A.T. KEARNEY

Smart Boxes

RFID Can Improve Efficiency, Visibility and Security in the Global Supply Chain

The International Cargo Security Council (ICSC) is a professional association of cargo transportation and security professionals. Members represent a broad spectrum of cargo security companies, including air, truck and rail, maritime and intermodal. The ICSC's mission is based on four key objectives: to improve cargo transportation security through voluntary government and industry efforts; to serve as a central clearinghouse for the collection and distribution of information; to provide a platform to address transportation industry matters relating to security of cargo; and to assist and support voluntary and self-help initiatives by government, transportation centers and industry cargo security interests.

When a business traveler loses luggage in transit, it's an inconvenience. She may spend a day wearing rumpled clothes and have to take time for shopping. But when a major company loses key components in transit, it can stall manufacturing lines, disrupt product deliveries, and impose an economic impact far greater than a quick trip to the store.

Today, most companies' supply chains increasingly rely on over-ocean shipping. Every day 20,000 containers enter ports in the United States—that's almost 14 containers per minute. Overseas shipping now accounts for more than 90 percent of worldwide trade, with 95 percent of all U.S. cargo passing through the nation's 361 ports.

So while manufacturers cut costs by producing goods in offshore facilities, frequently with no loss of quality, they can suffer when it comes to shipping these items. The tangle of containers, ports, carriers, customs and border security checkpoints confounds the goals of simplicity and transparency in the supply chain.

How are companies acquiring information about their products being shipped? How do they gain visibility into their supply chains, knowing when items will arrive in order to reduce inventories and lead-time variation? Have they found ways to reduce working capital *and* risks in these new arrangements? Because over-ocean shipping has not traditionally warranted much management attention, these complex problems have so far eluded easy solutions.

Further complicating the matter is the global security threat. Complex global supply chains are coinciding with growing concerns about potential terrorist activity at ports. More than 95 percent of containers go uninspected. The occasional inspection by customs officials poses a wild card in managers' relentless quest for reliability in the supply chain. Is there any way companies can protect and streamline that process?

To answer these and other questions about over-ocean supply chain operations, A.T. Kearney surveyed some of the biggest companies in the United States that import or export products abroad. We sought out high-level supply chain and logistics executives at the top 100 importing and top 100 exporting companies, and collaborated with the International Cargo Security Council (ICSC) to reach the organization's international

shippers. The executives in our survey represent companies in the retail and consumer packaged goods, automotive, chemicals and high-tech industries *(see sidebar: About the Study)*.

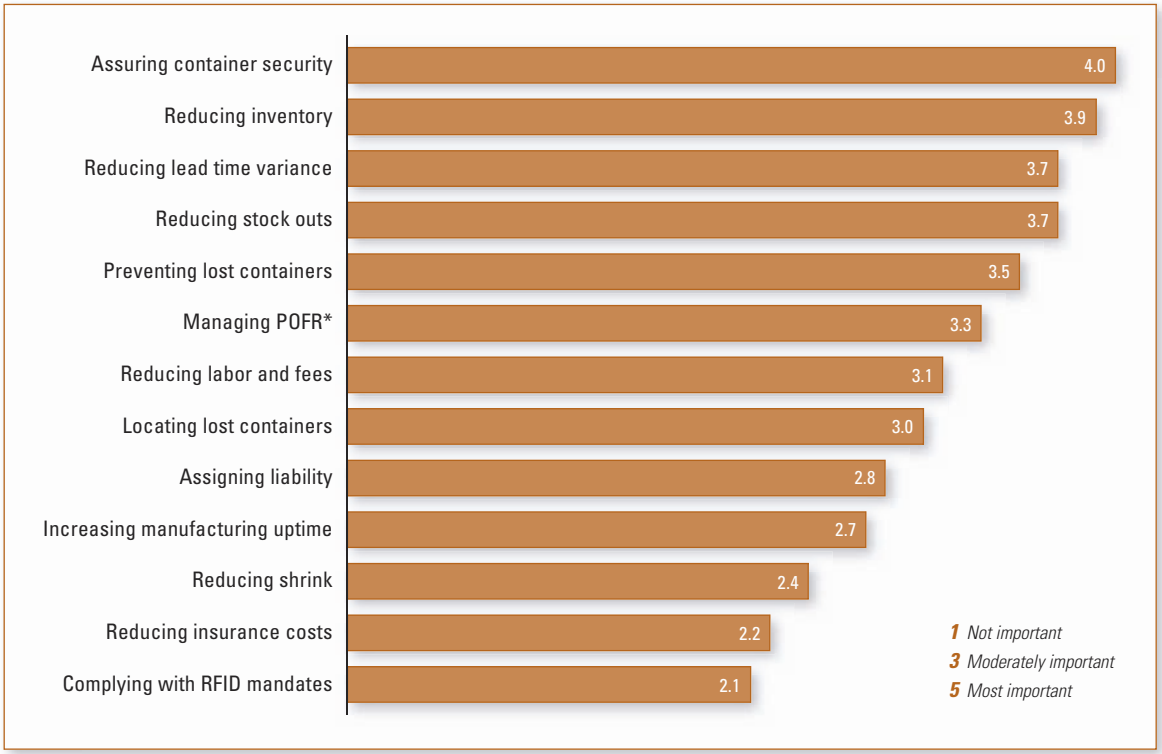
We asked the executives about their key concerns, and about a proposed supply chain solution using radio frequency identification (RFID) tracking and security. This report summarizes our findings.

