. **Cumulative subtotal:** not applicable
Activity at inland shipping origin	**Activity:** shipper receives and loads an empty container. **Cost:** cost of loading (or "stuffing") is borne by the shipper as an operational and labor cost. **Cumulative subtotal:** not applicable	**Activity:** shipper hires a truck and trailer; loads bags into trailer. **Cost:** cost of loading is borne by the shipper as an operational and labor cost. **Cumulative subtotal:** not applicable
Transit to river terminal	**Activity:** delivery of loaded container to river terminal. **Cost:** 12¢/cwt — based on an average rate of two trucking firms;* Raz tariff charges 5¢/ton loaded mile (or 9¢/cwt)** **Cumulative subtotal:** 9 to 12¢ cwt	**Activity:** delivery of loaded trailer to river terminal. **Cost:** breakbulk truck rate — 22¢ cwt for Moscow to Lewiston. **Cumulative subtotal:** 22¢ cwt
Activity at river terminal	**Activity:** empty and loaded container moved from barge to truck and truck to barge. **Cost:** Port of Lewiston through-put rate — $33 per container (or 8.7¢/cwt) **Cumulative subtotal:** 17.7 to 20.7¢/cwt	**Activity:** trailer unloaded; bags palletized; pallets lifted into LASH barge; forklift arranges pallets inside LASH barge. **Cost:** trailer unloading included in truck rate; pallets are a cost to the shipper $6.50 each (or 32.5¢/cwt); Port of Lewiston wharfage 30¢/ton (or 1.5¢/cwt); LASH barge loading 5.00 ton (or 25¢/cwt) **Cumulative subtotal:** 81¢/cwt
Barge transit	**Activity:** movement of empty and loaded container on river by barge. **Cost:** $140.06/container (or 36.4¢/cwt) based on a regression estimate for Lewiston to Portland* **Cumulative subtotal:** 54.1 to 57.1¢/cwt	**Activity:** movement of empty and loaded LASH barge on river. **Cost:** 30¢/cwt **Cumulative subtotal:** $1.11/cwt
Activity at ocean port	**Activity:** container unloaded from barge; moved to container yard; moved to shipside. **Cost:** Port of Portland through-put charge — $78/container and wharfage $2.60/short ton-barge unloading included in through-put charge if at same terminal **Cumulative subtotal:** 54.1 to 57.1¢/cwt	NONE **Cumulative subtotal:** $1.11/cwt
Loading of ocean vessel	**Activity:** shiploading **Cost:** shiploading included in ocean transportation charge; the port bills the ocean carrier for activity at ocean port. Ocean carrier bills shipper — handling $9.20/MT and wharfage 2.87/MT (total-54.7¢/cwt) **Grand total:** $1.09 to $1.12/cwt	**Activity:** LASH barge lifted onto LASH vessel. **Cost:** included in LASH ocean transportation charge **Grand total:** $1.11/cwt

*See Belcher, Gary L. 1978. Inland waterway/ocean movement of Pacific Northwest dried pea and lentil exports: A linear programming transshipment analysis. Unpublished M.S. thesis, Univ. of Idaho.

**Derived by (5¢ ÷ 20 = .0025) × 35 miles = 9¢/cwt.

Experience has shown that managment of steamship firms using BCV's has been reluctant to disperse the barges to remote inland waterway points. One steamship official (personal interview) guessed that only about 10% of the cargo carried from the Gulf region by his line's BCV's originated upriver. Most cargo was loaded on lighters from areas near the port and berthing point of the mother vessel. This reluctance may be due in part to design shortcomings in the construction of the barge. Indeed, one operations management official stated that LASH barges are not suitable for towing except in ideal conditions. However, some of the operational problems could be solved by false bows, tucking the small lighters into larger tows and other procedures. Moreover, the design of the barges themselves could be altered. Designers and management in the early stages have given more thought to making the barges compatible to the mother vessel than to inland river navigation requirements.

Management has shown a lack of knowledge of the cargo available at inland river points. This probably reflects the fact that management personnel in steamship lines and steamship agencies are accustomed to focusing marketing efforts at ports rather than at the interior inland points. As experience is gained with door-to-door management, some of these problems may be resolved. Incidentally, this is also the case for containerized cargos.

