Inland Waterways in the Soviet Union and Some Comparisons With U.S. Waterways

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An overview of the existing inland waterway system in the Soviet Union and its features and trends of development is presented. The major characteristics of commodity flows, channels, fleets, and ports in the United States and the Soviet Union are analyzed and compared. An economic estimate considers such specifics of U.S.S.R. waterways as the time lag between expenditures and utilization of capacity; the value of waterways in pioneering and developing Siberia and the Arctic area; distribution of costs and benefits in multipurpose projects; and other aspects. The main differences between the U.S.S.R. and U.S. inland fleets are evaluated, and major existing waterways and future projects under consideration in the Soviet Union are described.

The inland waterways system of the Soviet Union consists of more than 145 000 km (90 000 miles) of navigable channels, canals, reservoirs, and lakes, which makes it the longest system in the world--3.5 times longer than the U.S., 5.5 times longer than the German, and 10 times longer than the French waterways systems. However, U.S.S.R. waterways cannot match U.S. waterways in quality. Table 1 (5, 6) compares some of the characteristics of the two inland waterways systems.

The U.S. waterways system in general has much greater traffic density. It should be noted, however, that actual U.S.S.R. traffic density should be doubled because the waterways are frozen during nearly half of the year. The U.S. network contains a greater percentage of canals and canalized rivers. About 87 percent of U.S.S.R. waterways are open rivers where channel depths have been maintained by dredging and river training. A distinguishing feature of the U.S.S.R. waterways system is the great variety of its navigation conditions. For instance, the controlling depths of waterways range from 0.9 m (3 ft) in the so-called domestic rivers to 5 m (16.5 ft) in the major part of the Volga-Kama system. In comparison, the U.S. network is much more uniform.

The condition of U.S.S.R. waterways can be explained in large part by the special hydrologic features of the country and its general transportation peculiarities, e.g., diversity in the hydrologic regimes of the rivers, high seasonal variations in discharges and water levels, the vastness of the Siberian territory where water transportation is virtually the only mode of cargo movement, and the shortcomings of the highway network.

Therefore, it is necessary to single out the European part of the U.S.S.R. waterways system where from the 1930s has been formed what is called the integrated deep-water system of inland waterways (IDWS). The IDWS is highly similar to the main part of the U.S. network, perhaps more similar than any other developed waterways system in the world. The region serviced by the IDWS includes the most developed economic areas of the Soviet Union, those with a relatively high level of industrial and agricultural production.

The shipping of cargo on the IDWS is at the center of the inland water transportation operation of the Soviet Union. The IDWS represents the interrelated segments of canalized river and canals with controlling depth from 3.65 to 5 m (12 to 16.5 ft). Three standard lock chamber sizes are used: 30 x 300 m (100 x 1000 ft), 30 x 150 m (100 x 500 ft), and 16.5 x 150 m (55 x 500 ft). A fuller description of the IDWS will be given later.

During the last 15 years, the total length of the U.S.S.R. waterways system has increased by a factor of 1.2 and waterways with depths of more than 2.5 m (8.3 ft) have increased by a factor of 1.5. Thus, the change in the network of inland waterways was more qualitative than quantitative. In the future, the greatest attention is expected to be paid to improving and standardizing navigation conditions on the existing network and to increasing the percentage of canalized waterways.

WATERBORNE COMMERCE

Inland waterways in the Soviet Union and in the United States are a component part of national, multimodal transportation systems. However, the structure of these transportation systems and the role of waterways in them are somewhat different. Table 2 (1, 3, 4, 8) gives a comparison of the factors that tend to dictate the commodities and types of movements for which each transport mode is best suited. Obviously, these parameters are very conditional. Nevertheless, they indicate that, although areas of water transportation operation in general are similar, the relative effectiveness of water transportation in the Soviet Union is higher in comparison with truck transportation and lower in comparison with rail transportation. In the United States, modal shares are much more balanced than in the Soviet Union where rail traffic predominates (Tables 3 and 4). Domestic waterborne commerce in the United States accounts for nearly twice as much of the nation's megagram-kilometers of intercity cargo (9.3 percent) as it does in the Soviet Union (4.9 percent). In part, this can be explained by the limited duration of U.S.S.R. navigation. The rate of growth in waterborne commerce in the Soviet

Table 1. Characteristics of U.S. and U.S.S.R. waterway networks.

