A FORECAST OF THE EFFECTS OF CONTAINERIZATION ON THE TRANSPORTATION SYSTEM IN THE STATE OF VIRGINIA

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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STATUS OF TWIN TRAILERS ON PUBLIC ROADS

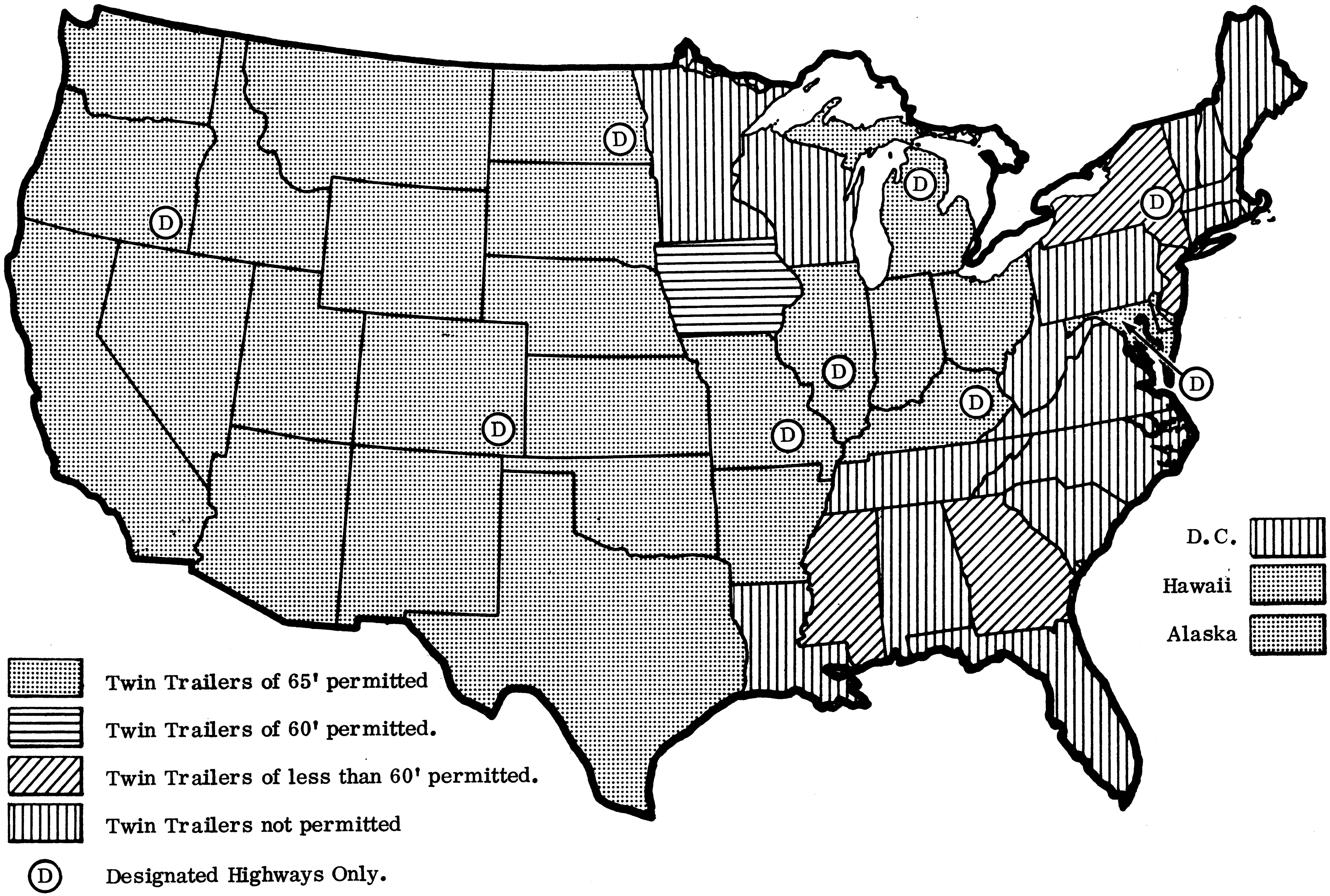

Figure A1. Status of twin trailers on public roads, January 1972.

SOURCE: Department of Research and Transport Economics, American Trucking Associations, Inc. Washington, D. C. 20036

I. SUMMARY OF FINDINGS AND CONCLUSIONS

A. Data Gathering

1. When studying containerized freight, data should be collected on the movement of container units. This is not as tautological as it may seem, because most studies use a 20-foot equivalent method.* However, using this method the researcher cannot define the ratio between the number of 20-foot containers to the number of 40-foot containers, nor is the number of empties traveling the road defined. However, most data are in total tonnage figures and the 20-foot equivalent must be used.

2. Valid predictions of the use of containers are extremely difficult to make because of the lack of reliable data. The predictions are more problematical at the local level than at the national level due to the margin for error being much smaller.

3. If reliable data on freight activities were available, the development of a mathematical prediction model would still pose problems. During the time of this study, changes in the political and economic arenas took place. Locally, the ports negotiated for international consolidation, the dollar was devalued, and relations with foreign countries and the nation's export policies were changed. These economic and political fluctuations would be extremely difficult to account for in a traffic model. A thorough understanding of the underlying political and economic implications behind the decisions governing freight movement must be developed. This study was not able to identify these implications, therefore, the predictions suggested in this report are by no means put forward as being comprehensive.

B. Inhibitors to Container Travel

1. Because the states through which most container traffic flows, N.C., W. Va., and Tenn., do not allow twin-trailers, the Virginia twin-trailer prohibition is not considered to be a significant inhibitor to such traffic.