The BCV concept, like the container concept, is designed to circumvent or reduce labor costs associated with the handling and shipping of cargo. Labor resistance has accordingly been encountered. River pilots initially argued against the safety of anchoring the mother vessel at the mouth of the Columbia. The argument was superficial, but its appeal to this group possibly lay in a bias against the BCV concept. If the vessel takes on and discharges cargo at the mouth of the Columbia, the services of river pilots who normally direct the vessel up the river are no longer required. In other situations BCV companies have been required to allow shore crews to operate their vessel gantry crane to load and discharge cargo when the ships' own crews could have performed this task. Also possibly attributable to labor resistance is a regulation imposed in Japan requiring that each individual lighter had to be moved from the vessel to the port under a separate tow, thus greatly increasing the loading and discharging costs of the BCV in that area. In consequence, many of the purported economies of the BCV concept, and containerization as well, have been aborted by labor group practices and obstructions.

Another illustration of the type of constraints that must be overcome to initiate the barge-carrying vessel concept is the instance of Indonesia categorizing ports open to foreign flag shipping. Shipping and ports in the country are divided into various categories with river and inter-island tugs and barges treated separately from ocean shipping (Lauriat, 1977). Ports served by the first two categories of vessels are closed to vessels operated by foreign lines and thus, LASH or SEABEE barges could be restricted from calling upon those ports. Special flag dispensation can be requested but, reportedly, inflexibilities and delays in granting suspensions of these restrictions frequently create serious problems.

The list of continuing problems encountered by BCV operators can be extended. Another example is the allegation that conferences have been dominated by container operators and thus have been insensitive if not outright discriminatory to the operational and rate-setting needs of BCV barges.

Barge-carrying vessel and container-vessel operators have also been impeded by past practices that are not suited to door-to-door intermodal shipment practices. For example, the USDA's Commodity Credit Corporation has only recently amended its financing procedures to include commodity export shipments from U.S. inland or coastal points on bills of lading on two or more different modes of transport (USDA-FAS, 1978). Marine insurance procedures are still being modified. Finally, government regulatory practices have been criticized for creating artificial hurdles for intermodal shipments. Fragmented authority of the ICC and the FMC has been one of the problems.

Future of BCV in Columbia/Snake Shipping and Barging

These illustrations of impediments encountered by barge carrying operators were cited to emphasize that many factors have cast doubt on the BCV concept. However, the system, when employed in the right circumstances, may still prove to have certain advantages. Skepticism is warranted but it is premature to rule out any future for BCV on the Columbia/Snake River system.

BCV service could enhance the competitive position of Middle Columbia and Snake River ports in Pacific Northwest cargo movements in certain instances since it links inland waterborne transportation directly to ocean-borne movements and reduces vessel expenses and time spent in deep sea ports. Lower Columbia River deepwater ports may or may not benefit, depending on whether the system diverts more or less upriver cargo from these ports than could be attracted from other ports, or otherwise obtained by increased volume directly attributable to BCV service. The actual magnitude of these impacts will depend on the importance that BCV service eventually assumes in waterborne commerce involving Pacific Northwest ports.

To date, BCV service has played a minor role in general cargo shipment on the Columbia/Snake Rivers. BCV cannot be expected to influence the competitive position of Columbia and Snake River ports until it becomes fully operational at other ports and in most of the major sea trade routes linking the region to markets abroad. Columbia/Snake hinterland cargo markets are insufficient to sustain this service. Since Sacramento and Stockton are the only other U.S. Pacific Coast ports providing inherent advantages to BCV service, its implementation will hinge more on how suitable and how well received the concept is in overseas markets than on how well the system exploits the needs of Columbia/Snake navigation.