Network	Total Length (km)	Depth ≥2.75 m: Kilometers	Depth ≥2.75 m: Percent	Canalized Rivers and Canals: Kilometers	Canalized Rivers and Canals: Percent	Network Density (km/1000 km²)	Waterborne Traffic: Teragrams	Waterborne Traffic: Megagram-Kilometers (000 000 000s)	Waterborne Traffic: Density (Gg/km)	Waterborne Traffic: Average Haul (km)
United States	41 130	24 000	60	29 000	72	4.3	511	398	12	770
Soviet Union	145 160	48 000	30	19 000	13	6.5	450	226	3	500
U.S.S.R.-European integrated system	12 400	12 400	100	10 000	78	-	270	158	22	580

Note: 1 km = 0.62 mile; 1 m = 3.3 ft; 1 km² = 247 acres; 1 Tg = 1 102 311 tons; 1 Mg·km = 0.68 ton-mile; and 1 Gg = 1102.3 tons.

Table 2. Characteristics of U.S. and U.S.S.R. modes of commodity transportation.

	Carrying Unit Capacity (Mg)		Speed (km/h)		Fuel Consumption (L/1000 Mg·km)		Cost[a] (¢/Mg·km)	
Mode	U.S.	U.S.S.R.	U.S.	U.S.S.R.	U.S.	U.S.S.R.	U.S.	U.S.S.R.
Inland waterway	1 000-60 000	300-7500	5-13	10-20	6.8	9.0	0.1-0.5	0.16
Rail	1950	2000	40	40	12.7	12.9	0.3-1.5	0.16
Truck	10-15	6	85	50	45.0	26.0	1.0-2.4	4.0
Pipeline	-	-	-	-	-	-	0.06-0.75	0.07
Airline	-	-	750	750	-	-	9-12	9

Note: 1 Mg = 1.1 tons; 1 km = 0.62 mile; 1 L/Mg·km = 0.44 gal/ton-mile; and 1 Mg·km = 0.68 ton-mile.
[a]Official exchange rate of $1.39/ruble.

Table 3. Mode shares of U.S. and U.S.S.R. 1974 intercity freight.

	U.S.		U.S.S.R.	
Item	Megagrams	Megagram-Kilometers	Megagrams	Megagram-Kilometers
Freight (billions)	5.4	4085	7.5	4680
Modal share, %				
Rail	31.1	34.9	47.0	80.0
Truck	36.2	18.7	42.8	6.3
Oil pipeline	15.4	19.5	3.4	6.8
Waterways				
Coastal and Great Lakes	7.8	17.7	1.4	2.0
Inland	9.3	9.3	5.2	4.9

Note: 1 Mg = 1.1 tons; 1 Mg·km = 0.68 ton-mile.

Table 4. Length and density of U.S. and U.S.S.R. modal networks.

	Length (000s km)		Density (000 000s Mg·km/km)	
Modal Network	U.S.	U.S.S.R.	U.S.	U.S.S.R.
Rail	324	172	4.2	26.3
Truck	1100	500	0.7	0.6
Oil pipeline	360	40	2.2	7.9
Inland waterways	41	175	8.9	1.6

Note: 1 km = 0.62 mile; 1 Mg·km = 0.68 ton-mile.

Table 5. Percentages of principal commodities in U.S. and U.S.S.R. waterborne commerce in 1974.