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* A 20-foot equivalent is the amount of weight assumed to be in an 8 ft. x 8 ft. x 20 ft. container, usually ten tons.

2. Virginia's permit laws allow for flexibility in container usage, but permits for overweight containers are not requested frequently.

3. The weight laws in Virginia governing axle distances can be considered inhibitors to container movement in theory. However, actual sampling has indicated that less than 1% of the containers entering port are overweight.

C. General Comments

1. Many factors deemed inhibitors to the use of containers will be eliminated as technology within the container industry grows.

2. The use of 20-foot containers is declining in relationship to the use of 40-footers, but is increasing in terms of numbers.

3. The 20-foot containers are not as economical to haul as larger containers; therefore, motor carriers are reluctant to move them, and some methods used for moving these containers economically are illegal.

4. As the practice of pooling grows within the industry, the number of empty containers moved is expected to decrease.

5. The laws governing the use of containers are enforced at a different governmental level for containers of foreign origin than for those of domestic origin. Foreign shipments are subject to Federal Customs regulations, which are not a consideration in domestic shipments. Consequently, the term "indivisible load" in many state codes may apply to cargo under federal seal, thus qualifying it for special permits in those states.

6. Trends in some port states other than Virginia are towards liberalizing laws so as to facilitate the movement of container traffic through the ports.

D. General Recommendations

1. Some attempt should be made to standardize regulations throughout the states, if not for all roads at least as they apply to the interstate system.

2. Some method of information exchange between entitites within the container industry and government ought to be developed.

II. INTRODUCTION

To accommodate the intensified industrialization of the areas they serve, Virginia's major port cities — Norfolk, Portsmouth, and Newport News — have had to expand their freight handling capacities. And, since a growing percentage of the freight they handle consists of "containerized" shipments, they have had to increase their capacity to handle container traffic. This multimodal traffic into and through the state will probably increase, although the extent to which it will affect highways is not certain. It may travel to a large extent by rail, and thereby decrease the volume of truck traffic on highways. On the other hand, it may go largely by "rubber wheel" and increase the truck traffic. A third possibility is that small-truck traffic to consolidation terminals will increase, while truck traffic from these terminals to the railhead or the seaport will decrease. In any case, because of the growth of Virginia's ports and the emphasis on containerization, the volume and type of truck traffic in the state will likely change.

The first objective of the study reported here was to predict the change in traffic flow directly related to containerization and the possible effects of the change on the highway system in Virginia.

Many factors have developed which make a prediction of freight movement difficult. Not the least of these is the fact that the movement of containers and freight in general is highly bound up in the political and economic decision-making process. To a large extent, containers move internationally and are thereby affected by international economic activities as well as activities at the state and local levels. Therefore, trends in container movement can be altered by such activities as fluctuations in the value of the dollar, changes in U. S. trade agreements with different countries, embargos, and tariff fluctuations. In addition, the entire system can be affected by local legislation. If a state or local government were to enforce regulations which would make container travel difficult (such as decreasing limits in weight or size laws), it is possible that the container freight handled by a port in that state or city would be shifted to another port.

The container industry is a dynamic one, laws are changing, ports are building, and philosophies on international relations are undergoing changes. It does not appear to this researcher that a highly predictive model can be developed to account for the changes in such an industry.

For these reasons, the attempt to develop a model for predicting container movement was abandoned. Instead, an attempt was made to combine data developed by the Port Authority with certain raw data culled by the researcher from various files in the Ports. Although these data allow some rough predictions to be made, the information is not purported in any way to be comprehensive.

It should also be noted that the transportation industry has been found to have a strong code of ethics under which the interests of a carrier's shipper are protected. This code, which appears to apply from the smallest carrier up to the steamship lines, makes data gathering a very difficult job. In cases where the data are obtainable they must be general enough to protect this ethical code. For this reason, different modes of transportation do not know the extent of the market they service. For example, a given truck company will know the amount of freight it hauls out of a given state but will have little information on the total amount of freight hauled by other truckers and by rail. Consequently, it does not know what percentage of the market it serves. Marketing within the transportation industry is highly competitive and the details of transactions are highly valued information.

III. PROJECTION OF FUTURE CONTAINER SHIPPING IN VIRGINIA

A. Explanation of Techniques Used

In addition to the problems previously mentioned, data collection is made difficult by the complexity of the documentation needed to move a container and the lack of standardization and sophistication in record keeping.

The Virginia Port Authority is attempting to centralize and modernize its record keeping, but due to the recent reorganization of the ports this system has not yet been completed. For this reason the historical data used in this study date only from March 1967. Since the data for fiscal 1972 are not yet available, the only complete set of data is for the years 1968 through 1970.

The data in Table 1 indicate the total freight movement; however, it is necessary to distinguish between traffic moving from the ports and that moving to the ports. The data in Table 2 breakdown the imports and exports except for the year 1972, for which data are not yet complete.

Table 1
Total Traffic Generated at Hampton Roads
March 1967 through September 1971

	1967 [a]	1968	1969	1970	1971 [b]	1972
Totals	9,459	23,485	41,790	87,016	96,280	138,826
20-foot	4,565	12,395	19,964	29,771	28,643	-
40-foot	4,316	10,505	20,888	45,451	56,483	-
Others	578	585	938	11,794	11,154	-

[a] March — December

[b] January — September

Table 2
Import/Export Traffic
Handled at Hampton Roads

	1967 [a]	1968	1969	1970	1971 [b]	1972
Total	9,459	23,485	41,790	87,016	96,280	138,826
Loaded export	4,003	11,346	20,286	40,384	46,012	66,636 [c]
Empty export	388	457	724	2,798	2,784	2,776
Loaded import	1,629	5,801	11,588	24,437	26,799	37,483
Empty import	3,439	5,881	9,192	19,397	20,685	31,930

[a] March - December

[b] January - September

[c] Estimated

From the data in Table 2 for each of the years 1968-1971 it appears that the ratio of imports to exports is approximately 50%. To fill in the data for 1972, the 50% ratio was used, as were the ratios calculated for empty to loaded containers. Excluding the year 1967, basically because the ratios appear to be atypical, the ratio of loaded exports to empty exports is 96/4; the ratio of loaded imports to empty imports is 54/46. Since these ratios have held for the last four years, the extension is made to the 1972 data.