The future for BCV waterborne technology in Pacific Rim countries may indeed be promising, particularly in trade with island nations such as Japan, the Philippines and Indonesia. Island and coastal BCV barges could be collected at a central point for shipment to the deep sea vessel. A feeder LASH system has been successfully initiated in Southeast Asian/U.S. Gulf Trade with a LASH mothership picking up the barges at three main ports — Port Klang, Singapore and Bautham (Journal of Commerce, 1977). Numerous and extensive river systems in the Pacific Rim region also offer potential for barge-carrying vessel service. The Yangtze in the People's Republic of China and the Ganges-Brahmaputra-Hooghly River of India and Bangladesh are the world's most densely populated river basins (Chilcote, 1971). Others include the Mekong of Indochina, the Chao Praya of Thailand, the Irrawaddy of Burma and the Yellow River of China. One U.S. BCV operator has already discussed the possibility of initiating service in the People's Republic of China as a part of the U.S./Sino trade negotiations.

India has indicated interest in acquiring LASH ships as a part of its fleet. The U.S.S.R. is also constructing BCV vessels for the Siberian River network. The magnitude of trade carried by BCV in Pacific Northwest/Asian routes that evolves from these developments will ultimately determine the potential for this kind of service for Columbia River ports.

Intermodal Support Facilities and Services On the Columbia/Snake

The future role played by Columbia/Snake River navigation in intermodal shipping will be influenced by developments in ocean shipping systems and the existence or development of facilities and services on the river to accommodate those systems. This section of the report describes shore-handling facilities and services available at Lower Columbia River deepwater ports and at inland river ports on the Middle Columbia/Lower Snake navigation systems.

Profile of Lower Columbia River Ports' Role in Intermodal Transportation

Most containerized general cargo shipped via the Lower Columbia River has been handled through the Port of Portland. In 1976 Portland ranked 20th among North American ports and 61st among the world's major container ports in terms of 20-foot equivalent container units (TEU's) handled. Its two major competitors on the U.S. Pacific Coast, Seattle and Oakland, ranked third and second respectively among U.S. container ports and seventh and sixth among the leading world container ports. Portland handled 68,452 TEU's, Seattle 574,850 and Oakland 602,877. The Port of Portland was a relatively latecomer in the container trade when it opened its major specialized container-handling facility at Fulton Terminal 6 in 1974, and it continues to lag behind Seattle and Oakland. Seattle's growth of container units from 1975 to 1976 alone was 93,756 TEU's, considerably more than the total handled in Portland. In spite of its diminutive stature relative to Seattle and Oakland as a general cargo port, Portland has scored some success in containerized general cargo traffic. Total tonnage of containerized cargo increased from 393,347 tons in 1974 to 767,914 tons in 1978 (Table 5).

Port of Portland Container Facilities

The Port of Portland's container vessel handling facilities include 7 container berths with a total quay length of 4,644 feet and 1 ro-ro berth of 700 feet.[2] Portland's ship-loading equipment includes 6 cranes ranging in lift capacity from 33 to 50 tons. Port of Seattle in comparison has 18 container berths with a total quay length of 12,050 feet. Seattle has 24 cranes ranging in size up to 50-ton capacity. Oakland, another major port that seems destined to expand its dominance as a loadcenter in container oceanborne commerce on the U.S. Pacific Coast, has 11 full container berths and 2 combination container/breakbulk berths with a total quay length of 8,795 feet, plus 2 ro-ro berths that can accommodate containers on chassis. Oakland is equipped with 14 cranes ranging from 30 to 50 tons and 2 mobile cargo/container cranes with 200-ton capacity.

Terminal facilities at Portland include 57 acres of container yard area and another 420 acres available to meet future container terminal needs (Container News, 1978). Portland authorities feel that this expansion potential is one of their strongest advantages relative to Seattle and Oakland. However, Oakland now has 325 acres of developed staging area for containers.

Land availability can be important in shaping the role of a port area in intermodal transport. Relatively larger tracts of land adjacent to berthing facilities are required to support container marshalling and storage than are needed with breakbulk techniques of handling cargo. This is particularly true where chassis-mounted containers are involved since the boxes cannot be stacked vertically. Container pools are more land demanding. Minibridge and landbridge movements require storage of large numbers of containers before shipment, just as do large container ships. Scarcity of land and concomitant high prices likely caused much of San Francisco's general cargo to be diverted to Oakland as container facilities were built. Whether Portland will benefit similarly is possible, but probably to a much lesser extent.

