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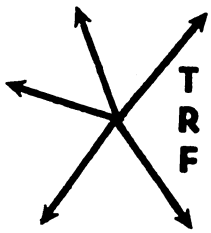

TRANSPORTATION RESEARCH FORUM

Containerization: Concepts and Research on the Santa Fe

*by W. L. Paul**

The term containerization has various meanings to transportation people. In recent years, however, the team has become more or less synonymous with improved cargo handling techniques in the marine industry. The marine industry has been successful in improving inter-modal transfers of cargos while at the same time increasing the productivity of cargo handling labor and the utilization of ships.

The tremendous increase in the cost of stevedoring and ship delays has provided a substantial incentive for the marine industry to implement container systems. Excellent leadership in taking advantage of the potential of containerization has been provided by Sea-Land and Matson, two non-subsidized ship operators. I do not want to dwell on the marine container story here, however, but rather on the general potential that the container concept offers the railroad industry.

Unfortunately, I have found that the term "containerization" precipitates controversy in the railroad industry. Often the controversy is based on emotion rather than knowledge of the subject. Since my company has not established an overall policy regarding containerization, the following remarks are necessarily colored by my own interpretations, and I hope are not too controversial.

Stimuli to Investigation of Containerization on the Santa Fe

In the first place, I believe many of us have suspected for a long time that the employment of highway, van-sized containers could or should be a tool for increasing the efficiency of contemporary transportation systems. Vans have the flexibility of being able to go virtually anywhere and can be transferred among pneumatic highway wheels, flanged steel rail wheels, ships' hulls and air frames. A system employing universally interchangeable van containers captures the imagination, but unfortunately the implementation of such a seemingly simple system bogs down in a myriad of details concerning ratios, controls and equipment standardization. The imagination easily transgresses minutia to conceive of a system that the practical mind has difficulty developing. The profit potential may be there for the railroad industry, but it has not been obvious enough to stimulate the planning, coordination, control and development organizations needed to produce a total system concept for tapping this profit potential. Developing a new system requires changes in orientation and organization. The basic railroad organization developed over a period of one hundred years specifically to operate a locomotive-freight-car-steel-rail-system enjoying a monopoly environment. It is very difficult for the industry to think in any other terms. Old ideas die hard.

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Considerable thought lead some of us to the hypothesis that a well-engineered container (or COFC) system would improve Santa Fe service and profitability. The hypothesis was based on three assumptions: First, containerization could provide a lower cost method of providing rail-highway service than TOFC. Second, COFC is a more efficient mode than rail cars for handling the smaller range of shipment sizes. Third, container service could be superior to both TOFC and rail-car service.

To attempt to quantify the advantages and disadvantages of containerization and test our hypothesis the Market Research, the Cost Analysis and the Technical Research departments embarked on a joint project to investigate the potential of containers.

Objectives of Santa Fe Study

A. To determine the more profitable intermodal transportation system for the Santa Fe, COFC (container on frame cars) or TOFC (trailers on flat cars).

B. To determine the most profitable role of an intermodal system on the Santa Fe.

C. To recommend a course of action which will permit the Santa Fe to take advantage of any findings in the study.

The first objective required a comparison of the economics of COFC and TOFC. The second objective required a comparison of a rail-highway system with an all-rail car system.

The final objective required an analysis of the practical problems involved in attaining the benefits of an optimum rail-highway system.

Summary of Areas of Research

Interviews with various railroads and equipment suppliers indicated that very little research had been done on the economics or potential of rail container systems. Most of the research work done had been toward developing devices to facilitate integrating non-rail van-type equipment into present rail systems. Good examples of this are the rail handling of highway trailers and marine containers like box cars.

During our research we developed the following criteria for an intermodal system:

1. Ability to operate at passenger train speeds.
2. Ability to handle different container sizes.
3. Ability to be phased into present TOFC and Flexi-Van operations if necessary to avoid establishing a completely separate system all at once.
4. Ability to select and transfer containers to or from any point in a train.
5. Ability for containers to be transferred by cranes.
6. Ability for containers to be transferred with low capital cost equipment at low volume points.

7. Ability to transfer a trainload of containers rapidly.
8. Automation potential for future transfer systems.
9. Conformity to highway weight, size and bridge requirements.