On the basis of the above information it can be assumed that approximately half of the total container traffic consists of imports moving from the port to some destination in the United States.

Knowing the total volume of container traffic is not enough; some of this traffic will move by truck and some by rail. The Port Authority shows the following breakdown:

Norfolk International Terminal (NIT)

Mode	% Container Movement
Rail	10
Truck	90

Portsmouth Marine Terminal (PMT)

Mode	% Container Movement
Rail	38
Truck	60
Unknown	2

The breakdown of total traffic moving from NIT and PMT in 1972 is:

Port	No. of Containers		Projected Imports		Projected Truck Movement	Projected Rail Movement
NIT	101,933 x (.50)	=	50,996 x (.90)	=	45,896	5,100
PMT	36,833 x (.50)	=	18,416 x (.60)	=	11,050	7,366
Total	138,826		69,412		56,946	12,466

Applying the 50% export/import ratio and the mode ratio to the data from the NIT and PMT, of the 138,826 containers handled by the ports, it can be estimated that approximately 69,412 containers traveled from the Hampton Roads ports to some destination in the United States in 1972. Of these, 56,946 were transported by truck and 12,466 by rail. For the moment, consider the container movement by truck. Although it was decided that no routes beyond the boundary of the state of Virginia would be considered, some area beyond that boundary must be selected for use as an information base for the prediction of future traffic. Consequently a sample of origin and destinations was taken from the ports of Norfolk and Portsmouth.

These data indicate that the states to which most of the container traffic flows are North Carolina, 44% or about 25,056 units; Virginia, 31% or about 17,653 units; South Carolina 8% or about 4,555 units; and Georgia 5% or about 2,846 container units.

This estimate accounts for 80% of the destinations; the other 20% are scattered over 17 other states in magnitudes of less than 2%.

B. Projections

1. Imports

The general cargo tonnage projection developed from the data obtained from the Virginia Port Authority is given in Table 3.

TABLE 3
IMPORT DATA

Year	Breakbulk	Container	Total	20-ft. Equiv.
1970[a]	619,475	327,456	946,931	32,746
1971[b]	570,113	386,774	956,774	38,677
1972	557,865	494,711	1,052,576	49,471
1973	544,182	613,652	1,157,834	61,365
1974	522,183	751,434	1,273,617	75,143
1975	490,343	910,636	1,400,979	91,064
1976	539,377	1,001,700	1,541,077	100,170
1977	569,043	1,056,793	1,625,836	105,679
1978	600,340	1,114,917	1,715,257	111,492
1979	633,359	1,176,237	1,809,596	117,624
1980	668,193	1,240,931	1,909,124	124,093

[a]Actual

[b]First nine months

In an explanation of the derivation of these data, the Port Authority said that the "cargo projection was arrived at by calculating the average annual increases of general cargo exports and imports for Virginia as recorded for the years 1966 through 1970 and projecting them on a straight line basis. Annual increases in exports of 7.0% were indicated by this method. This average annual percentage increase was then applied to each year in the forecast through 1980." They further stated that the projections beyond the year 1980 become increasingly vague.

This study did not attempt to go beyond 1980; and no data beyond that year are available.

Based on the research of the Port Authority staff it has been forecasted that 65% of the total general cargo of the port is suitable for containerization. Based on the development of the technology in the field of containerization, it was felt that 70% of all general cargo commodities would move by containers by 1975. Table 4 was developed on the basis of that assumption.

TABLE 4

PREDICTION OF BREAKBULK/CONTAINER TONNAGE

Year	Breakbulk Tonnage	Container Tonnage	Totals	Per Cent Containerized
1970[a]	1,297,463	868,601	2,166,064	40.1
1971[b]	1,203,816	1,203,816	2,255,107	46.6
1972	1,144,011	1,304,151	2,448,162	53.3
1973	1,069,271	1,588,818	2,658,089	59.8
1974	973,760	1,912,631	2,886,391	66.3
1975	923,776	2,210,935	3,134,711	70.5
1976	1,005,317	2,399,522	3,404,839	70.5
1977	1,055,317	2,517,516	3,573,467	70.5
1978	1,109,158	2,641,373	3,570,531	70.4
1979	1,165,074	2,771,383	3,936,457	70.4
1980	1,223,835	2,907,859	4,131,694	70.4

[a]Actual

[b]First nine months

By using the 20-foot equivalent factor, the destination data developed from our sample and applying them to the information in Table 3, a prediction of the increase in container traffic flow to the states served by the Ports was developed and is in Table 5.

TABLE 5
DESTINATION OF CONTAINER IMPORTS

Year	Total Container Movement	No. Carolina %	Virginia %	Georgia %
1970	32,746	14,408	10,151	1,637
1971	38,677	17,015	11,988	1,933
1972	49,471	21,767	15,336	2,473
1973	61,365	27,000	19,023	3,068
1974	75,143	33,062	23,294	3,757
1975	91,064	40,068	28,229	4,553
1976	100,170	44,074	31,052	5,008
1977	105,679	46,498	32,760	5,284
1978	111,492	49,056	34,563	5,574
1979	117,624	51,755	36,463	5,881
1980	124,093	54,600	38,469	2,605

2. Exports

The method of predicting the export container movement was much the same as that for the imports. Once the ratio of export-to-import container movement was established a sample was used to determine the origination of that movement and is shown in Table 6.