The Port of Portland has 9 straddle carriers, 1 forklift with spreader, 4 45-ton Trainstainers and 1 35-ton Portpacker. In comparison, Seattle has 29 straddle carriers alone.

The Port of Portland opened a 200,000 square feet distribution warehouse in 1976 adjacent to John M. Fulton Terminal 6 to facilitate inland movement of cargos.

Portland is served by 66 trucklines (9 are transcontinental), 4 transcontinental railroads, 10 regularly scheduled airlines and 5 barge lines.

Specific ranking of the container cargo-handling capacity of the Port of Portland vis-a-vis Seattle or Oakland is not possible from this inventory of marine vessel facilities and terminal handling facilities. Estimating terminal capacity exceeds the scope of this particular study since many additional dimensions to the problems have to be considered.[3]

[2]The statistics cited in this section are taken primarily from Containerization International Yearbook, (London, 1977 and 1978). Two other useful sources on port equipment are The Official Intermodal Equipment Register (Intermodal Publishing Company, Ltd., May, 1978) and Aerospace Corporation, Port System Study for the Public Ports of Washington State and Portland, Oregon, Vol. II, Technical Supplement, Part 2, Port Facilities Inventory (Springfield, Va.) National Technical Information Service, U.S. Department of Commerce March, 1975. Because different classification schemes are used by these sources, only the first was cited for comparative information.

[3]For a technical presentation of methodology for estimating capacity of marine terminals see Manalytics, Inc. Port Capacity Methodology (prepared for U.S. Maritime Administration and U.S. Department of Commerce), Vol. I (San Francisco, 1976).

Table 5. Portland container statistics.*

	1974	1975	1976	1977	1978
Import					
Loaded units	28,532	24,724	29,097	32,404	NA
Total tonnage	163,905	139,868	170,415	176,825	NA
Export					
Loaded units	37,135	31,250	39,355	43,725	NA
Total tonnage	229,442	380,940	469,503	486,657	NA
Total containers handled	65,667	55,974	68,452	76,129	82,649
Total containerized tonnage	393,347 roll-on roll-off	520,808	639,918	663,482	767,914
Total freight tonnage (excl. grain)	2,154,931	1,899,463	NA	NA	NA

*Container figures represent actual movements. Weights are given in tons and include tare weight. Unknown data are designated as NA - not available.

The figures quoted here only indicate that Portland is not equipped to handle the same mass of containers as the other two major U.S. Pacific Coast rivals. This lends momentum to the efforts of Seattle and Oakland to capture oceanborne container traffic. Ship operators are highly sensitive to delays caused by calling on smaller ports, since a modern container vessel's daily cost can be as much as $40,000. A delay of one day at each port of call on the U.S. Pacific Coast could increase the cost of container service by $320,000 per voyage. Hence, vessels prefer calling on as few ports as possible. This propensity is offset somewhat, however, if consolidation of containers at large ports leads to congestion that reduces through-put capacity at those sites, and if the cost of the land segment of container movement is increased measurably.

Shippers upriver who are evaluating the merits of routing cargo to overseas markets via the Columbia/Snake River system must consider whether adequate steamship service is available downriver.

Portland reports container service by 33 steamship lines while Seattle reports 20 deep sea lines and 4 short sea lines involved in the Alaska trade. Oakland is served by 21 lines offering full container service plus 3 part container service lines. At first glance, Portland seems to have superior steamship service. But when lines calling on San Francisco are added to Oakland services, the total number of lines calling on the greater Bay area is over 50. Adding lines serving Tacoma to those serving Seattle, 49 lines offer container service to the Puget Sound area. Figures are not available for the number of

Table 6. Containership service to overseas ports of call.

