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VALUE AND COST ANALYSIS

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Intermodal firms move thousands of chassis and containers around the country and around the world each day. This intermodal equipment goes from shipper to carrier to carrier to drayage to consignee, but too often none of these entities knows quite where it is. The equipment's owners often charge for keeping the equipment out of service for more than 24 or 48 hours, free time intended to allow consignees to unload, reload, and reposition equipment. Because current tracking systems often overlook equipment and none monitor the equipment in real time, equipment is too often held far past the time when it begins to incur demurrage and detention charges. The entities who operate the intermodal system in the U.S.—owners of containers and chassis, carriers, drayage firms, and shippers—vary in their incentive to make the system more efficient. While adopting leading edge technology would lower the long run total cost of the intermodal system, the short run incentives to move in that direction are often lacking.

The U.S. differs from Europe in ownership of containers and chassis, a factor that takes on unexpected importance in managing the respective fleets. Where large, national and multinational firms own the equipment in the U.S., the drayage and trucking firms own the chassis in Europe. This ownership provides the local firm with strong incentives to keep track of the equipment and to keep it moving. The lack of local ownership in the U.S. means that

equipment has a way of getting lost long-term in the U.S., and even the short-term 'absence' of equipment can be costly, especially to carriers who lease containers and chassis for their operations. The key issue is whether their customers pay the detention charges or not.

The key question this research sought to answer was: what is the value of knowing that equipment's location. This establishes the value of systems and software for tracking and tracing equipment. The research also evaluated the feasibility of bar code, radio frequency identification, and global positioning system solutions to these problems. The research did not answer these questions in the manner anticipated, but rather encountered circumstances that establish a potential value for real-time equipment tracking, but also show how far the market has been from achieving this goal.

This research relied on telephone interviews, e-mail contacts, and personal interviews with vendors, managers, and operating personnel in the intermodal supply chain. We interviewed or informally surveyed 60 people, primarily users of positioning and tracking systems. We also reviewed the relevant literature and examined the technology currently available.

Importance of Tracking Intermodal Equipment

Two issues affect the importance of tracking intermodal equipment: (1) tracking and monitoring the load for customer service and claims; and (2) tracking equipment for operational and capital-use efficiency. The ideal system would allow authorized users to track equipment real-time with little human intervention. This would serve both major purposes—service and efficiency. Unfortunately, many practical problems interfere with the implementation of a completely automated electronic system. This paper focuses on tracking the equipment, not the contents.

Estimating the value of such systems requires making far-reaching assumptions and forecasts for inventory management improvements. Nonetheless, the value is enormous and, even with such assumptions, the analysis worthwhile. This document will describe the available technology, discuss issues in implementation, and estimate the value and cost of implementing tracking and tracing based on a per-million-dollars in equipment scenario.

We work with the following values for intermodal equipment, all derived from interview data: New chassis: \$5000; Used chassis: \$3000; New 20 ft container: \$2500; Used 20ft container: \$1500; New 40ft container: \$2800; Used 40ft container: \$1800. We also used values of \$30 per day for detention on chassis and \$50 for containers and \$8.00 for container leasing, with a 3 day minimum. These estimates are near the middle of the range of values discussed with our informants in the research. Each also represents standard technology. The containers are plain boxes, not refrigerated or otherwise specialized. The numbers will be used primarily for illustration of the potential savings that can be derived from improved fleet management, probably the result of applying new technology.

Typical Tracking Systems

Tracking systems rely on three principal technologies: bar code scanning, radio frequency identification, and global positioning. Bar code scanning is by far the most widely used data capture method for tracking and tracing. A variety of industries have used the method for decades and have improved the technology for capturing the bar codes dramatically. Holographic scanners can read codes from almost any orientation and pen-based portable scanners allow workers to read bar codes anywhere. These technological advances have greatly increased distribution efficiency and data integrity. However, they continue to require human intervention, usually at several points along the distribution route.

Radio frequency identification (RFID) offers a new approach to tracking and tracing. RFID uses small tags, which are implanted in packages or containers. They can be passive, drawing their power from the reader, or active, drawing on battery power (Brunell 1999; Langnau 2000). Passive systems have limited range, but can be useful in close quarters. Active systems have greater range, but cost more because of the batteries. The range depends on the size of the battery. Once information from RFID tags is read, it is organized and stored in users' computers. Manufacturers and warehouses are just beginning to use RFID (Fong 2000; Owen 2000). We found no firms using it to track and trace container equipment, but it seems to offer some potential for intermodal applications.