TABLE 6
SAMPLE OF ORIGINS OF EXPORT CONTAINER MOVEMENT

State	Trips	%
Virginia	996	62
North Carolina	232	14
Tennessee	170	11
Kentucky	128	8
Florida	21	1
South Carolina	29	2

The states listed in Table 6 represent 98% of the sample taken, the other 2% was spread over 8 other states each having less than .6% of the movement.

Using the data developed for export container movement shown in Table 6 the percentages can be applied to arrive at some idea of the future movement of containers as shown in Table 7.

TABLE 7
DESTINATION OF CONTAINER MOVEMENT
(By 20-ft. Equivalents)

Year	Container Tonnage	20-ft. Equiv.	Va.	N. Car.	Tenn.	Kent.	Fla.	S.Car.
1970	541,145	54,115	33,551	7,576	5,952	4,329	541	1,082
1971	664,517	66,452	41,200	9,303	7,310	5,316	665	1,329
1972	809,440	80,944	50,185	11,332	8,904	6,475	809	1,619
1973	975,166	97,517	60,460	13,652	10,402	7,801	975	1,950
1974	1,161,197	116,120	71,994	16,256	12,773	9,290	1,161	2,322
1975	1,300,299	130,030	80,618	18,204	14,303	10,402	1,300	2,601
1976	1,397,822	139,782	86,664	19,569	15,376	11,182	1,397	2,796
1977	1,460,723	146,072	90,564	20,450	16,067	11,686	1,460	2,921
1978	1,526,456	152,646	94,640	21,370	16,791	12,212	1,526	3,053
1979	1,595,146	159,515	98,899	22,332	17,546	12,761	1,595	3,190
1980	1,666,928	166,693	103,349	23,337	18,336	13,335	1,666	3,334

As mentioned earlier the breakdown of 20-footers to 40-footers to empties is useful. The data for the years in which actual information is available, given in Table 8, show this comparison.

TABLE 8
CONTAINERS HANDLED AT HAMPTON

Year	20-Foot	40-Foot	Empty (Both 20's & 40's)	Total
1968	12,395	10,505	585	23,485
1969	19,964	20,888	968	41,790
1970	29,771	45,451	11,794	87,016
1971	28,643	56,483	11,154	96,280

3. Probable Division of Container Traffic Between Road and Rail

Containerized shipments can be interchanged from truck to rail, or ship, or even to air; some container movements in Virginia are trimodal and many are bimodal. A large proportion of container traffic moving into and through the port of Hampton Roads is carried by truck. Figures obtained from the Virginia Port Authority show that containers moving through the PMT in the year 1972 were divided 38% by rail, 60% by truck, and 2% by barge or "other." At the NIT, 10% were transported by rail and 90% by truck.

A sample of truck/rail movement taken from information obtained from the Port Authority is shown in Tables 9 and 10. The information given in these tables was taken from a sample of the first quarter data for 1971. The sample was limited to the PMT because of the high percentage of rail movement from that port.

The researcher expected to find that the greater the distance from the point of origin to the destination, the greater the possibility that freight would be shipped by rail. It seemed reasonable to assume that few, if any, rail shipments would occur within 150 miles of the ports. Figure 1 bears this out. Opinions gathered from interviews suggest that rail shipments under 150 miles were often the result of dispatchers' errors.

The expected truck movement is not so clear. The number of truck trips will decrease when longer distances are involved but the lack of rail service to some areas and higher rail rates are factors which make it difficult to predict precisely which form of transportation will be used. Since much of the container traffic is imported from other countries, unfamiliarity with our transportation system may be another factor which would cause the actual practices of shippers to differ from expectations.

Since the largest portion of movement through the Port of Hampton Roads is by truck, it is important to know what routes would be most affected by this movement. It has been stated earlier that the bulk of the imports move through the Port of Hampton Roads to North Carolina. The routes affected by this movement are U. S. 460 and 58. Container shipments within Virginia travel mainly on I-81, I-85, and I-64. If the container shipment predictions above hold true, U. S. 460 and 58 can be expected to carry approximately 66,726 container trucks by 1975 and 89,142 by 1980.

Table 9

Container Movements by Rail/Truck from Destination to Port

EXPORTS

Mileage	From	Truck	%	Rail	%	Total
233	Greensboro, N. C.	232	75	79	25	311
379	Columbia, S. C.	29	64	16	36	45
711	Nashville, Tenn.	170	77	52	23	222
589	Atlanta, Ga.	1	5	18	95	19
1,013	Jackson, Miss.	0	0	1	100	1
804	Orlando, Fla.	11	48	12	52	23
406	Charleston, W. Va.	8	89	1	11	9
565	Rochester, N. Y.	3	33	6	67	9
90	Richmond, Va.	471	95	23	5	494
753	Bowling Green, Ky.	128	70	55	30	183
604	Columbus, Ohio	6	43	8	57	14
862	Bloomington, Ill.	0	0	26	100	26
851	Lansing, Mich.	0	0	6	100	6
759	Birmingham, Ala.	8	35	15	65	23
739	Indianapolis, Ind.	3	3	96	97	99
1,233	Des Moines, Iowa	10	32	21	68	31
		1,080	1,515	435		