	Including Construction Materials		Excluding Construction Materials	
Commodity	U.S.	U.S.S.R.	U.S.	U.S.S.R.
Petroleum and petroleum products	41.5	12.0	46.8	24.0
Coal and coke	14.7	6.3	16.6	12.6
Iron ore and iron and steel	9.3	2.7	10.5	5.4
Sand, gravel, and stone	11.5	51	-	-
Grains	2.8	1.5	3.1	3.0
Logs and lumber	2.7	19.0	3.0	38.0
Chemicals	5.6	0.3	6.3	0.6
Other	11.9	7.2	13.7	16.4

Union has, however, been relatively high. In the United States, inland water barge traffic has increased over the past two decades at a compound rate of slightly more than 5 percent/year; in the Soviet Union the rate for the same period was 6.6 percent.

The types of commodities moved by water are similar in both countries (Table 5), particularly if sand, gravel, and stone are excluded. Though these commodities make up an unusually high percentage of the megagrams of U.S.S.R. waterborne cargo, they do not exceed 10 percent of total megagram-kilometers. Relatively few bulk commodities account for most waterway traffic in both countries. Amounts of grain and coal are practically the same, but relative megagrams of petroleum and lumber are lower and higher respectively in the Soviet Union.

In recent years, the role of U.S.S.R. inland waterways in foreign trade has increased significantly. Crude oil and petroleum products, coal, iron pyrite, metals, and lumber are all exported. The railroads and the main waterways have numerous points of intersection where cargo is transferred from one mode of transportation to another. Coal from the Ukraine and Asia; Siberian, Kozachstan, and Northern Caucasus grain; northern and Siberian lumber; Ural and Bashkir iron pyrites; and iron ore from the Kola Peninsula and the Ukraine are shipped by combined rail and water transportation. However, the interaction of river and rail transportation has been inadequate up to now. This is explained by the absence of the necessary coordination in the operation and also the low capacity of railroad-port transfer nodes.

A significant portion of freight movements has been carried by mixed river-seagoing ships. These ships, which have drafts of 3.6 to 4.5 m (12 to 15 ft) and may be compared with the miniships system in the United States, are a distinctive feature of U.S.S.R. inland navigation. The operation of ships adapted to navigation both on inland waterways and on the coastal maritime routes has resulted in an increase in the range of shipping and the complete bypassing of seaports.

Another feature of U.S.S.R. water transportation is relatively developed passenger movements. Though passenger traffic on inland waterways makes up slightly more than 3 percent of total traffic (151 million passengers in 1974), the corresponding revenue reaches 15 percent. There are two types of passenger movements: business and pleasure. The first is developed in large urban centers and in regions that have inadequate highway systems. The most common vessels used for these movements are hydrofoils and other high-speed ships. The second form of passenger traffic is vacation traffic, which is served by the conventional luxury vessels and is becoming more and more popular.

CONDITIONS AND TRENDS IN THE FORMATION OF THE WATERWAYS NETWORK

The development of the U.S.S.R. river network and the improvement of navigation conditions on the rivers are being based primarily on the multipurpose use of water resources. This approach is analogous to U.S. development of the Tennessee River and Columbia River basins, but it is extended in the Soviet Union over a much larger geographical scale.

On the navigable U.S.S.R. rivers, in the last 30 to 40 years, a number of hydroelectric power plants have been built to form large reservoirs that regulate seasonal runoff in many river basins. The backwater from dams on the one hand and the augmented water flow during the navigation period on the other have permitted basic improvement of navigation conditions. For instance, after construction of the cascade of reservoirs on the Volga, the controlling water depths have increased from 1.6 to 3.65 m (5.3 to 12 ft) for a distance of 1187 km (1900 miles).

Simultaneously, the multipurpose use of water resources has created the prerequisites for building interbasin connections--navigation canals that join the river basins or the river and marine basins and also approach the large industrial centers.

For many years, economic justification of waterway development in the Soviet Union had been in a rudimentary stage. Decisions had been made based on political rather than economic considerations. But, since the early 1960s, an economic assessment has become a required part of any proposal. Waterways planners have quickly found that traditional methods are not sufficient to justify waterway improvements. Analysis of economic effectiveness has revealed that a number of proven structures with unquestioned importance for the U.S.S.R. economy are not economically feasible when a standard economic evaluation is applied. In response to this situation, a sophisticated methodology has been developed for determining the economic effectiveness of waterways.