The Big Issues

The survey set out to validate key concerns in the over-ocean supply chain. But when we asked executives to prioritize these issues, the results were somewhat surprising. While many people expected high-risk, low-frequency issues such as locating lost containers and assigning liability to be among the top priorities, we found they took a back seat. Of all possibilities, security is the number one concern.

Figure 1 ranks the relative importance of the top 10 management issues in the over-ocean supply chain. Ensuring container security leads the list, reflecting the difficulties of doing business in a post-9/11 world. For example, one chemical executive says that for certain import and export

Figure 1
The relative importance of over-ocean supply chain challenges



**POFR stands for perfect order fill rate, a measure of order accuracy, timeliness, quality and completeness.*
Source: A.T. Kearney

About the Study

A.T. Kearney conducted interviews with supply chain executives from companies on the lists of the United States' top 100 importers and top 100 exporters, using the 2003 list from the *Journal of Commerce* that ranked companies by TEU volume (20-foot equivalent unit, the international standard measure of containers). We worked with the International Cargo Security Council (ICSC) to identify and interview key additional participants among major international shippers.

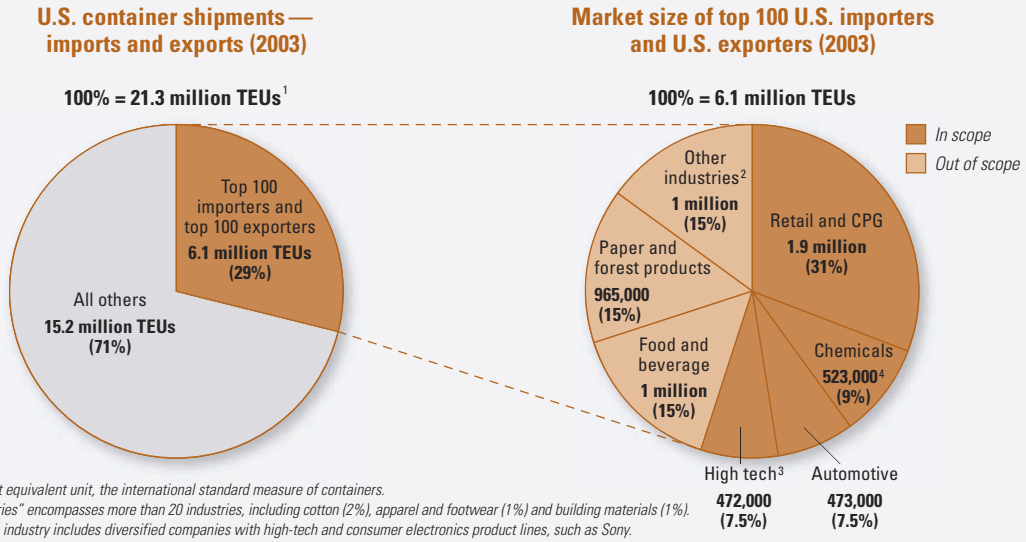
The United States' container shipments market for both imports and exports comprised 21.3 million TEUs in 2003. Our survey covered 183 companies that account for 29 percent of the total market *(see figure below)*. Most container shipments come from a small number of firms; even among the lower half of the top 100, volumes dropped precipitously. Because several interviews took place among the very top importers and exporters, we are confident that the insights of key players in the market have been captured.

The study was limited to four key industries of importers and exporters: retail and consumer packaged goods, chemicals, automotive and high tech. Together, these industries account for 55 percent of this market, and container shipments are growing at a 5 percent compound annual growth rate. Retail drives this growth, and is expected to continue to do so with the elimination of United States textile quotas.

We conducted 35 in-depth one-hour interviews with executives responsible for logistics, supply chain, transportation and operations activities. The executives were distributed equally among the four industries. Although the executives' titles varied, all had responsibility for strategic decision-making of advanced supply chain processes and technologies.