Global Positioning Systems seem to offer the ideal tracking and tracing systems for containers and chassis. The systems are relatively inexpensive to implement—at least the software—and provide instant location information. They use government operated satellites to position equipment anywhere on the globe. Unfortunately, they are battery dependent, often require human intervention, and still require extensive maintenance (Higgins 2000). While they offer real prospects for the future of tracking and tracing, they are limited at the moment. A newly introduced technology—containers with GPS built in—may change the market dramatically over the next 5-10 years.

A key issue in implementing any one or a combination of these technologies is the amount of human involvement in maintaining data integrity. Tracking the North American container fleet as a whole right now relies on a variety of systems, each dependent on the current operator of the container and the entity currently holding it. For example, a liner company may take possession of a container and enter information about the container into its computer system. The ocean liner's system will maintain information about that container until it reaches

the port and transfers possession of the container through the port to a trucking firm or a railroad. The carrier then takes possession and maintains information on the container until it reaches a destination city. The drayage firm takes responsibility from the railhead to the destination customer, who then takes responsibility. However, each of these interchanges requires the entry of equipment data into a system belonging to the responsible entity. Equipment owners require interchange documentation at each exchange, but the system still loses track of equipment.

Intermodal equipment suffers severe treatment in handling, suggesting that expensive tracking equipment would be wasted if it required high dollar value devices to be attached to the containers and chassis. As this report was being written, we received information about a company that is now marketing containers and chassis with tracking and tracing technology built into it—a necessity for developing a true, real-time tracking system. Until that technology becomes widespread, the system contains multiple flaws and enormous, needless costs.

The Finances of Current Tracking Practices

Understanding the finances of current intermodal equipment tracking first requires an understanding of incentives, investment values, and returns. In practical terms, this means the cost of the equipment and the detention charges applied to keeping equipment longer than the specified free period. Once these elements of the system are well understood, the value of better tracking and tracing can readily be estimated.

A firm owning a fleet of containers would appear to have little incentive to manage the fleet more efficiently. They receive lease payments as long as the container is in the possession of the operating carrier. Based on the raw numbers, a \$5000 investment in a new container has a payback period of approximately two years at \$7-\$8 per day. The more equipment they have out, the more frequently they earn this revenue.

The firm operating these containers may have a different view. For example, a firm might allow its customers 15 free days usage for a 40ft container that moves from the Port of Charleston to Phoenix, AZ. If the customer routinely fails to return the container for 30 days, the customer pays 15 days detention at \$50 a day—a total of \$750 in one month. That is in addition to the lease charges for use of the container in the first place. Some firms do achieve this, but by no means all.

The difficulty in collecting these charges influences the rate of return. According to our informants, approximately 50% of the customers—usually the largest—seldom or never pay detention charges. They get the charges waived by threatening to take their business elsewhere. Another 25% of customers pay the charges, but at a deeply discounted rate. The last 25% pay the charges as stated. If we examine the hypothetical 40ft container in this light, the \$5000 investment returns only a fraction of the \$750 each month—roughly one third, or \$250.

Still \$250 in revenue per month from a \$5000 investment seems excellent—a 60%-annual return. Unfortunately, this scenario assumes that the container is in constant use throughout the year. With no incentive to make effective use of the equipment, many large customers may keep the equipment well over the intended period. Also, because of its inefficiencies, the U.S. intermodal equipment fleet is at least 25 percent larger than necessary to move the amount of available freight. This means that the container is idle 25% of the time just because there are too many containers available.

If we reduce the return by 25% for idle time for overabundance and reduce it further for excess, unpaid detention, the return from detention charges could easily fall to 30% annually—before taxes and expenses. So what at first blush might appear to be an outstanding investment becomes average at best. And, of course, they continue to pay the \$7-\$8 in daily lease payments

on the containers.