67% of total

Table 10

Container Movements by Rail/Truck from Destination to Port

IMPORTS

Mileage	To	Truck	%	Rail	%	Total
233	Greensboro, N. C.	252	91	26	9	278
379	Columbia, S. C.	43	98	1	2	44
711	Nashville, Tenn.	9	21	33	79	42
589	Atlanta, Ga.	30	88	4	12	34
1,013	Jackson, Miss.	13	17	63	83	76
804	Orlando, Fla.	11	48	12	52	23
565	Rochester, N. Y.	3	33	6	67	9
406	Charleston, W. Va.	8	89	1	11	9
90	Richmond, Va.	168	99	1	1	169
753	Bowling Green, Ky.	4	11	34	89	38
604	Columbus, Ohio	5	45	6	55	11
862	Bloomington, Ill.	1	10	9	90	10
851	Lansing, Mich.	5	100	0	0	5
759	Birmingham, Ala.	0	0	0	0	0
739	Indianapolis, Ind.	1	100	0	0	1
1,233	Des Moines, Iowa	0	0	0	0	0
		533	749	196		

33% of total

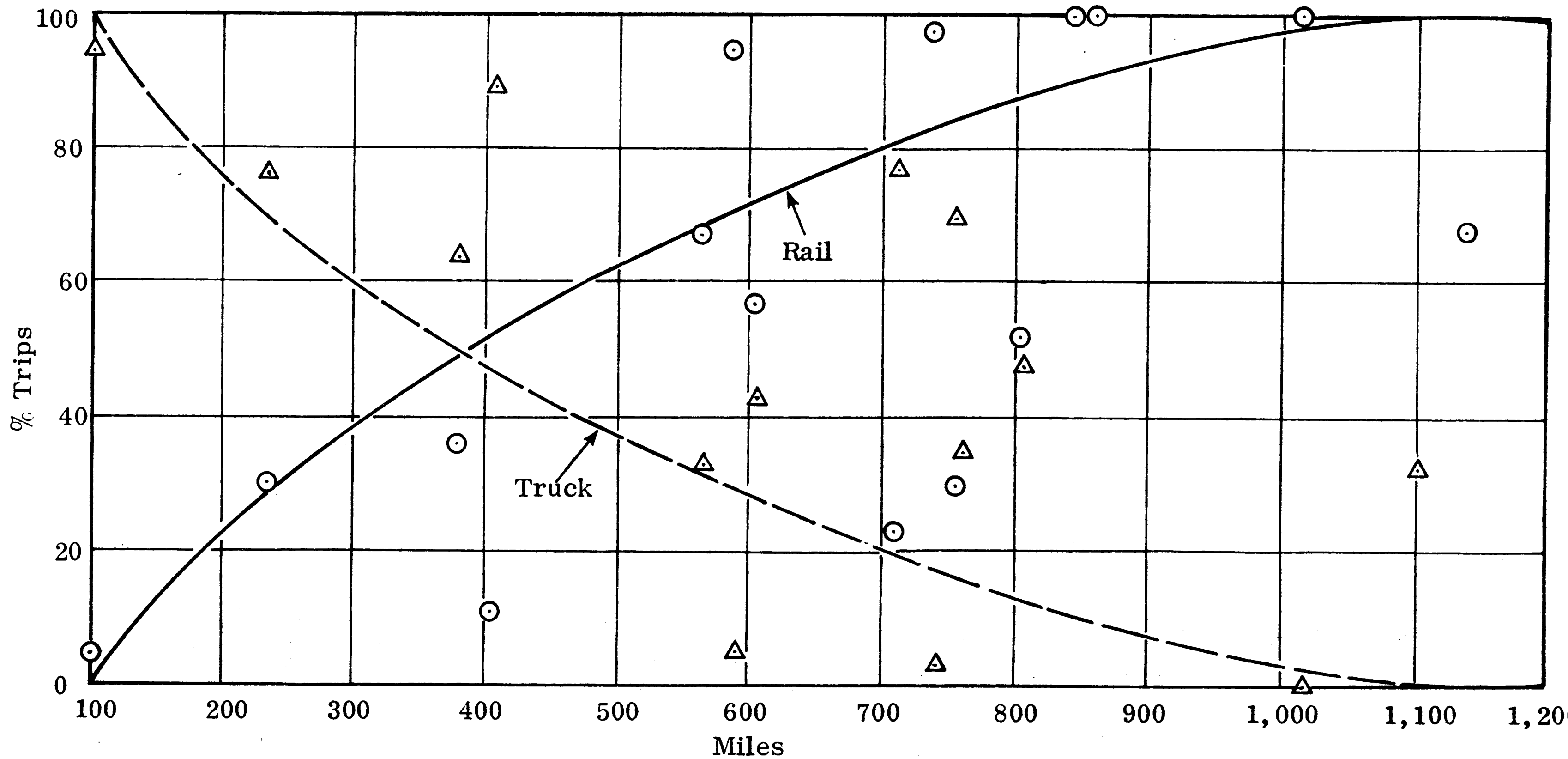

Figure 1. Expected vs. actual movement of containers - exports.