Each executive ranked and quantified the key issues facing over-ocean supply chain logistics operations. We then discussed the proposed RFID-based security and visibility solution—and its potential impact, benefits, value, pricing and implementation readiness. The result of the survey is a comprehensive view of the conditions these corporations face, and how this solution measures up against others.

Survey covered 183 U.S. companies, including the top 100 importers and exporters



[1] *TEU is 20-foot equivalent unit, the international standard measure of containers.*
[2] *"Other industries" encompasses more than 20 industries, including cotton (2%), apparel and footwear (1%) and building materials (1%).*
[3] *The high-tech industry includes diversified companies with high-tech and consumer electronics product lines, such as Sony.*
[4] *According to chemical industry respondents, intermodal containers (dry vans) account for more than 98% of their volume in imports and exports listed by TEU. And even their cylindrical tanks (which represent 1% to 2% of respondents' TEU volume) are designed with a skeleton that allows them to be treated as dry vans.*

Sources: World Shipping Council and Journal of Commerce (2003)

products, his company is willing to do "whatever it takes to guarantee container security."

This comment and others underscore the role of "reputation management"—companies that manufacture products with a high degree of brand value are especially concerned with being caught in a security breach. In the chilling event of a nuclear device or other terrorist weapon being concealed in an over-ocean container, companies with strong brand value fear having their name associated with the incident. At worst, they could suffer a huge decline in stock value, such as the billion dollars Union Carbide lost in the five days after Bhopal. At best, they want to be able to reassure the public that they did everything they could—perhaps even going beyond government mandates—to prevent such a breach.

"If Al Qaeda **threatened to shut down a port,** I believe the first containers out would be **those whose security and contents are easily verified."**

— Automotive executive

But container security is not entirely a matter of preparing publicity to survive a company crisis. It's also smart preparation for responding to somebody else's crisis. If you can demonstrate your containers' security, you may be able to do business even during a terrorist alert that grinds shipping to a halt. As one automotive logistics executive says, "Container security is important to me because if Al Qaeda threatened to shut down a port, I believe the first containers out would be those whose security and contents are easily verified."

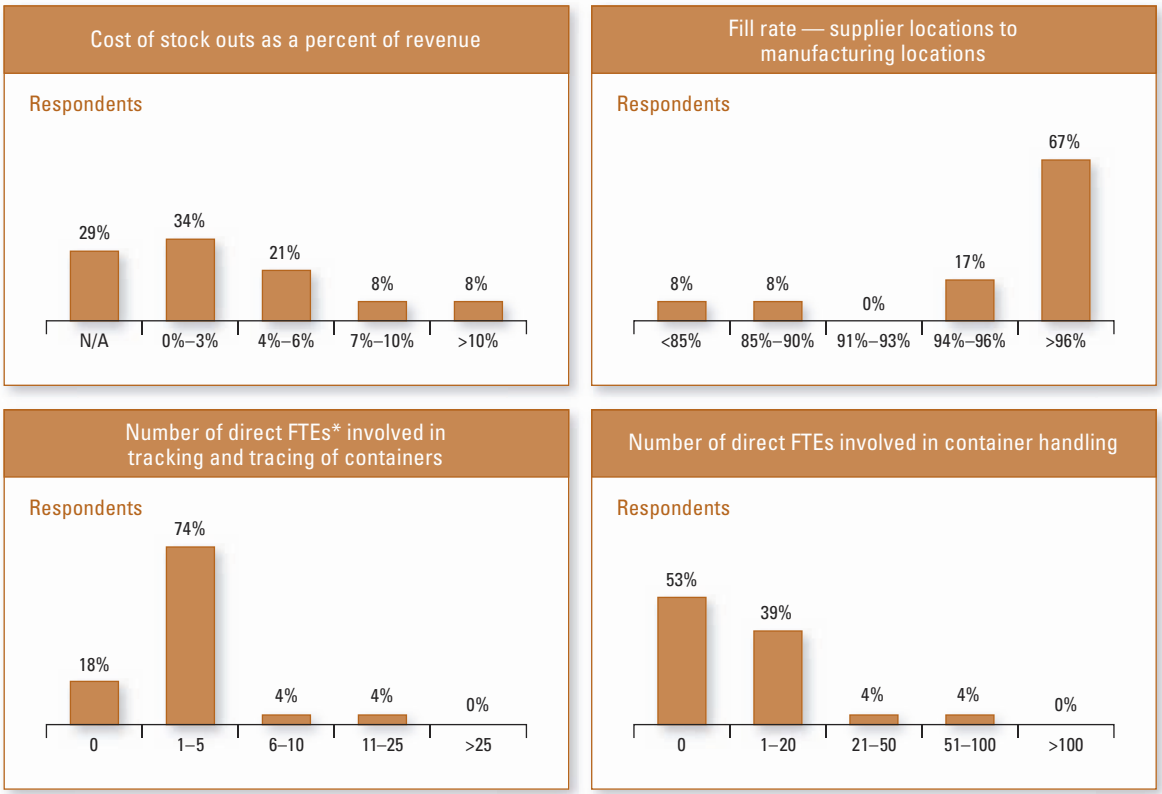
Following closely behind container security were concerns about supply chain efficiency—reducing inventories, lead-time variances and stock outs, and preventing the loss of containers and their contents. Respondents have a firm grasp of the economics of lean supply chains, seeking to reduce their working capital tied up in inventory by having as much information as possible about replenishment. In short, improved visibility would improve efficiency. One automotive executive sums it up this way: "More [data] reliability would allow me to reduce my inventory with confidence." A retail executive notes that, "with better data I could pull levers more quickly" to control pipeline inventory and reduce buffer inventory.