The formation of a water transportation network entails relatively heavy capital investments. The approach to the capital investment estimate has to contain a full presentation of expenses and benefits to be expected while taking into consideration the economic features of waterway development. These economic features are

1. The long time lag between expenditures and complete return of capital investment because of the extremely slow buildup of structures to the designed capacity;
2. The value of waterways in the pioneering and developing of certain regions of the Soviet Union, particularly the country's North and Northeast, development of which (in addition to the direct effect on transportation) helps industrial, agricultural, and social formation in contiguous territories; and
3. The linkage between waterways development and two other systems in the national economy: (a) a unified transportation network and (b) the multipurpose use of the country's water resources.

The capacity of structures for ship passage that may be built in the future can be increased only in discrete steps, and this means these structures must be built with large excess capacity. The time required to make full use of this excess is 10 to 15 years and often longer. Hence, the objective feature of hydraulic engineering construction for transportation purposes is the "freezing" of capital investments for much longer periods of time than is the case in other branches of the national economy.

The regional development value of waterways and the great indirect economic effect inherent in them (as applicable to other branches of the national economy) evolve in the course of economic development in many regions of the country, particularly in the East and the North where such development would be unthinkable without waterways. River transportation was imperative for the development of Yakutsk diamonds, for the creation of an oil and gas industry in Siberia, and in many other cases.

The U.S.S.R. inland waterways are used by many organizations for purposes other than transportation. These include the lumbering, fishing, gold mining, and building industries, trade organizations, farms, sports societies, and others. The waterways are invaluable for providing recreation facilities (there are 100 000 privately owned small boats in the Soviet Union).

The majority of those who participate in a water management complex begin to derive economic benefits immediately after a hydroelectric installation begins operation. Water transportation often fails to show a reduction in expenditures as a result of the start-up of the installation and in fact suffers a loss now and then. Channel depths are not increased, lakelike navigation conditions prevail, and the lock must be passed. The fleet must be strengthened for these conditions and is delayed en route.

Water transportation does not begin to derive the full economic benefit of hydraulic engineering construction until the "cascade" of hydroelectric installations is completed because not until then do depths increase over the entire route. It can take as long as 10 years to build these series of hydroelectric installations. The entire cascade of installations, not just a particular one, must be reviewed during the planning stage if a correct assessment is to be made of the economic effectiveness reconstructions will have on water transportation. This is necessary for purposes of correctly apportioning the so-called cascade effect among the individual installations in the cascade.

Research has shown that only about 50 percent of the cost of maintaining the waterways should be allocated to commercial shipments. Based on this concept, the costs allocated to support the activities of other sectors of the economy are excluded when the effectiveness of river transportation is calculated.

The first stage in the creation of an integrated deep-water system in the European part of the Soviet Union has now been completed. Its base is the Volga-Baltic waterway, the Volga and Kama rivers, and the Volga-Don waterway. Conditions over most of the length of these waterways are such that the waterways can be used by ships of up to 3.6-m (12-ft) draft. However, in the chain of hydroelectric reservoirs there are still three reaches with open flow: those on the Volga and Kama rivers and on the Don River downstream of the Volga-Don Canal. The limitations on water traffic in these bottlenecks are to some extent similar to the situation at Locks and Dam 26 on the Mississippi River. The effects of depth and capacity limitations on these reaches include a reduction in fleet capacity, additional shipment costs, and a reduction in the economic effectiveness of operating large, self-propeller vessels and tows. If the last of the cascade dams were operational, the controlling depth of the entire IDWS would be increased by as much as 4.5 m (15 ft). However, after these dams were already under construction, questions about their efficiency were raised. The objections have been based mostly on the large amount of land to be inundated. The decision was finally made to proceed with construction, but slowly, with relatively small annual appropriations.