All the equipment components necessary to meet all of the above criteria are presently available. In fact, our investigation revealed that it is possible to establish a complete container system almost overnight with existing equipment components. Equipment is not a problem; planning, coordination and control is.

Perhaps the most interesting or at least exciting aspect of the research carried out was the train resistance tests in October 1966. I am sure that these tests set some kind of a record for the railroad industry, because the total time from conception to accomplishment was less than three weeks and involved only three major memorandums on our railroad. This is remarkable when you consider that the tests required cooperation between two major railroads, the New York Central and Santa Fe, involved tying up twenty miles of high-speed mainline track for parts of two days, and a number of Flexi-Van cars, piggyback cars, Flexi-Vans, trailers and five brand new 2800 horsepower passenger diesel units. Usually, this type of thing takes months, if not years, of planning and letter writing and generates mountains of files with reasons why it can't be done. To me, the fact that the tests were accomplished in short order with almost no flaws is a shining example of what can be accomplished in the railroad industry.

The purpose of the tests was to determine the comparative resistance of a train made up of container-on-flat car (COFC) equipment and a train made up of trailer-on-flat car (TOFC) equipment.

The COFC train consisted of 31 Flexi-Van type rail cars carrying two 40-ft. Flexi-Van type containers on each car. The container cars and containers were loaned by the New York Central for this test. The tests with the COFC train were run on October 9, 1966.

The TOFC train consisted of 29 flat cars 85 ft. to 89 ft. in length carrying two 40-ft. highway trailers per car. The tests with the TOFC equipment were run on October 12, 1966.

The test equipment consisted of a dynamometer car running in reverse behind the locomotive in order that the resistances measured would be only that of the test portion of the train. The train resistances in pounds per ton were calculated from quantities measured by the dynamometer car.

Five new General Electric U28CG passenger diesel units of Santa Fe Class 350—a total of 14,000 horsepower and 988 tons—were used to pull the test trains. The tests were near Coal City on the Illinois Division.

The target speeds for the test runs were 35, 50, 65, 80 and 90 mph. Strange as it might seem, it was not possible to reach a speed of 90 mph. within the test location with the full tonnage, and it was necessary to reduce tonnage of the trains to attain this speed.

The tests had significant line-haul cost implications. At speeds greater than 60 miles per hour, much of the total train resistances is in the form of

air resistance. Air resistance increases with the square of the speed of a train. Thus at 80 mph. the effort required to overcome air resistance is much more critical for semi-trailers than for containers, because of the greater height, and the wheels, trailer hitches, landing gear, etc. that must be pushed through the air. The excess cross-sectional area of semi-trailers over containers is approximately 30 percent.

Another major factor in comparing the COFC train with the TOFC train is the tare weight. The average weight of the COFC cars carrying empty containers was approximately 36 tons, as compared to approximately 50 tons for the TOFC cars carrying empty trailers. This difference is a considerable amount, and is an especially significant factor in grade territory and in accelerating and decelerating trains.

Many of the other components of train resistance (grades, rolling, flange, etc.) tend to increase with the weight on cars. Thus it is readily apparent that the semi-trailers are at a disadvantage for a given revenue load because of the extra tare weight of the cars and trailer appurtenances that must be hauled. The extra weight (and the effort required to move this weight) is from 15 to 35 percent greater than that for containers depending upon the average load per van. Therefore, even a casual observation of the two test trains indicated that the cost of hauling a ton of freight is lower in containers than in semi-trailers.

The tests indicated that use of containers will at least mean a savings in fuel, locomotive maintenance, locomotive units, equipment investment and train miles. The cost of handling a given amount of traffic is definitely less in containers than in comparable semi-trailers.

The train-resistance data developed from the tests were used in a train-simulation computer program to estimate comparative costs and schedules for various configurations of COFC and TOFC trains. The computer estimates indicated that COFC and/or TOFC trains could be operated on fast schedules between the Midwest and California. An all-container train would have the advantage in speed, fuel consumed, motive power requirements and dependability.