Respondents indicate wide variability in performance measures of their over-ocean supply chains *(see figure 2).* Most measure the fill rate for supplier locations to manufacturing locations—and 67 percent exceed a 96 percent fill rate, although not as efficiently as executives would like given that the threshold is often achieved with the assistance of expedited shipping. More than one-third of respondents indicate that stock outs continue to have a significant impact on their revenues, by 3 percent or more. Most peer group companies contract with third-party logistics providers (3PLs) or freight forwarders and so use a limited number of FTEs (full-time equivalent) to track and trace containers or handle container materials.

The increase in global container shipments also plays a role in placing the over-ocean supply chain high on the executive agenda. Global container traffic has increased an average of 10 percent over the past five years, rising 15 percent in 2004 alone. With such increases, containership charter rates have risen as well; for some TEU (20-foot equivalent unit, the international standard measure of containers) capacity levels, the rate has been as high as 50 percent. And as prices rise, you want to make sure you're maximizing efficiency. One chemical company executive notes that for several years his company focused on improving the efficiency of its domestic supply chain—and neglected the over-ocean piece. But when executives studied the issues from the perspective of inventory, rather than geography, they realized the value of increased visibility and efficiency in their over-ocean operations.

After having implemented sophisticated supply chain systems, respondents indicate that such existing technologies are only somewhat effective at addressing over-ocean visibility issues. The problem? Poor quality data.

Figure 2
There is wide variability in over-ocean supply chain operations



*FTE is full-time equivalent.
Source: A.T. Kearney

The Bottleneck

One step in improving security is knowing where your containers are. At the very minimum, can you locate all of your containers? Can you reroute containers away from a terrorist hot spot? Quarantine sensitive materials? Announce with confidence, just hours after a terrorist event, that you are sure your containers were not involved? Receive assurances that your container has been secured since it left its origin point? In general, survey respondents say they cannot.

> "Sixty to 65 percent of **my data regarding container movement is timely and accurate.** The 35 to 40 percent of remaining data is **missing or inaccurate."**
>
> *— Retail executive*

Respondents also say they need real-time data for accurate visibility into their supply chains. One retail executive says, "Sixty to 65 percent of my data regarding container movement is timely and accurate. The 35 to 40 percent of remaining data is missing or inaccurate."

Many companies outsource these information functions to a freight forwarder or third-party logistics provider—but that doesn't solve the problem of unreliable data. As one automotive executive says, "My freight forwarders provide me with poor data quality, but it's not their fault." The data simply does not exist, and the entire community knows it. Shippers, freight forwarders, ports, and the import and export companies must work together to mitigate the challenges of accurate data visibility.

Respondents view information they receive now from shipping companies, ports and freight forwarders to be generally unreliable. It may be manually entered, with all of the typographical errors that a manual process introduces. It may arrive long after the fact, not reflecting the physical movement of the cargo. And in some cases, it may be trying to hide underperformance or even liability issues. Respondents would prefer an independent source of clean, accurate data.

Visibility and Security via RFID

During the first Gulf war in 1991, the U.S. military had a shipping problem: Nearly one-third of the containers they shipped to the Middle East were lost or unaccounted for when needed. And when containers did arrive—in the hot desert, in the middle of a war zone—soldiers had to manually open almost two-thirds of them to see what was inside.