The U.S.S.R. inland waterways are extremely important to the development of the economic potential of Siberia, the Far North, and the Far East. Water transportation usually plays the role of the pioneer in exploiting the vast natural wealth of the country's eastern regions and in many cases is the sole mode of transportation available.

Multipurpose hydraulic construction, however, is not as influential on the network of waterways in the eastern regions as it was on those in the European part of the country. The principal approach to improving shipping conditions in the eastern regions is one of increasing dredging works combined with partial regulation of river runoff. The result is that today the depths along the main reaches of such major waterways as the Ob', Irtysh, Yenisey, and Lena rivers can accommodate large tows with drafts of from 1.8 to 3.0 m (6 to 10 ft). Still, the steplike nature of the channel dimensions along the rivers in Siberia and in the Far East remains. The shallow bars in Siberian rivers hamper the development of shipments in sea-river types of vessels as well as the provision of transportation to the Arctic coast.

The increase in the length and the improvements in the navigation conditions of the waterways were accompanied by an increase in the volume of waterway maintenance, most of which was in the form of dredging and river training. The volume of dredging increased by a factor of more than 2 in the past 15 years and reached 250 million m^3 (9.8 billion ft^3) in 1975. The U.S.S.R. river-dredging fleet includes suction dredges, which make up 70 percent of the total fleet and have unit capacity of up to 2500 m^3/h (98 250 ft^3/h), and multibucket dredges that have unit capacity up to 600 m^3/h (21 180 ft^3/h). The total dredging fleet capacity exceeds 150 000 m^3/h (5.3 million ft^3/h).

The total capital investment in the development of waterways in the past 15 years has been 955 million rubles ($1330 million) of which 25 percent went into the dredging fleet, 20 percent into strictly navigational structures, and 45 percent into navigational structures of multipurpose projects. Waterway operation and maintenance costs increased 76 percent over this 15-year period and reached about 200 million rubles ($280 million) in 1974. In total about 3300 million rubles ($4600 million) was appropriated for navigation in the past 15 years. According to the U.S. Army Corps of Engineers, $7725 million was appropriated in that period of time in the United States. Note, however, that direct comparison of these figures is very difficult.

Waterways improvement, operation, and maintenance works are financed by the U.S.S.R. state budget, and the waterway network is toll free. The problem of waterways user charges has been studied in the Soviet Union and, so far, all fees have been rejected on the following grounds:

1. Waterways are used for many purposes, including recreation, military, fisheries, water supply, and hydroelectric generation, so that it is extremely difficult to single out commercial navigation.
2. The truck and railroad industries also have a number of subsidies that approximately balance the competitive capability of all three transportation modes.

In general, the current status of the network of inland waterways in the Soviet Union is that of unfinished reconstruction of the most important links, and therein lie the main drawbacks: the steplike nature of depths along the main rivers; the wide gap between maximum and minimum depths, which hampers standardization of transportation equipment; and the lack of communication between some river basins and others (Table 6).

Table 6. Characteristics of major U.S.S.R. waterways.

Waterway	Length (km)	Depth (m)	Locks Number	Locks Average Lift (m)	Locks Chamber Size (m)
Volga River	2000	3.5	6	16	30 × 300
Kama River	1180	3.5	2	25	30 × 300
Don River	500	3.5	1	26	16 × 150
Dnieper River	920	3.5	6	19	30 × 300
Moscow Canal	128	5.5	7	8	30 × 300
Volga-Don Canal	101	3.5	13	10	16 × 150
Volga-Balt Canal	850	3.5	7	13	16 × 300
White-Baltic Sea Canal	222	3.2	19	6	13 × 140
Ob'-Irtysh rivers	6200	2.0-3.0	2	15	18 × 150
Yenisey-Angara rivers	4000	3.0	4	90	18 × 90
Lena	3800	2.2	-	-	-
Amur	2800	2.0-3.0	-	-	-

Note: 1 km = 0.62 mile; 1 m = 3.3 ft.