		Columbia River		Puget Sound		Bay Area	
		Calls per month	Carriers	Calls per month	Carriers	Calls per month	Carriers
		(Number)		(Number)		(Number)	
Antwerp	direct call	8	4	9	4	14	5
	mini bridge	13	3	13	3	15	4
	total calls	21	7	22	7	29	9
Gothenburg	direct call	8	4	9	4	14	5
	mini bridge	17	4	17	4	13	3
	total calls	25	8	26	8	27	8
Hamburg	direct call	8	4	9	4	14	5
	mini bridge	15	4	15	4	17	5
	total calls	23	8	24	8	31	10
Le Havre	direct call	8	4	9	4	14	5
	mini bridge	20	5	20	5	17	5
	total calls	28	9	29	9	31	10
Liverpool	direct call	7	3	9	3	13	4
	mini bridge	13	3	13	3	13	3
	total calls	20	6	22	6	26	7
London	direct call	7	3	9	3	13	4
	mini bridge	17	4	17	4	14	4
	total calls	24	7	26	7	27	8
Rotterdam	direct call	8	4	9	4	14	5
	mini bridge	20	5	20	5	16	5
	total calls	28	9	29	9	30	10
Genoa	direct call	3	2	3	2	4	3
	mini bridge	13	4	13	4	13	4
	total calls	16	6	16	6	17	7
Piraeus	direct call	1	1	1	1	3	2
	mini bridge	16	5	16	5	16	5
	total calls	17	6	17	6	19	7
Marseilles	direct call	2	1	2	1	4	2
	mini bridge	13	3	13	3	13	3
	total calls	15	4	15	4	17	5

container steamship lines serving other Lower Columbia River ports, but it is generally safe to say that Bay area and Puget Sound ports are called upon by a larger number of lines offering container service than are Columbia River ports.

When service is expressed in terms of vessel calls, the disparity becomes even greater because Sea-Land and American President Lines both have abandoned direct Portland calls by transoceanic containerships and they operate with much greater frequency of service than some of the other lines. A profile of steamship service to selected destinations from Portland, Seattle and Oakland/San Francisco is presented in Table 6. Fewer vessels servicing overseas ports call on Columbia River ports in almost every case, with Bay-area ports showing the largest advantage. Portland's comparative disadvantage appears to be greatest in the Asian trade.

Lower Columbia River Ports — Longview, Vancouver and Astoria

In addition to Portland, three other deepwater ports provide at least limited container service on the Lower Columbia. These are Longview, Vancouver and Astoria.

The Port of Longview on the Washington side of the Columbia River has adapted some of its existing

Table 6. Cont'd.

		Columbia River		Puget Sound		Bay Area	
		Calls per month	Carriers	Calls per month	Carriers	Calls per month	Carriers
		(Number)		(Number)		(Number)	
Beirut	direct call	0	1	0	1	0	1
	mini bridge	3	2	3	2	3	2
	total calls	3	3	3	3	3	3
Capetown	direct call	1	1	1	1	1	1
	mini bridge	6	2	6	2	3	3
	total calls	7	3	7	3	4	4
La Guiara	direct call	3	2	3	2	5	2
	mini bridge	0	0	0	0	0	0
	total calls	3	2	3	2	5	2
Curacao	direct call	0	0	0	0	0	0
	mini bridge	4	1	4	1	4	1
	total calls	4	1	4	1	4	1
Kingston	direct call	4	1	4	1	6	2
	mini bridge	0	0	0	0	0	0
	total calls	4	1	4	1	6	2
Persian Gulf	direct call	10	3	14	4	13	4
	mini bridge	19	8	20	8	25	10
	total calls	29	11	34	12	38	14
Bangkok	direct call	13	6	17	7	28	9
	mini bridge	0	0	0	0	0	0
	total calls	13	6	17	7	28	9
Singapore	direct call	31	12	37	14	58	19
	mini bridge	0	0	0	0	0	0
	total calls	31	12	37	14	58	19
Hong Kong	direct call	47	14	55	17	71	21
	mini bridge	0	0	0	0	0	0
	total calls	47	14	55	17	71	21
Yokohama	direct call	30	9	37	9	61	16
	mini bridge	0	0	0	0	0	0
	total calls	30	9	37	9	61	16

*Compiled and calculated from the following sources: Port of Seattle, Tradelines, 5-1-78; Port of Portland, Scheduled Steamship Service, Spring 1977, Pacific Shipper, Vol. 53, No. 48, 1-15-79; Marine Digest, 12-23-78; Journal of Commerce, 12-8-78; Daily Shipping News, 12-18-78.

facilities and added certain new ones to handle containerized cargo. One complex includes a berthing facility with a ro-ro dock. In the middle 1960's, Longview had as many as 800 calls annually from vessels designed to carry general cargo by breakbulk techniques. With the advent of containerization, general cargo vessel calls have dropped to about 450 a year. The port is attempting to win back vessel calls by expanding its container-handling capacity. Long-range development plans include expanding the port's ship and shore-side container-handling capacity.[4] A 30 long-ton container crane is expected to be erected by 1980 (Daily Shipping News, 1979). The crane will be supplemented by 3 dockside whirley cranes and a 600-ton capacity crane. A 176-acre tract of land has been purchased to provide container yard back-up facilities. The port plans to spend $25,000,000 over 15 years.