Actual Truck Movement △

Actual Rail Movement ⊙

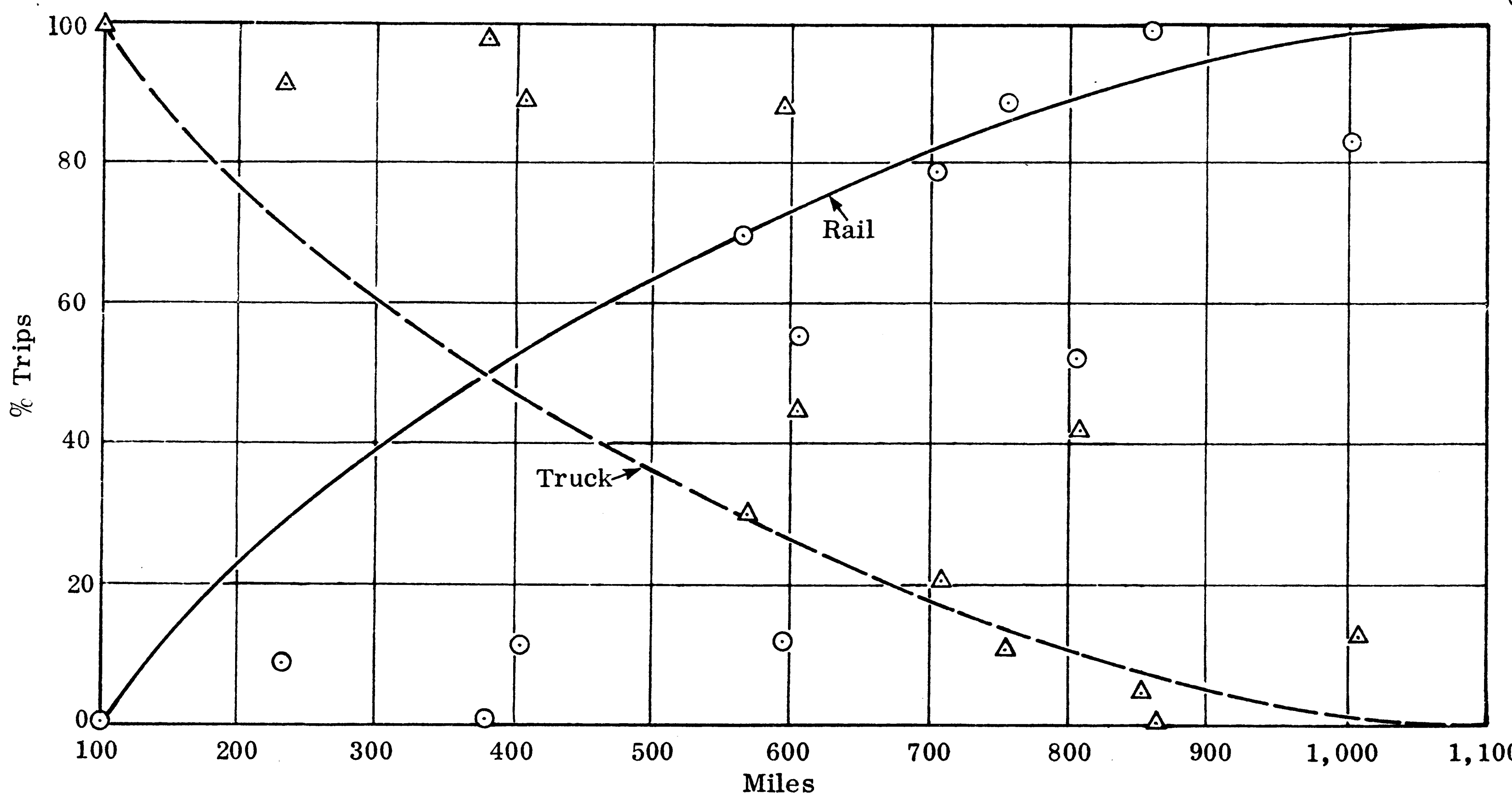

Figure 2. Expected vs. actual movememt of containers-imports.

Actual Truck Movement △

Actual Rail Movement ⊙

IV. ANALYSIS OF INHIBITORS TO CONTAINER TRAFFIC

The factors acting as inhibitors to the growth of containerization come basically from two sources: first from within the industry and second from governmental regulations.

A. Nonlegal restrictions on container use

Within the industry itself there are major problems relating to standardization of packaging, documentation, and equipment. Due to the international market in which the container is used, these problems become more complex. These problems are easily understood but probably cannot be quickly solved.

Another major problem within the industry is the lack of equipment. The rigs used in handling a 20-foot container are not sufficient to efficiently handle a 40-foot container. Furthermore, there is a lack of coordination between users in the industry. A container having been emptied at one location must oftentimes be shipped back to its home empty. Experts in the field believe that as the industry grows and makes technological advances, these problems will be cured. Presently, however, the primary restrictions are in the form of governmental regulations.

B. Legal restrictions on container use

1. Federal Law

The federal regulations governing the movement of containers are no more restrictive than are those concerning other freight except in the areas of customs and antitrust. Because of the international movement of containers and the fact that the cargo is composed of many small packages, inspection can mean a complete unloading and thus an extra expense. Because of the concern for freight termed "dangerous goods," e.g., narcotics, the probability of such inspections is becoming much greater.

The "pooling" of containers between modes and users within modes is a growing practice. By pooling, more efficient use of the empty containers and rigs will be accomplished. However, there are various federal regulations, e.g., antitrust laws, which make this practice illegal. Nevertheless, there is strong evidence which suggests that these regulations will be modified to allow some degree of pooling in the near future.

The restrictions at the state level are more important because they are not standardized throughout the U. S. Consequently a container may travel the majority of its trip legally and be restricted at its destination. Uniform regulations would allow for better handling and greater ease in travel.

Interviews with various truck lines and ship lines indicated that the main problem, and possibly the only problem, at the state level is the regulations on size and weight.

2. Twin-Trailer Regulation

The state of Virginia does not allow twin-trailers on any road; however, although this does restrict the movement of the containers in Virginia, from a view of the transportation system, research has not found this regulation to be a significant inhibitor.

The analysis of regulations on twin-trailers shows that they are not allowed in West Virginia, Tennessee, North Carolina or the District of Columbia. To the extent that freight moves to these states the Virginia restrictions on the use of double-bottoms is not considered an inhibitor.