MAJOR U.S.S.R. WATERWAYS

The Moscow Canal was built in 1937 for multipurpose use including water supply for the city of Moscow and a deep-water connection between Moscow and the main network of waterways. The canal runs a total of 128 km (79 miles) and has five single-chamber locks and two double-chamber locks. The chambers are 30 m (99 ft) wide and 300 m (990 ft) long, and the depth on sill is 5.5 m (18 ft).

The introduction of the Volga-Don navigable canal resulted in the connection of the Volga and Don river basins. Of the total length of 101 km (63 miles), in the artificial section there are 56 km (35 miles) and the remaining 45 km (28 miles) belong to the reservoirs. In the canal there are 13 single-chamber locks that measure 16 x 150 x 4.5 m (53 x 495 x 15 ft).

The Volga-Baltic waterway (1964) joins the waterways of the Volga-Kama basin to Leningrad and the Baltic and White seas. The total length of this waterway is about 850 km (527 miles). On a 350-km (217-mile) canal portion of the waterway, seven single-chamber locks that measure 16 x 300 x 4.5 m (53 x 990 x 15 ft) with a total head of 93 m (307 ft) were constructed. The special feature of the canal is the absence of paved banks. Instead, equilibrium bank slopes have been formed under the effect of the ship waves during operation of the canal.

The White Sea-Baltic Canal connects the Volga-Baltic waterway and the White Sea. Its total extent is 222 km (138 miles), and it contains 19 locks that measure about 13 x 140 x 3.3 m (43 x 462 x 11 ft). The White Sea-Baltic Canal was the first one created under the Soviet system, mostly by the labor of prisoners. Many of its hydroengineering structures were built of wood. In recent years, work has been done on capital repairs and modernization of the structures. The canal now has more military than commercial significance.

Capital improvement of the navigation conditions of the main European rivers--the Volga, the Kama, the Don, and the Dnieper--has been carried out, as stated above, on the basis of building hydroelectric complexes for multipurpose use. Currently, six multipurpose reservoirs have been built on the Volga River, two on the Kama, and six on the Dnieper. All of these complexes include dams with head ranges from 12 to 30 m (40 to 99 ft), hydropower stations, and two chamber navigation locks that measure 30 x 300 x 5.5 m (99 x 990 x 18 ft). The capacity of some locks of this system is currently insufficient. The required increase of lock capacity is to be achieved by building additional chambers that in some cases will be relatively small and intended for small, high-speed passenger vessels only.

THE INLAND WATERWAYS FLEETS AND PORTS

The qualitative changes in the navigation conditions of the U.S.S.R. inland waterways during the past 20 to 25 years have permitted basic changes in fleet classes and capacity.

The following are the main differences between the U.S.S.R. and U.S. inland waterways fleets:

1. A significant part of the U.S.S.R. fleet consists of self-propeller vessels including sea-river ships. Currently, the proportion of self-propeller ships is about 30 percent with respect to the amount of freight and about 55 percent with respect to productivity (megagram-kilometers). After numerous studies, this proportion has been accepted as an optimum. The largest capacity of a self-propeller vessel is 5300 Mg (5830 tons).

2. The tonnage of a tow and subsequently towboat power is much lower in the Soviet Union than in the United States. The largest tow in the Soviet Union is 7500 Mg (8250 tons) with a 1000-kW (1340-hp) boat compared with 60 000 Mg (66 000 tons) and 7463 kW (10 000 hp) in the United States. Average U.S.S.R. towboat power is 2.7 times lower. A study has been conducted of the expediency of operating tows with a freight load of 16 000 to 27 000 Mg (17 600 to 29 700 tons) with a 2985-kW (4000-hp) boat. It is common opinion, however, that further enlargement of tows in U.S.S.R. conditions would be inefficient. An average unit barge loading in both countries is similar. Unlike the U.S. operational pattern, in the Soviet Union a towboat is usually permanently assigned to a specific tow.

3. In the Soviet Union, fleet parameters such as watts per megagram of capacity, speed, and fuel consumption are significantly higher than in the United States.