The Port of Vancouver, Washington has no cranes specifically designed to handle loading and offloading containers on ocean vessels. The port does engage in container service indirectly by accommodating an over-the-road service from Seattle for Sea-Land Steamship Service. A container crane may be acquired but, given the surplus capacity already existing at Portland, no plans exist to develop extensive container-handling ocean vessel facilities.[5] The port had no service connections with general cargo river barge carriers as of spring 1978.

The Port of Astoria, near the mouth of the Columbia, has played a limited role in container traffic. Its present facilities are not well designed to accommodate such traffic. The existing pier area offers inadequate space for marshalling and storing containers. However, this bottleneck may be removed in the future if the port authority is successful in acquiring the old naval facilities at Tongue Point. This addition would increase the Port of Astoria by 55 acres. The port has suffered from a less than desirable link to inland truck and rail movement. The absence of an adjacent large scale market such as Portland enjoys in its metropolitan setting also constrains Astoria.

As far as general cargo commerce is concerned, Astoria's greatest promise may lie in its potential role in an ocean feeder service that would link with other U.S. Pacific Coast loadcenter ports. The potential coastal feeder service might be augmented with a feeder service linking inland container-on-barge and barges designed for barge-carrying vessels. The expense of bringing ocean vessels up the Columbia could be minimized this way. This could save thousands of dollars per Columbia River call for the ocean vessel in terms of reduced fuel and pilotage expenses and increased vessel turnaround time. At the same time, shallow draft barge service could more fully exploit Astoria's geographical position by offering inland points a longer river haul. A barge feeder service might enhance the feasibility of providing barge service to Middle Columbia River ports that currently are disadvantaged by the short distance that the barge mode can be used for cargos transshipped in Portland.

General Cargo Barge Shipping On the Middle Columbia and Snake Rivers

Historically, the inland navigation reaches of the Middle Columbia and Lower Snake Rivers have played an important role in the development of the Port of Portland and other Lower Columbia River ports serving deepwater vessels. Indeed, no other port area on the U.S. Pacific Coast enjoys comparable access to inland navigable rivers. Water access to a productive inland hinterland has been a significant reason that the Port of Portland can claim its status as the largest U.S. Pacific Coast export shipping point in terms of tonnage volume. Grains were moved to ocean vessels in steam powered paddlewheel river vessels for many years and in tug/barge tows after slackwater navigation was initiated in 1938 with the construction of Bonneville Dam and lock. Slackwater inland barge transportation currently extends to the Port of Lewiston, about a mile above the Clearwater confluence with the Snake River in Idaho.

Commodity movements on the river have historically consisted primarily of bulk commodities destined for downriver movement. Approximately 70% of the volume moved on the river in 1976 was downbound, and grains and forest products accounted for about 97% of this volume. The lack of a large populated industrial settlement inland, or of road and rail networks extending eastward to such centers, has meant that upbound commodities have primarily been restricted to shipments of inputs, such as petroleum products, fertilizers and chemicals used in the agricultural industries. The river/barge system of shipment attracts low value nonperishable commodities which carry less penalty for relatively slow transit times.

One of the strongest comparative advantages of barge shipments is that large quantities can move in individual shipments. One barge can haul up to 3,600 tons of grain, as much as 36 large grain hopper cars, or many more trucks. Commodities other than grains, petroleum, woodchips, logs, etc., have not

[4]Interview with Gary Burns, Port of Longview, March 22, 1978. A container crane was expected to be in operation within a couple of months of the interview.

[5]Personal interview with Arthur Milne, Port of Vancouver, on March 20, 1978.