Not knowing what was in the containers, commanders frequently made redundant requisitions, in a practice they called "just-in-case" logistics. Just in case the boots, bullets or other material so essential to their success had not actually arrived, they made multiple back orders. The result? "Iron mountains" of containers on docks and in the desert—and a lesson for the United States Department of Defense (DoD): When it comes to the rapid deployment of forces, logistical support requires real-time tracking of critical sup-

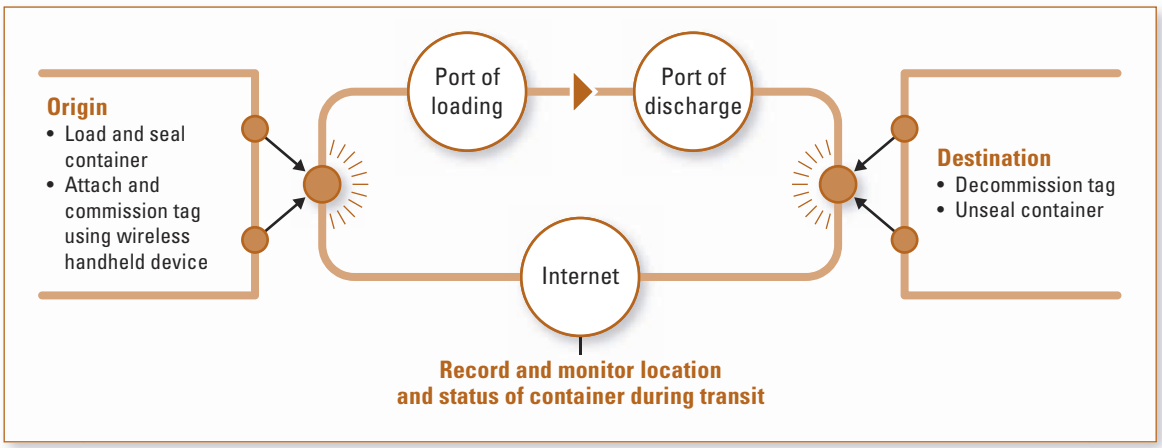
plies as they move through the global supply chain.

Enter RFID technology. Through seed grants from the Defense Advanced Research Projects Agency—the same agency that fostered development of the internet—military officials tested and validated RFID solutions. An RFID chip attached to any size logistic unit can be read at key checkpoints—distribution centers, seaports, truck terminals—to beam information into a global computer network. DoD now deploys its InTransit-Visibility (ITV) network to track military supplies from factory to foxhole. ITV stretches across more than 1,600 locations in more than 45 countries. Used in both Afghanistan and Iraq, ITV has reduced overall losses to less than 8 percent. During Operation Iraqi Freedom, the military deployed 90 percent fewer containers compared to Operation Desert Storm, and attributes more than US$300 million of efficiency savings to RFID. The military had the financial strength to invest in developing new technology; then, as happened with the internet, adoption costs eventually decreased to the point where the solution also became commercially viable.

Figure 3 shows a conceptual view of the RFID solution. It starts on the left, when the container is loaded. An active RFID tag is attached to the container as it is sealed *(see sidebar, Complementary Technologies: Active and Passive RFID)*. Each tag has a unique number, and by linking that number to the container's manifest, you always know the contents of that container. You can then set up a reader to track your items at various points throughout the supply chain. Chokepoints where readers might be positioned include the spot where a truck is loaded or unloaded, on a crane that transfers containers, a weigh station, the port of loading, or at the port of discharge. Each reader is linked via middleware to the internet and automatically feeds information to networked software tools, providing the visibility that few companies enjoy today.

Figure 3

RFID allows monitoring location and status of containers at key chokepoints along the supply chain



Source: A.T. Kearney

Complementary Technologies: Active and Passive RFID

The technology for RFID tags has developed in two primary channels: active and passive tags. Each type of tag contains a digital identification code on a microchip that can be scanned by a reader—the difference is in how that scanning takes place.

For passive tags, the reader emits a signal that activates the tag, allowing it to speak back to the reader. In contrast, an active tag contains a battery supply that continuously powers the tag, allowing it to emit a signal without having to be activated by the reader.

Active tags, which are also programmable, reusable and store much more data, are thus more expensive—they may cost as much as US$10 or US$50, compared to about US$0.50 for a passive tag. However, since they both have read and write capabilities, the information on the active tag can change. Thus, the tag can give the reader not only an ID number but information on where it has been and how it has been handled. Active tags offer the following benefits:

- They can monitor a container even when there is no reader nearby, which means they can detect tampering, vibration, light, humidity, temperature changes and other environmental fluctuations.
- They may be more reliable because they transmit information over longer distances than passive tags. Where passive tags may require a communication range of three meters or less, active tags can have a range of 100 meters. This allows a single reader to collect information from thousands of tags at once—even when they're in motion at speeds up to 100 miles an hour.
- They do not suffer from some of the problems currently afflicting passive tags. For example, in retail implementations, the radio signal of passive RFID transmits poorly through liquids and can be distorted by certain types of nearby metal objects.

The network will support a "nested visibility" concept, which allows the various elements of shipments to be monitored along the supply chain.

Each technology, of course, is still evolving. Passive tags may yet conquer some of their current problems. And active tags may yet come down in price, especially with higher volumes of usage.