4. A major part of the U.S.S.R. fleet must have the stronger (subsequently more expensive) hulls in order to navigate on the lakelike multipurpose reservoirs.

It is interesting to note that general trends in inland waterways fleet development are similar in both countries. Table 7 gives changes in some of the fleet parameters during the past 10 years (as a 1974 to 1964 ratio). A rapid increase in power and a corresponding increase in tow-vessel size are the most significant trends in commercial fleet development.

The U.S.S.R. passenger fleet predominantly includes modern two- and three-deck ships used for long-range tourist lines and also a high-speed hydrofoil fleet of the Raceta and Meteor classes. The efficiency of using the large-capacity fleet is reduced by the amount of idle time these vessels spend in ports for processing and waiting for loading operations. This is explained by the insufficient development of the port and docking facilities.

The total volume of cargo handled by inland port facilities is about 400 million Mg (440 million tons). The total extent of the mechanized docking frontage is about 75 km (47 miles) of both common and client docks. As a result of the insufficient number of loaders, the mechanization of the docks remains low. On the average, for each 100 m (330 ft) of dock there is only a little more than one front loader, but study shows that the optimum number should be about two to three loaders. The amount of warehouse space, especially in the transfer ports, is also insufficient; this affects the processing times of the ships and cars and holds up the transfer of cargo between rail and river transportation. One of the most important deficiencies in the current state of the inland ports is poor development of the intraport and approach railroads, which limits the capacity of dock frontage.

Table 7. Parameters of U.S. and U.S.S.R. inland waterways fleets.

Parameter	U.S. Tow	U.S.S.R. Tow	U.S.S.R. Self-Propeller
Barge freight			
Average, Mg	1340	1100	1350
Ratio of increase (1964 to 1974)	1.2	1.4	1.7
Unit power			
Average, Mg/kW	8	5	4
Ratio of increase (1964 to 1974)	0.85	0.85	0.80
Boat power			
Average, kW	1000	373	336
Ratio of increase (1964 to 1974)	1.5	1.5	1.5
Speed			
Average, km/h	9	11	17
Ratio of increase (1964 to 1974)	1.2	1.4	1.2

Note: 1 Mg = 1.1 tons; 1 kW = 1.34 hp; and 1 km = 0.62 mile.

FUTURE DEVELOPMENT OF U.S.S.R. WATERWAYS

Basic Trends

The multipurpose use of water resources remains a basic approach to waterways improvements. However, the trend and structure of the water resources complexes will be somewhat changed. Intensive reconstruction of the rivers is proposed for purposes of reclamation and water supply rather than for hydropower. There is also the problem of redistributing the runoff between basins. Consequently, for the future, in addition to the cascades of reservoirs, navigational use of the large multipurpose canals that connect arterial rivers will be part of the development of the waterways network.

According to existing plans (1, 2), two stages can be distinguished in the future development of U.S.S.R. waterways. During the first stage (7), which may mean approximately 1985 to 1995, the waterways will develop along the following lines. The next phase of the IDWS connecting the main river basins will be completed in the European part of the country, thus providing the conditions needed for the use of large ships and tows with 4.0-m (13.3-ft) controlling depths and even as much as 4.5 m (15 ft). The waterways in Siberia will be improved on the basis of dredging and runoff regulation with controlling depths of 3.0 to 3.5 m (10 to 12 ft).

The basic lines along which the waterways will develop during the second stage (beyond the year 2000) include the formation of an integrated deep-water system for the eastern basins; the combining of the European and eastern systems; and tying the country's unified deep-water system into the water transport systems of Poland, East Germany, the countries along the Danube River, and the countries of Western Europe.

Projects Under Consideration

The following waterways projects are under consideration in the Soviet Union:

1. Partial reconstruction of the Volga-Don and Volga-Baltic waterways--Though these canals are relatively recently built, their dimensions match neither the size nor the speed of the existing fleet.