To the north, Maryland permits double-bottoms and, having a port which is in competition with those in Virginia, could take away some of the container traffic from Virginia. However, according to the sample of destinations mentioned earlier, little of the Virginia ports' traffic goes north. It seems, therefore, that this is only a limited inhibitor because the highly developed ports which serve the Maryland area are attracting the container traffic which fall into their sphere of influence.

To the west, Kentucky limits the travel of twin-trailers to designated highways. Permitting the use of twin trailers in Virginia would open a route from the ports to the West. However, the great distance from the ports to the western Virginia boundary makes rail shipment more economical than highway shipment. An illustration of variations in state laws governing twin-trailers can be seen by referring to Appendix I.

3. The Availability of Special Permits

Since the state of Virginia does issue permits for oversize and overweight vehicles, regulations on permits cannot be considered as inhibitor except for the time restriction on permits for travel on interstate highways.

The regulations for issuing permits in other states are not as clear as other regulations governing the use of containers. Some of the other states surveyed such as Delaware and Maryland, do issue permits; others issue permits only in exceptional circumstances. As a general rule, "indivisible" loads will receive permits. Containers, frequently sealed by customs officials, qualify as "indivisible" loads.

4. Weight and Size Regulations

Since containers are usually "stuffed" in accordance with a well formed commodity flow program, they are often at capacity vis-a-vis weight. Consequently, the weight restrictions at the state level affect container movement more than other methods of moving freight. In comparison with the surrounding states, Virginia has the lowest limit on maximum weights. Virginia's maximum is 70,000 lb. compared to Delaware with 73,280 lb., Maryland with 73,280 lb., West Virginia with 73,280 lb. (revised in recent amendment — July 1, 1972), Tennessee with 72,000 lb., and Kentucky with 73,280 lb. It should be noted that Virginia allows a 5% tolerance; therefore, the legal maximum is 73,500 lb.

Further, Virginia regulations apply a formula which defines limits of weight in relation to the distance between the axles (commonly known as the "bridge law"). The states of Delaware, Maryland and West Virginia use a similar formula. Tennessee, Kentucky and North Carolina do not. This law presents a problem with respect to 20-foot containers. As can be seen in the Maryland version of the law, this problem was solved by exempting the containers carrying international freight into and out of the Port of Baltimore.

However, the Virginia Department of Highways in cooperation with the Virginia Port Authority surveyed a sample of freight hauling vehicles leaving the Hampton Roads Ports. The survey was held from June 5, 1973 to January 30, 1973 surveying 2,515,728 vehicles of which 14,743 were hauling containerized freight. Of the total sample (e.g., all vehicles) there were 7,300 violations or 0.29%; of the containerized freight there were 90 violations or .61% violations.

Although there is a tendency for containers to be overloaded more than general freight .61% does not seem to be a significant problem.

V. AN ANALYSIS OF THE TWENTY-FOOT CONTAINER PROBLEM

A. Why Twenty-Foot Containers Have a Special Problem

In Table 11 the relationship of the growth of the movement of 20-foot containers to that of the 40-foot containers can be seen.

Table 11
Containers Handled at Hampton Roads

Year	1968	1969	1970	1971
20-foot	12,395	19,964	29,771	28,643
40-foot	10,505	20,888	45,451	56,483
All others	585	938	11,794	11,154
Total	23,485	41,790	87,016	96,280

Although the ratio of 20-foot containers to 40-foot containers is decreasing, the fact that the movement of 20-footers is definitely increasing cannot be ignored. As mentioned earlier, there are some definite disadvantages that the 20-foot containers have which are not experienced by the 35-and 40-foot containers. Obviously all containers enjoy the benefits mentioned earlier, i.e., intermodal transit, minimum handling, and generally reduced costs. Because of the ease with which a container can be moved from one mode of travel to another, the time expended on a 40-foot box is no more than that spent on a 20-foot box. The 40-foot box, however, contains more cargo and thus returns more profit for time expended. This explains the truckers' reluctance to haul the 20-footer over a distance greater than 150 miles.

Thus it can be seen that the 20-foot container has intrinsic limitations, but the problems go further. Many of the solutions to these intrinsic problems are prohibited by the Virginia weight and size limitations.

B. Possible Solutions

1. Loading Practices

The 20-foot box loaded to capacity would in all probability not exceed the maximum gross weight allowed by law. The actual weight of any one shipment, of course, depends on the goods being carried; e.g., frozen meat would be heavier than textiles. The carrying capacity of one of these boxes is 20 long tons, or 38,080 lb. This weight combined with the tare weight of 15,000 lb. for the tractor, 3,600 lb. for the container, and 3,500 lb. for the chassis equals 60,180 lb., or 9,280 lb. under the 70,000 lb. allowed by Virginia law.

Under the bridge law, however, the weight allowable on the highways is not solely dependent on gross weight but on the number and spacing of axles on the vehicle, including both tractor and chassis. (Virginia Code § 46.1-339 (d)). The requirements of the bridge law are given in Table 12.

Table 12
Requirements of the Bridge Law

Distance in feet between the extremes of any group of axles	Maximum weight in pounds on any group of axles
4	32,000
5	32,000
6	32,000
7	32,000
8	33,500
9	35,000
10	36,500
11	38,000
12	39,500
13	41,000
14	42,000
15	43,000
16	44,000
17	45,000
18	46,000
19	47,000
20	48,000

(c) single axle weight on any vehicle or combination shall not exceed eighteen thousand pounds,...