A major study was also carried out to compare terminal and pick up and delivery costs of intermodal systems with rail car systems. First, comparing various COFC and TOFC terminals there appears to be very small differences in cost per unit for any of the transfer systems available. Second, in comparing rail-car and intermodal systems, the cost differences depend upon whether the systems are compared in the short-run or the long-run. In the short-run, the rail-car system has lower costs, because fixed facilities are available and intermodal systems are labor intensive. In the long-run, or where rail facilities are not available or can be eliminated the opposite may be true.

We tried also to tie the comparisons of the different systems to the impact on shippers distribution and inventory costs. COFC has two characteristics which should make it more desirable than TOFC or rail cars to many shippers. These characteristics are:

1) The ability to produce faster and more reliable schedules.

2) The ability to handle a variety of container sizes economically.

The lower center of gravity will permit COFC trains to operate at higher speeds than TOFC around restrictive curves. This, plus COFC's reduced train resistance will permit it to maintain a schedule with relatively far less effort than TOFC, permitting a reduction in overall schedule time, and an improvement in schedule reliability.

COFC and rail-cars have different effects on shipper distribution costs. The major areas of differences occur in 1) inventory costs, 2) transloading costs, and 3) loading and unloading costs. In all of these areas, COFC will produce lower costs than rail cars.

The effects of various transportation characteristics on inventory costs were studied. We know that inventory costs decrease as shipment size, transit time, and loss and damage decrease—and as reliability of service increases.

With regard to transloading, one of the most widely recognized benefits of containerization is the ability to transfer goods shipped in containers from one transportation mode to another without physically transloading the commodities being shipped.

COFC can eliminate the transloading of some goods when the transloading operation is used to break bulk. Shippers are forced to break bulk to transfer goods from a line-haul vehicle into a vehicle suitable for pick up and delivery operations and also to utilize incentive rail-car rates.

COFC cannot eliminate transloading where the shipper must inventory goods. However, COFC may eliminate the need for inventories for some products and therefore the need to transload.

The final area of distribution savings accruing to a shipper utilizing intermodal services occurs in loading costs. Loading either containers or semi-trailers permits shippers to reduce the cost of loading and bracing freight. Shippers have revealed that they have considerable less bracing and dunnage costs with intermodal shipments. Added to this is the fact that many shippers do not have rail facilities or could eliminate rail facilities and could load more efficiently into vans than into rail cars. Four to five vans can be loaded at a dock in the space taken by one rail car. As each van is loaded it can be easily removed from the dock area. Compare this with rail cars where some cars must be loaded through other cars, loading requires 90-degree turns with forklift trucks and the dock may be switched only once or twice a day.

The impact of railroad service on shippers' distribution costs has a direct relationship to the price a railroad can charge. If the use of a rail-car results in higher shipper distribution costs than a truck, the rail price must be lower than the truck rate to compensate the shipper for the increased distribution costs he will incur when he ships rail. On the other hand, if the use of a container results in lower distribution costs than a rail-car the COFC price may be higher than the rail price and still produce a lower total cost to the shippers.

In other research studies we attempted to understand competition with

other modes, the potential containerizable traffic which now moves by rail and traffic which does not now move by rail.

Briefly, these studies indicated that there is enough containerizable domestic traffic presently moving between major points on the Santa Fe to justify the development of a container system. There is not enough export-import traffic to justify the development of a COFC system in itself. However, when the latter is added to the potential domestic container traffic it ensures that there is sufficient volume to warrant development of a container system. Note that the foregoing ignores the possibility of obtaining traffic not now moving by rail.

One other study of considerable scope that was undertaken was that of attempting to determine the potential utilization of all-rail cars. I believe that most people familiar with the railroad industry suspect that there is room for improvement in the utilization of rail cars. Any comparison of intermodal systems should be with potential rail car systems, not the present one.

Knowing the prospective traffic flows and probable equipment utilization factors it is possible to design optimum container and box car systems for handling the traffic. Interestingly enough, our studies indicated that even substantial improvements in freight car utilization would not be enough to overcome the economic advantages of a container system for the smaller range of shipment sizes. The utilization of frame cars between terminals and vans between terminals and loading docks and maintenance facilities can be far superior to a rail car system, in spite of high labor costs.

