Cuthbert
Special Situations in Software Development

For ocean containers and chassis, the question has been on the table for years.

Why RFID?

Wal-Mart demands it. The US military is doing it. And every magazine is writing about it. But what will RFID do for containers and chassis?

Sixty-two percent of transport and logistics providers say that the business case for RFID is not strong enough for their companies. Results from the same study commissioned by eyefortransport indicate that 53 percent believe that "currently installed technology gives us all the efficiency, accuracy, and visibility we need."

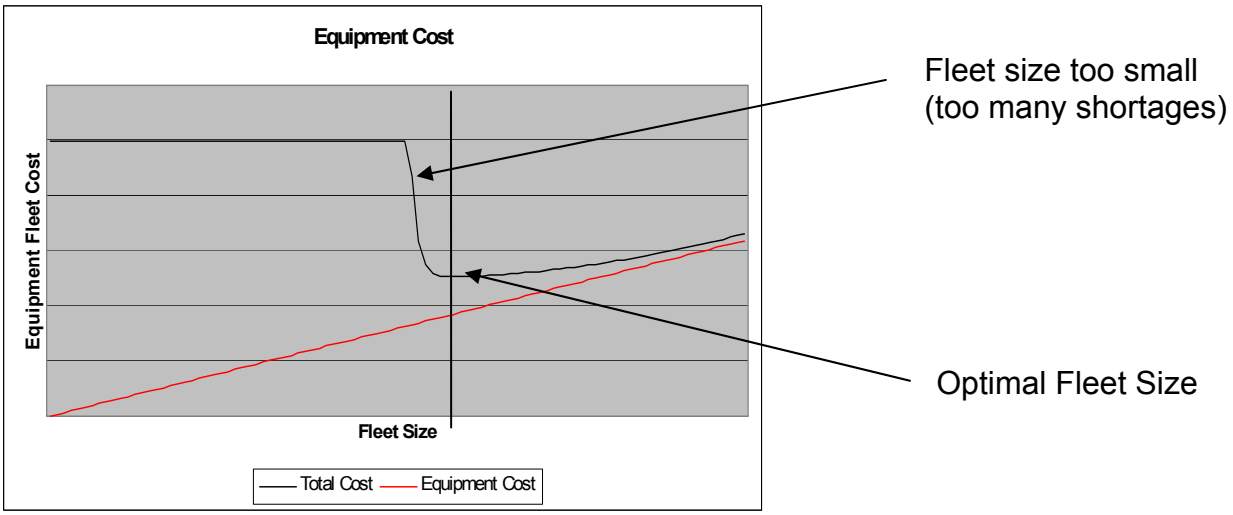
The business case for RFID may be too weak for the container industry, but it was strong enough a decade ago for the railroads to adopt it wholeheartedly. If you think about it, the railroads have a lot fewer places to lose cars than we do containers. For the railroads, RFID is old news; they have fortified RFID with even more advanced technologies, including GPS, real-time engine health monitoring, and communication by wireless.

What is the business case that the container industry cannot seem to make? If better container tracking information were available, couldn't carriers decrease fleet size, increase utilization, and decrease cost? Sure. But the costs of tagging containers, installing reader infrastructure, and building systems to use the data depend on widespread adoption; a single carrier can't do it cost effectively. No one wants to go first and bear the cost. The result is that the technology has languished for 10 years while each carrier waits for another to make the first move.

The existing scheme for tracking containers and chassis is a perpetual inventory. This inventory is a series of lists of where things are, based on the last time we saw them at certain key points, specifically at the terminal gate and at the crane. If we know a container entered the terminal last week, and hasn't been laden to a vessel, it must be in the yard. Some operators employ yard management software that operates on the assumption that a container placed in a particular spot will stay there until it is moved. When a container or chassis is lost, a perpetual inventory does nothing to alert you.

RFID offers logistics operators something that gate control and OCR cannot – periodic inventory, as often as you want it. A periodic inventory is a snapshot of the inventory at a particular point in time. As accountants will testify, a perpetual inventory *should* provide the same results as a periodic inventory. As operations staff will attest, a perpetual inventory perpetuates errors. Once there is an error in a perpetual inventory, if a container is lost, it will remain lost until a periodic inventory is conducted. In the terminal world, the periodic inventory takes the form of a search for a particular container. One would hope that, once the container is found, its record would be corrected in the perpetual inventory. The costs for such an exercise are high, both in hours expended and in lost customer goodwill.

The real cost savings from equipment tracking accrue when you know for certain what your inventories are in every location at every hour. Then you can whittle away at the number you need to accommodate reasonable customer demand. Suppose you can reduce your empty equipment inventory to push utilization from 50 percent to 60 percent. Would you not then save yourself a pocket full of money? In the case of a chassis, in increase in annual utilization from 50 percent to 60 percent is a reduction in cost of 35 days, or about US$300 per year. You can buy a lot of RFID tags and computer systems for $300 a chassis.



The determination of optimal equipment fleet size is a twist on the standard inventory control problem described in university business classes. In other industries, one solves the problem to determine the Economic Order Quantity. In our world, the order quantity is usually 1 or 2 (with a train representing perhaps dozens); equipment is returned to the terminal 1 or 2 at a time. In logistics, we solve the problem for total fleet size. The objective is the same,

however: To determine the point at which the total cost of operating the fleet plus the cost of stock-outs (lost business and equipment repositioning cost) is minimized.