Again, because of the 20-foot container's size, the number of axles on the chassis used to haul the box and the distance between these axles make it impossible to legally haul a loaded 20-foot container on a normal truck.

2. Combining Two Containers

A second method of making 20-footers economically attractive is to combine two 20-foot boxes to enable the combination to be hauled at near the profit margin realized for 35-and 40-foot boxes. The combining of these 20-foot containers can be done in one of three ways.

(a) Two 20-footers on a 40-foot chassis

Two 20-footers can be placed on a chassis designed for one 40-footer. The major problem with this arrangement is that many times the two containers will have different destinations and at some intermediate location they must be separated. The separation of these containers requires a crane, which results in additional handling and time expended. For this reason this method, although legal, is probably not profitable.

(b) Twin 20-foot containers coupled (marriage)

Two 20-foot containers can be coupled together to form a single traveling unit. The coupling is inserted in the end circular openings of the bottom corner fittings of abutting containers and twist-locks into place. This coupling remains in tension. A top fitting serves as a compression member. Specially designed chassis are used to transport the coupled containers over the road.

This method has the same problem as the previous method, i.e., the possible need for separation at some intermediate point. However, to uncouple these containers it is not necessary to use a crane, but a level platform is desirable so that the couplings do not bind when being removed. It is true that extra time is necessary to perform the uncoupling but when compared with the economics of hauling a single unit this extra time is insignificant.

This method is therefore preferable to the one described above. However, in some states, as in Virginia, this method is probably not a legal alternative. The Code of Virginia (§ 46.1-335) states the following:

> No motor vehicle shall be driven upon a highway drawing or having attached thereto more than one motor vehicle, trailer or semitrailer unless such vehicle is being operated under a special permit from the State Highway Commission,...

(c) Twin 20-footers

Two 20-footers can be combined by means of a converter dolly and be drawn by a truck tractor. This method, because of the ease with which the units can be uncoupled, is preferable to the two methods previously mentioned. Once again, however, difficulties would be encountered under the regulations of many states including Virginia. (See § 46.1-335 above).

C. The Importance of Twenty-Foot Containers

The obvious question to be asked is: Why, with all of these drawbacks, is the use of 20-foot containers increasing? There are two basic reasons why 20-foot containers are used; the first revolves around the factors of time and commodity, the other has to do with transportation conditions in foreign countries.

The capacity of a 20-foot container allows it to be filled and ready for shipment much sooner than a 40-footer. For a company that produces small items (e.g. toys) the time saved by stuffing and shipping a 20-footer rather than waiting to fill a 40-footer can be an advantage. Other shippers dealing in perishable commodities (e.g., frozen meat) need the extra time saved by the shorter loading period required for the 20-footers.

The road conditions in many foreign countries restrict the use of the larger 40-foot containers. The weight of a 20-footer can be handled with a smaller tractor, which is an advantage in some foreign countries. Obviously, in countries with modern rail systems, the condition of the roads will have less effect on the use of larger containers.

Table 13 illustrates the consistency of containers which have entered the country through one port in the year 1971.

Table 13
Norfolk International Terminal
Year — 1971
Import

Loaded		Empty	
20-ft. —	7,380	20-ft. —	3,363
40-ft. —	13,977	40-ft. —	10,536

From the table it can be seen that a substantial number of 20-foot containers are entering the Norfolk port. Of the total, about 46% are empty and would present no weight problem.

There are various reasons why empty containers are shipped into this country. Most of these containers have been unloaded at their foreign destinations and are being returned to the owner. Some of them, however, have been manufactured overseas and are being shipped to buyers in this country. Although the number of empties is substantial in relationship to the total, it is expected that it will drop sharply in the near future. One of the greatest problems within the container industry is that heretofore there has been no use of pooling arrangements. The exchange of containers by different owners has only recently become a serious objective. As the problems presently inhibiting the growth of this practice are resolved, the more efficient use of these boxes will be realized and the numbers of empty containers will be proportionately reduced.

As container transportation is perfected, many problems will be eliminated. Special chassis will be in sufficient use to reduce the present carrier reluctance to ship 20-foot containers, fewer empty containers will travel over the road, and possible more containers will be moved by rail. Until that day, however, the problems of container freight will be shared between the industry and the governments having jurisdiction over their movement.

Special problems are involved in the international shipment of containers. Some problems are minor, such as elaborate documentation and proof of ownership. Other problems are much more significant. For example, when a motor carrier considers picking up cargo in a domestic area he has the options of picking up a full load, part of a load, or no load. The carrier must determine the weight of that load and act accordingly. He must take into account only the law of those states he will pass through. On the other hand, a carrier picking up a containerized shipment which has originated in a foreign country must pick up the freight as is or not pick it up at all; he cannot pick up a partial load. This is because most overseas shipments are under U.S. Customs' seal; once this "red ball" seal is placed on a container the only agency authorized to break the seal is U.S. Customs. The trucker must deal with international as well as state laws. He is faced with a choice of illegally transporting the overweight box or turning the job down. In the latter case, the port must find another method of moving these boxes, i.e., barge or rail, and faces a possible congestion problem.

D. The Trends in Other Port States

The port states of New Jersey, New York, Delaware, and Maryland have modified their laws in recent years to permit the hauling of the double-bottom trailer. More recently Maryland has dropped the "bridge law" requirement on containers of foreign origin.

Additionally, in recent years some port states have modified their highway laws to permit the movement of some problem freight such as 20-foot containers. Whether this modification was instigated by the ports or if it was implemented primarily to allow traffic to move out of the ports and thus make them more competitive with other port states is not known at this time.

Interviews and other investigation have suggested that restriction due to the bridge law is a definite inhibitor to the movement of 20-foot containers.

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