The Infrastructure

The global information network will be built on an open architecture designed for active RFID, but will also accommodate other automatic identification data collection technologies, such as barcodes, passive RFID technologies—such as electronic product codes (EPC)—and global positioning systems used to track ships and trucks that transport ocean containers.

In fact, the network will support a "nested visibility" concept, which allows the various elements of shipments to be monitored along the supply chain. An example of nested visibility is illustrated by the association of cases tagged with passive RFID loaded in ocean containers that are tagged with active RFID.

Many suppliers participate in initiatives by retailers such as Wal-Mart and Target that require EPC passive RFID tags on cases and pallets. As these initiatives expand, more suppliers will find it economical to apply the passive RFID label to the case at the point of manufacturing (which is often outside the United States). When these cases are loaded into containers, a passive RFID reader records the contents of each container, transferring that information to the network software. Then an active tag will be attached to the container, which can be tracked by active RFID readers.

The network software will thus reflect the location and state of both the container and its contents, providing shippers with nested visibility through complementary technologies.

It's a logical extension of the internet to the real-world conditions of the supply chain, one that market analysts have been calling for. Goods flow worldwide; information flows worldwide. And because untimely and inaccurate information is not useful, this solution boosts the power of global information networks by ensuring the flow of information is directly linked to the physical flow of goods.

In addition to timeliness and accuracy, the solution provides an unprecedented level of granularity. In other words, it provides an audit trail of each container's journey. Where do dwell times, delays or damages take place? With specific data, you have a history that helps you better understand and improve upon these patterns.

Because active tags can record data based on certain triggers, you also gain information about what has happened to the container. The tag serves as an electronic seal that records tampering and unauthorized openings. Even more sophisticated, when linked with sensors, RFID tags can record environmental factors such as changes in vibration, light and temperature, or detect exposure to chemicals, radiation or biohazards.

Interview Responses

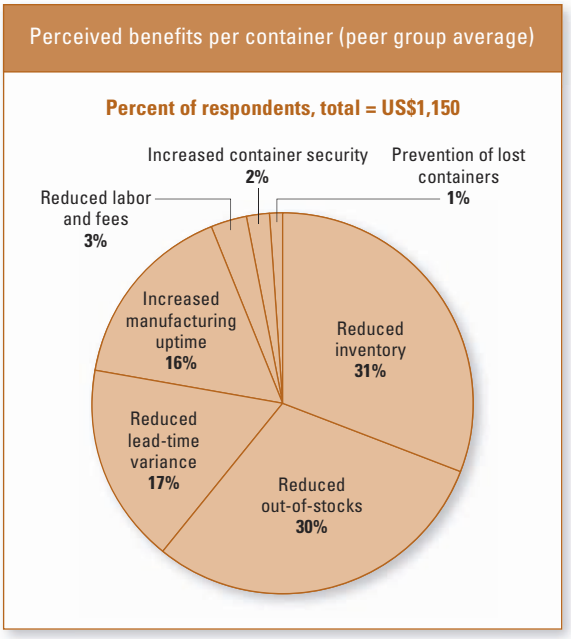
We discussed this proposed solution with our interviewees, asking them about its value proposition and potential impact. If you had this level of information—in a clean, untampered environment at this level of granularity—how would it impact your operation? We asked them to quantify these benefits, and figure 4 presents the results.

The figure shows that the total average benefit per container is about US$1,150, with most of that coming from the savings of tightening supply lines. For example, if a reader at the port of discharge indicates that a set of parts has just arrived and has been loaded onto a truck, the inventory manager can release those parts, knowing they are about to be replenished. He doesn't have to wait for the truck to arrive to see what's in it. The visibility into additional information allows him to reduce inventory levels. The reliability and timeliness of this information also allows companies to reduce out-of-stocks, minimize lead-time variance and increase manufacturing uptime—these four factors combine to provide 95 percent of the solution's benefits.

However, the relative importance of each factor depends on the industry and the company's business model. Indeed, we saw significant variance across companies. Respondents confirm that they have already been thinking considerably

Figure 4

What do respondents consider the benefits of RFID tracking?



Source: A.T. Kearney

about these issues. When asked about the probability of implementing this kind of technology at some time in the future, 57 percent indicate they would do so. As one retail transportation executive says, "Under our current system, there's a fair amount of distrust in data accuracy as much of it is entered by hand. We're currently very active in evaluating new technologies to improve efficiency in supply chain operations."