The math in the problem is not particularly complex, but it doesn't add to this discussion. Nevertheless, to do the math, we need four kinds of information:

- Historical data describing use of the fleet;
- Current data describing equipment, availability, and location of each piece in the fleet;
- Projected dates of return of equipment currently in the possession of a customer; and
- The cost of *not* having a required piece of equipment.

RFID adds significant value to the data in the first two categories. It increases substantially the accuracy of current location data. If you know for sure that you have equipment of a particular size and type in the yard, you can confidently take bookings and expect to make deliveries against bills of lading. When RFID surveillance is extended to rail and customer facilities, you can make certain assumptions about the near-term availability of equipment, even though it is not yet returned to general availability. When this focused information is retained in a useful database, the fleet operator, through its systems, can start generating information in greater and greater detail. Just a few years ago, it was only possible to determine the average time a chassis was in the community (time from out-gate back to in-gate); now it is possible to extract the same information by terminal, customer, trucker, equipment type, and even by day of the week.

The missing piece, and one that RFID alone will not provide, is a look to the future. In the same way that automobile rental companies are crucially interested in the time you say you will return their car, we should seek to get from our trucker, shipper, broker, and rail partners an estimate of the time and date of equipment return to the terminal. Historical data is one way to generate estimates. Appointment systems are another way to gather this information. In the long run, fleet operators will need to provide an incentive (economic or otherwise) for their partners to make accurate estimates of delivery time and tender this information to the operator. To the extent that operator is collecting RFID information that is valuable to the partner and delivers it to the partner, the partner can be induced to make similar information available back to the ocean carrier and terminal. This is a win-win proposition. Of course, it requires rather more widespread acceptance, so that partners' investments in RFID will play with most or all of their ocean carrier and terminal partners.

The math also requires an assumption about the cost of a stock-out. As you decrease fleet size, you will inevitably end up with more situations where you run out of chassis or containers. It's not the end of the world, although sales people and customers will complain. You simply need to assign a cost to the event. The granularity with which you do that is a matter for the analysis team. Lack of a reefer is more serious than the lack of a dry box. Dry boxes you can lease from a pool. Reefers represent more revenue, cost, and pre-trip maintenence. When a customer needs a chassis and there isn't one, what is the cost? An accountant will tell you that the opportunity cost is the foregone profit from the move the customer would have made. The line manager will complain that the carrier lost all the revenue from the move. And the sales guy might tell you that not having equipment available will cost the entire account. The three possibilities might be the loss of US$100 in margin, US$1,000 in container revenue, or US$ 1 million from loss of the account. The commercial approach should be determined by the ocean carrier. The mathematical approach is the same.

Our estimate of costs to equip a world fleet of 16 million containers is US$480 million. Our estimate to equip 5,000 facilities with 50,000 RF readers is US$200 million. One analysis of such an investment showed a positive ROI on all costs, capital and ongoing, with an increase in equipment utilization of just 0.6 percent. The average container introduced to service in 2003 cost US$1,800. A tag will add only US$30. If the world had a centrally planned economy, the decision would be a slam-dunk. Just do it. But these decisions need to be made by individual firms. Those decisions need to be based on analysis. Each firm will likely come to a similar conclusion: RFID is a good choice … if my competitors and partners do it too. Otherwise, I won't be able to count on every interchanged container being tagged or that there will be sufficient readers outside my own organization's facilities.

OK, so now you've designed the decision support model to help you decrease the fleet size. It will predict where and when you need equipment. You recognize the cost of whittling too much. You have quotes from vendors to install RFID. You are reasonably assured that the RFID units you buy will be industry compatible. Now the question is when to pull the trigger. You know that if you are an early adopter, you will gain some benefit, but the costs will likely outweigh the benefits. Only if there is widespread industry acceptance can you count on positive benefits from installation of RFID. Now is when you make a guess at what your competitors will do. If no one is talking through a conference agreement or international standards body, you have to count on every player doing what makes the most sense for itself only.

Game theory explains exactly the position we are in. Game theory is a branch of mathematics that uses models to study interactions with formalized incentives or rewards ("games"). There are two Nash equilibria for the RFID game. (Remember John Nash, the disturbed mathematician in *A Beautiful Mind*? In the game theory, if a situation has the property that no player can benefit by changing its strategy alone, the corresponding set of payoffs constitutes a Nash equilibrium.) One equilibrium occurs when the whole logistics industry adopts RFID. No player can better its position by opting out of RFID. The other Nash equilibrium occurs in the situation we have today, when no one adopts RFID. No player can better his position by adopting RFID alone. The only way to move from one equilibrium to another is to organize an agreement or consortium between the players to get them some of them to adopt. That's called a salient, and it's something the RAND Corporation knows about.

The good news is that there is some movement in just this area. The US Department of Homeland Security continues to talk about "smart containers", which implies RFID. The terminal operators in southern California have agreed to adopt RFID for all tractors in the region. Once the RFID reader infrastructure is in place, containers and chassis can be tagged at a low marginal cost. In December, an ISO committee met in Beijing to reaffirm the standards for container, chassis, and seal tagging. It looks like ISO will reconfirm the standards for passive chassis and container tags ("Container License Plates") in the 915 MHz range, and add an international standard for active tag container seals in the 433 MHz range.

The game changes as soon as one early adopter announces its intent to pursue container tagging. At that point, we move from an equilibrium condition to a situation in which it is beneficial for all others to follow. With an international standard to build from, it simply remains for the first few carriers to make a move. It is easy to conclude that the industry will soon follow, adopting RFID.

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