2. Pechora-Kama junction--There are a number of schemes for adding to the water resources of the Volga River. The most realistic of these is one that calls for the transfer of runoff from the northern basins. Transfer of part of the northern runoff into the Volga by way of the Kama River will have multipurpose importance because it will compensate for withdrawals of water and will increase the output of the hydroelectric stations, stabilize water level conditions in the Caspian Sea, and form new waterways that will link the Pechora River with the IDWS.

An intensive study is under way to divert a part of Siberian runoff to the arid middle-Asia region of the country. A main part of the project is a 2500-km (1560-mile) canal with an average discharge of about 100 m^3/s (36 000 ft^3/s). Navigational use of the canal would provide deep-water connection between the Siberian and Asian waterway systems. However, realization of the project is doubtful because of extremely high construction costs.

A difficult problem is that of maintaining the increased channel dimensions on the bars of the rivers of Siberia; this is essential if cargo is to be delivered to the mines and the oil and gas fields of the Far North. Intensive research is in progress, and the maintenance fleet is being increased by the addition of suction hopper dredges.

In the middle and upper flows of the eastern rivers, a number of hydropower dams with heads of 100 m (330 ft) and more have been constructed. The construction of ship lifts is the only solution here. A "sloping" ship lift is currently being completed on the Yenisey River. The lift chamber is to be mounted on a sloping, self-propelled trolley that travels on rails. The first experience has been rather negative because of limited capacity and operational difficulties and because construction and maintenance costs significantly exceed transportation benefits. Investigations are currently going on in the Soviet Union as to other, more efficient, types of lifts.

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Inland Waterway Ports as Intermodal Freight Centers

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The prospect of using terminals to facilitate solutions to the urban goods movement problem has been recognized since the 1930s. The most recent promising proposal has been for a network of interlocked intermodal freight transportation facilitation centers. This has the merit of being one of the few ideas in which all parties—carriers, shippers, consumers, and urban communities—can win. But it is difficult to implement because of archaic regulations, opposition from labor unions, short-sightedness by carriers, and considerable lag in public terminal policy. The inland waterways ports form a good but not an ideal place for launching a regional network of intermodal terminals. This will require the barge lines to diversify more into general cargoes and inland stores, port cities to augment port development, and the federal government to develop a port policy and enforce equitable arrangements of intermodal interchange.

The prospect of using terminals to mitigate the urban goods movement problem has been recognized for generations. Joseph B. Eastman, coordinator of transportation in 1936, proposed that "railroads could save over $50 million a year by consolidating terminals" and that such a move would improve their competitive position and contribute to community development. In the midst of the Depression, the Interstate Commerce Commission once suggested that "all terminal properties should be thrown open to all users on fair and equal terms." In 1946, Wilfred Owen concluded in The Metropolitan Transportation Problem that "the scattered location and obsolete design of freight terminals and the absence of satisfactory physical relationships among the several methods of transportation create a heavy volume of unnecessary traffic as well as delay and high costs that penalize business, the consumer and the community." More recent studies have brought the urban goods movement problem into sharper and city-specific focus. But studies have produced relatively little progress toward a solution to the freight aspect of the urban transportation problem.

PROPOSAL

Of all the proposed solutions to the urban freight problem that came to my attention at the U.S. Department of Transportation, the concept of a network of intermodal freight transportation facilitation centers (IFTFCs) is the most useful. There have been many difficulties in implementing the IFTFC concept, but at this point it is being proposed that the inland ports, seeking diversification and growth, might constitute the ideal launching points for a regional network of such intermodal terminals. This proposal poses three basic questions:

1. What functions would a network of IFTFCs perform?
2. How well would the concept fit into the structure, functions, and objectives of inland ports?
3. What else must be done to implement intermodal freight service at the inland ports and elsewhere?

THE FACILITATION CENTER

In their final configuration, the transportation facilitation centers (TFCs) would consist of a network of freight terminals around the periphery of each major metropolitan area, tied together by a computerized management information system. Individual units would be organized in accordance with local circumstances very much as ports are today. In most instances, they