Premium Service Train

There has been some publicity in recent months concerning the Santa Fe's plans to operate what has been termed a "premium service" train. This train stemmed originally from a joint idea of Jim McClellan of the New York Central and Dave Gunn of the Santa Fe that some of the theories of the potential of a dependable, high-speed container service could be easily and economically proven by merely adding a container car to a daily transcontinental mail and express train. At the time the idea was conceived, through mail service using Flexi-Van equipment was about to be established on daily schedules. What could be simpler than to add another Flexi-Van car to scheduled trains, publish a through rate based on motor-carrier costs, and announce the service? Such a service would provide good fourth-morning service and has the potential for third-morning service. Studies of the available market lead us to believe that there is a large potential for such a service, and that the service would attract enough traffic to warrant operating separate trains rather than adding cars to mail and express trains.

In May and June of this year, the Santa Fe ran test piggyback trains at passenger train speeds via both our Amarillo and La Junta routes to test the feasibility of providing a 40-hour premium service. In June of this year, the New York Central and Santa Fe cooperated to run a transcontinental test train of 36 loaded Flexi-Van containers from New York City to Los Angeles. The train by-passed Chicago, broke all previous speed records transcontinentally and on the Santa Fe, including Super Chief test trains, and arrived in our piggyback yard in Los Angeles 54 hours and 20 minutes after

departing from 130th Street in New York City. The test trains all included test equipment while on the Santa Fe, and the results of the tests of October 1966 were more than confirmed over a 2200 mile route.

Three of us rode this train all the way, and it was an exciting ride. From our observations, there are really no unusual problems to running trains such as this every day over a number of different routes and combinations of railroads. To me, the most inspiring aspect of the test was the tremendous enthusiasm of all the railroad people involved, executives, car inspectors, train and engine crews, etc. There seemed to be a universal feeling that somebody was trying to do something different and railroads might not be an anachronism after all. You have probably now heard that the Santa Fe is going to try running a regular 40-hour, premium rate, TOFC - COFC train called "Super C," beginning in January 1968.

Other Potentials of Containerization

Containerization makes a world-wide system of single-unit transportation possible with potential for efficient and speedy transfers between modes. It can facilitate combining the unit train concept with the flexibility of the motor carrier into a "Beeliner" concept for vans. Moreover, it can help serve as a tool to reorient railroad thinking from that of low-profit-margin, bulk commodities to high-profit-margin, small shipment commodities. There is a guaranteed growth in the latter business as the economy of the United States grows in sophistication. The container concept should allow railroads to better fit the logistical requirements of a "logistics" or distribution age.

In addition, the container concept allows development of a new system with a total system approach, where the container system can be kept largely separate from the present rail-car system. In other words, the interface between the two systems can be kept to a minimum such as it has for passenger service.

Container-concept thinking also provides the railroad industry with the opportunity to participate and even lead in the development of world-wide systems rather than stay with the apparent present course of largely attempting to adapt the old, rail-box-car system to every other mode's container systems. There is no reason why transportation techniques such as those being developed in the Northeast Corridor project, for example, cannot be used with containers. Why not a container Turbo Train, for instance?

Lastly, container systems can be a tool for changing labor's outlook in the railroad industry. Certainly labor is more receptive to new ideas where the ideas offer hope of increasing railroad employment rather than the steady elimination of jobs. I think the Reading Railroad proved this point with the management-labor cooperation that developed to institute the Reading's "Beeliner" service. For example, if containerization could result in a growing railroad industry by virtue of short, fast, dependable trains, labor might be more agreeable to smaller crews and longer runs. The net gain to railroad labor would be more jobs.

None of the foregoing concepts are new. Doubtless you've heard them before over the past several years. In fact, seven years ago Mr. Macomber

of A. T. Kearney and Company compiled a picture story called, "An Over-All View of the Impact of Containerization" which was presented to a containerization and piggyback roundtable of the Railway Systems and Procedures Association and which covered many of the concepts and potentials of containerization very nicely. What we have done at the Santa Fe is attempt to quantify many of the conjectured advantages and disadvantages of the concepts.

In my opinion, it is not in the best interest of the railroad industry to default in the area of container systems development, but rather to take the initiative and gain some of the advantages of containerization for itself. The implementation of a successful container system will require a higher degree of planning, coordination and control than railroads have known in the past. The incentives to the railroad industry are lower costs, less investment, higher rates and new markets—in short, higher profits and new life.