Table 7. Container movements from Mid-Columbia and Snake River ports, 1975-1977 (TEU).

Commodity	Umatilla	Pasco	Wilma	Clarkston
1975				
Containers received				166
Paper board				68
Total movements				68
1976				
Containers received		1,943		1,604
Paper board				1,624
Hay cubes		1,382		
Hay bales		2		
Peas		6		
Hides and skins		53		
Total movements		1,443		1,624
1977				
Containers received	37	2,473	36	2,470
Paper board				2,444
Paper waste		32		
Hay cubes	28	1,897		
Hay bales		59		
Hay pellets		60		
Peas			26	
Hides and skins	9	157		
Soybeans		62		
Misc.		49		
Total movements	37	2,316	26	2,444

Source: Portland District, Corps of Engineers.

moved in large enough consignments to exploit these advantages. However, the container-on-barge concept does allow for smaller consignments of individual commodities to be efficiently assembled into large shipments. Thus, barge movement of general cargo on the river is now feasible.

Containers have been moved by barge only since 1975 so it is not yet possible to discuss trends in general cargo shipments by this mode. Table 7 lists some of the containerized general cargo that has been shipped between 1975 and 1977. Container-on-barge service was initiated at the end of 1975 to Clarkston. Only 68 20-foot equivalent containers were shipped that year. In 1976, the number rose to 3,067; in 1977, container shipments increased to 4,823. In the fall of 1978, additional container-on-barge service received authorization and new services were implemented. Since then, over 1,000 containers per month have been moving to Lower Columbia River ports (predominantly to the Port of Portland) from inland river points. Paperboard has been the most important product shipped by container-on-barge. Other products include hay cubes, bales and pellets, hides and skins, soybeans, dry peas and lentils, groceries and waste paper. Shipborne barge service of the LASH variety has only been used on a limited basis to date.

Table 8. Upper Columbia and Snake River general cargo port facilities.

	River port					
Facility	**Morrow[1]**	**Umatilla**	**Pasco**	**Whitman Co.**	**Clarkston**	**Lewiston**
Dock length (ft.)	None	318	605	100[2]	130	120
Crane capacity	None	70 ton	36 ton	140 ton	20,40,65 ton[4]	35 ton
RoRo ramp	No	Yes	No	No	Yes	No
Truck lines serving	5+local	5+local	7+local	8+local	8+local	8+local
Rail service	Union Pacific	Union Pacific	Burlington Northern	Camas[3] Prairie	None	Camas[3] Prairie
Storage/holding area, acres	None	5	5	36	80	23
Warehouse facilities (sq.ft.)	None	None	1.5 million	None	60,000	None
Tank farm (gallons)	None	5.3 million	28 million	2.8 million	None	None
Scheduled barge service	None	Weekly	Weekly and 1st, 20th, 30th	on inducement	on inducement	weekly
Commodities handled	None	logs, hay cubes and pellets, hides, seeds, grain, petroleum	hay cubes and pellets, scrap paper, soybeans, hides, petroleum, grain	logs, wood chips, forest products, petroleum	grain, forest products	grain, forest products

[1]Facility currently undeveloped at Boardman.
[2]100-foot docks at Wilma and Almota; North Clarkston site includes 60-foot private dock.
[3]Connects with Burlington Northern and Union Pacific.
[4]Locally available on inducement.

The port and barge infrastructure needed to support container shipment by river is developing rapidly. Five ports currently provide such service: Lewiston, Clarkston, Wilma, Pasco and Umatilla. Potential for development also exists at Boardman (Port of Morrow County). The services and facilities available at these port sites are summarized in Table 8. Barge service at most of these ports is scheduled on a regular weekly basis by at least two firms. Additional service may be anticipated in the future since a number of other water carrier firms have applied for and received ICC authority to operate general cargo services on the Columbia/Snake waterway.

Container-on-barge general cargo service is a relatively recent innovation. Nevertheless, development of services and port handling facilities has occurred with minimal delay. This would seem to dispel most concerns that the development of general cargo traffic on the Middle Columbia River and Lower Snake River will be seriously constrained by inadequate handling and navigation facilities or services on the upriver portions of the navigation system.

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