For chassis an additional problem arises as well. One informant told the researchers of having to pay someone to enter a competitor's yard to identify and reclaim equipment that belonged to the informant's firm. They identified 50+ pieces of equipment being used by a competitor. Some chassis had been scavenged for parts to repair equipment that belonged in the yard. When questioned, the informant admitted that his yard probably had some of the competitor's equipment as well, and that his firm would probably scavenge parts in much the same way. In any event, his firm had managed to 'lose' \$150,000 worth of chassis in a competitor's facility.

To summarize, at first blush the firm that owns the containers and chassis appears to have little incentive to improve the efficiency of the system because of potential for high returns from detention charges. But their incentive to manage better increases as the reality of the returns sets in. That is, they have an incentive to keep their container investment moving and turning over more efficiently. They may lack the ability to influence large customers to help them improve the turnover.

The large customers have no incentive to increase the efficiency, but, at the moment, no incentive to block it either. Some of the excess capacity in containers and chassis simply clutter their yards and add little or nothing to their service levels. Their willingness to support improved efficiency will disappear as soon as the fleet becomes lean enough to inconvenience them.

The medium and smaller customers would like to see improvements in the efficiency of the fleet because they pay higher rates and are more likely to pay detention charges than the large customers. They would see lower costs in the form of improved rates and increased service if the system functioned more efficiently.

Overall, the system now requires too much investment in chassis and containers, but the technology and the incentives to use the technology are lacking. Right now the excess costs in the system represent additional revenue and profits to key players in the system. The new containers, with built in antennae for tracking and tracing, promise increased efficiency in the future.

The Human Element—A Brief Comparison between the U.S. and Europe

In Europe, local delivery firms own the chassis, where the large equipment operators own them in the U.S. This distinction seems minor, but the implications for fleet efficiency are profound. In the Europe, the person with the most incentive to keep the chassis moving also has the most opportunity to keep track of it and to request its timely return—the drayage company. In the U.S., because the firm's equipment is scattered throughout the region or the country, and because the firm that owns and operates the chassis does not physically move it most of the time, this opportunity is lost. Our informants estimated that this results in a 15%-35% loss in efficiency in the U.S. by comparison to Europe.

Financial Value of Tracking and Tracing Improvements Per Million Invested

So to the critical question: what is the value of tracking and tracing software to the overall U.S. intermodal system. Two critical issues remain: (1) the investment required in equipment; and (2) the utilization of that investment.

In many regards, the first question is easy. Once an estimate of percentage of potential improvement has been established, the equipment investment can fall by that percentage. In effect, the same profits might be generated using \$800,000 in equipment instead of \$1,000, 000. This amount of equipment could also accomplish the same work—by the definition of a 20% improvement in efficiency. We were unable to find a reliable estimate of the number of

containers in operation in the U.S., but a 20% reduced equipment inventory would save \$200 million in investment for every billion dollars currently invested in equipment. This would also avoid annual investment costs of \$70 million.

The savings to the shippers in detention charges for a 20% reduction would exceed \$2 million annually, based on billion dollar investment in 200,000 units with ten percent incurring 2 days of paid detention charges annually. This represents a very conservative estimate of paid detention, justified by the percentage of large customers who avoid these payments entirely.

Current attempts to track and trace equipment also cost a great deal, but resist precise estimation in the scope of this project. Using a standard overhead charge, however, suggests that the cost would approach \$70 million for every \$1 billion invested in equipment—a 7% overhead rate.

A bottom line estimate of the value—given a variety of assumptions and a caveat that further research is required—of tracking and tracing software for intermodal equipment is \$142 million per year.

Conclusions

The key to improved fleet management for intermodal equipment in the U.S. currently rests with human involvement, not technology. At this writing, effective systems for locating, identifying, tracking, and tracing chassis and containers require significant human involvement. While software improvements are crucial, the addition of built in electronics for the containers and chassis are far more important. This will allow for increased automation and reduced need for hands-on tracking and tracing.

The transition from the current, low technology fleet to the higher technology fleet will take between seven and ten years—and there will still be a market for the current containers and

chassis. A major reason for the slow transition to new technology is the lack of incentive to change on the part of key players in the system—container owners, operators, and shippers may all be indifferent to increased efficiency in many instances today. However, the technological impetus will eventually take over the intermodal fleet, producing a more efficient and effective intermodal system in the United States.

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