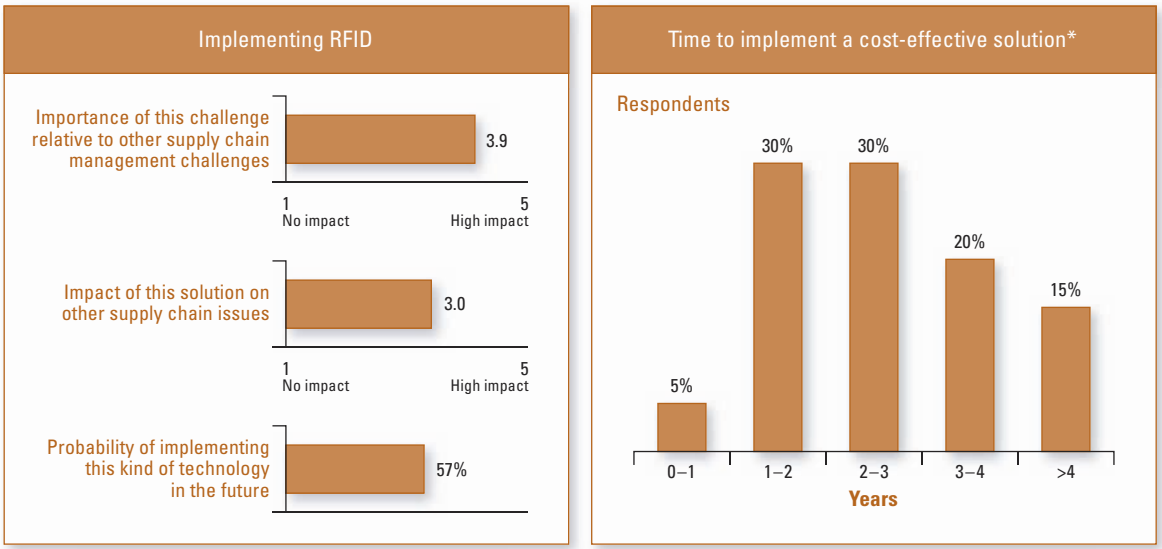
One-half of respondents say their implementation time frame is to have such a system up and running in two to four years *(see figure 5)*. Given that the implementation process (business case, pilot project, rollout) can take about 18 months, that means many companies are starting right now. Those on a slower implementation schedule note that their implementation might be accelerated by developments such as a terrorist event involving an intermodal container, a government mandate requiring certification of container integrity, or evidence that their supply chain performance is lagging behind their competitors'. Most expect a third party to provide the solution *(see sidebar: The Information Security Market)*.

The Government Perspective

We began the survey in fall 2004. A few months later, U.S. Customs and Border Protection (CBP) may have given a boost to the benefits of RFID. We joined with the International Cargo Security Council (ICSC) to further our research with some of its key members from the international shipping community.

Figures 1 and 3 show that assuring container security is the number one issue for the survey respondents, yet it contributes just 2 percent

Figure 5
RFID implementation



** Implementation time frame refers to developing the business case and conducting a pilot test.*
Source: A.T. Kearney

The Information Security Market

The survey establishes that importers and exporters are eager to address key issues regarding transparency and security in the over-ocean supply chain. But what will the market for such RFID solutions look like? We asked respondents for their preferences, and about what issues could serve as potential roadblocks.

Pricing. As the figure illustrates, most respondents (73 percent) prefer a transaction pricing model over a subscription model (18 percent, with 9 percent neutral). The transaction model allows the RFID tag to be applied to selected containers, such as those carrying high-value products, or traversing selected trade lanes, such as those with significant delays.

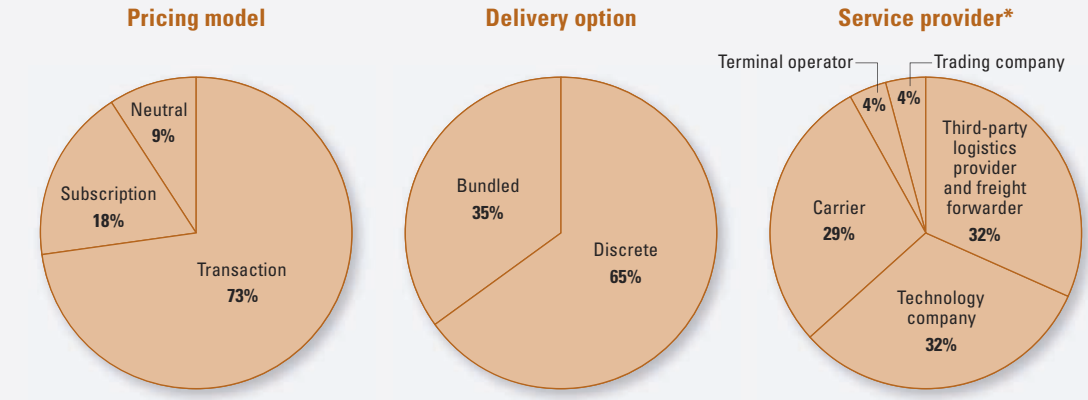
Delivery. The majority (65 percent) of respondents favor a discrete delivery preference—a stand-alone service purchased from a provider—rather than a bundled solution (35 percent). The bundled solution would include other consolidation, tracking, forwarding or customs services already purchased from a third party. In general, this response reflects the divide between companies that currently manage their interactions with shippers directly as opposed to those that employ third-party logistics providers (3PLs).

Providers. Companies that currently use third-party providers or freight forwarders will increasingly expect these independents to provide RFID solutions as part of their bundle. Several respondents note that such solutions would be a differentiator among 3PLs, and some even expect to include RFID requirements in their requests for proposals.

Roadblocks. Respondents identify several issues that have not yet been sufficiently addressed:

- **Reusable tags:** What happens to the RFID tag after the container is opened? Respondents do not want to manage an inventory of reusable tags, but will providers be willing to refurbish tags or develop cost-effective disposable tags?
- **Read rate reliability:** Respondents vehemently say that the RFID readers must have 99.9 percent reliability rates. Given the publicity surrounding reliability issues with passive tags, there is a perception among some that RFID technology as a whole is not yet sufficient to achieve this threshold. RFID is "a child that has to grow up," explains one chemical executive.
- **Data access:** While respondents like the clean capture of unadulterated data in an RFID solution, they see a challenge in ensuring consistency of data quality and timeliness—and funneling data from all those sites into their existing information technology systems.

Preferences for pricing models, delivery options and service providers



Source: A.T. Kearney

*Percentages are rounded

to the average benefit per container for this solution. Why? One reason is that it's difficult to build consensus on cost avoidance calculations. How do you measure the benefit of decreasing the likelihood of a terrorist event? Or, on a more mundane level, how do you measure the benefit of not having your containers slow down through customs—especially if you don't yet know exactly how customs officials will respond?

In late January 2005, CBP Commissioner Robert Bonner provided a clue to that response in announcing guidelines for the next level of the Customs-Trade Partnership Against Terrorism (C-TPAT). This next level, dubbed C-TPAT Plus, would provide "no inspection upon arrival—immediate release" for low-risk containers using technology that can automatically detect and record whether tampering has occurred with a container seal after being affixed at the point of origin. "Smart boxes" using RFID can meet this requirement.

Thus, on top of the US$1,150 average net benefit per container from improved efficiency, additional benefits are gained through this fast-track "green lane" qualification. These advantages establish a business case for enhancing security, which build on the business case for increased supply chain efficiency through increased visibility.

This type of RFID-based solution is not a government mandate—at least not yet. And some still think it will take a mandate to bring about wider adoption. But as noted earlier, several firms (especially those with high brand value) express an interest in going beyond CBP's minimum guidelines. When it comes to strengthening homeland security, the value of good corporate citizenship can be huge. Part of the value is that by taking a more active approach early on, you may preempt overly punitive government mandates later. And regulators may prefer market-driven provisions over restrictive mandates if industry players raise the bar on their own. In effect, that's what C-TPAT Plus is doing: achieving regulators' security goals by designing incentives that contribute to the business case for enhancing security.

As one high-tech logistics executive says, "We've been involved in several trials and expect to deploy this type of system within the next two years. The real incremental benefit is in the security feature."

When Will the New World Arrive?

Just a decade ago, consumers were reluctant to buy mobile phones because the coverage was too spotty. Most people agreed that great benefits would come once the infrastructure was fully set up, but until then, there was no need to hurry. Today, the mobile phone market is burgeoning and the people who have mobile phones far outnumber those who don't.

Setting up a global supply chain technology is structurally similar. And like the mobile phone market, it is quickly moving ahead. Because of government and industry initiatives, new interconnected global networks are steadily unfolding. Governments, port operators and others in industry are in the process of building a new infrastructure, with the promise of solving the key concerns of most logistics executives. All along the supply chain, economic security and physical security are directly linked. It now makes good business sense to improve security using RFID technology because of the associated benefits in operational and administrative efficiency.

Like port security, the over-ocean supply chain is suddenly the focus of a great deal of attention. But behind the headlines, and despite the spotlight, we find that most companies were already beginning to build a solid business case for deploying advanced technologies. Their goal: to solve the new-age issue of security and the age-old issues of reliability and efficiency.

A.T. Kearney is a global strategic management consulting firm known for helping clients gain lasting results through a unique combination of strategic insight and collaborative working style. The firm was established in 1926 to provide management advice concerning issues on the CEO's agenda. Today, we serve the largest global clients in all major industries. A.T. Kearney's offices are located in major business centers in 35 countries.

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