

The **Manufacturing Innovation** Series

Innovators in Supply Chain Security:

Better Security Drives Business Value

July 2006

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Foreword

On behalf of The Manufacturing Institute (institute)—the research and education arm of the National Association of Manufacturers (NAM)—and the IBM Corporation, we are pleased to present this new report, “Innovators in Supply Chain Security: Better Security Drives Business Value,” by Barchi Peleg-Gillai, Gauri Bhat and Lesley Sept of Stanford University.

This study is the latest in the institute’s “Innovation Series” and the third comprehensive report IBM has sponsored regarding supply chain security. In 2004, IBM partnered with Michigan State University to publish “Enhancing Security Throughout the Supply Chain” to help businesses better understand the threat to supply chains from disruptions. IBM partnered with the Massachusetts Institute of Technology (MIT) in 2005 to publish “Investing in Supply Chain Security: Collateral Benefits” that identified collateral, or indirect, benefits that companies may receive from security investments.

Recent global incidents such as acts of terrorism, natural disasters and energy shortages have exposed the vulnerability of supply chains to disruptions. Governments and many companies are aware of the potential impact to the global economy that disruptions in supply chains can cause and recognize the need to invest in security measures that will mitigate the risks to the global supply chain upon which business depends.

Companies traditionally find it challenging to justify security-related investments because they focus largely on the direct expenses and not on the collateral benefits (e.g., supply chain efficiency, improved customer satisfaction, improved inventory management, etc.) that may be realized. Limited research has been completed regarding the creation of collateral benefits from security investments. To fill this gap, the institute and Stanford University have conducted a study to confirm and quantify the magnitude of collateral benefits received by a select group of companies that are considered “innovators” in supply chain security in their industries such as chemicals, consumer goods, food, information technology, automotive parts and logistics service providers.

Although the results of this study should not be considered as representative of the industry average, the findings clearly indicate that significant business value accrues from supply chain security investments. The innovative companies participating in this study received the expected security benefits from their investments (e.g., reduced risk, less theft and pilferage, etc.), but also quantified numerous collateral benefits they received, such as:

- Higher supply chain visibility;
- Improved supply chain efficiency;
- Better customer satisfaction;
- Improved inventory management;
- Reduced cycle time and shipping time; and
- Cost reduction following the above-mentioned collateral benefits.

Additional work remains to be done, but we trust that the significant and numerous collateral business benefits quantified in this study will serve to encourage other companies and their trading partners to further invest in the security of the global supply chain we share.



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Robert W. Moffat, Jr.
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The Manufacturing Institute (institute)—the research and education arm of the National Association of Manufacturers (NAM)—partnered with Stanford University’s Global Supply Chain Management Forum (Forum) to develop this report. A generous grant from IBM and the active participation of several IBM executives made this insightful report possible.

We first want to thank the Forum team at Stanford which brought together their knowledge of the manufacturing and distribution supply chain to help shape the survey upon which this is based and then provided the analysis for the report: Director of Research Barchi Peleg-Gillai; Forum Co-Director Hau Lee; Assistant Director of the Forum Lesley Sept; and their Research Assistant Gauri Bhat. Their deep understanding of threats to business supply chains, patience and good judgment made it possible to proceed with this initiative expeditiously and professionally.

Several IBM executives and their teams gave generously of their time and expertise as well. Special thanks to Senior Vice President for Integrated Operations Bob Moffat, of IBM and a trustee of the institute, who set the gears in motion for developing this report in the first place. We thank him for his ongoing direction and support.

We also thank the representatives of all participating companies for the hours they spent completing the survey and providing us with further information regarding security initiatives taken by their respective organizations, as well as for providing us with further insights on the topic.

At the institute, we thank President Jerry Jasinowski for seeing the value of this report for all manufacturers and for encouraging us to pursue it. We also thank Vice President Bill Canis, who brought the manufacturing community views to bear in shaping the survey, identifying companies for the survey and managing this project at the institute’s end. We are grateful to the institute’s Vice President of Communications Laura Narvaiz for initiating the media program and promoting the report widely among the media.

Design kudos go to NAM Production Artist Ronni Hutchason, who designed this report and coordinated its printing, and to NAM Associate Director of Corporate Communications Kitty Brims for her many good edits and proofreading.

Executive Summary

Following terrorist attacks in recent years, firms have been taking multiple steps—either voluntarily or to meet mandated government regulations—to ensure safe transit of their goods across international borders. In parallel, natural disasters such as Hurricane Katrina, as well as many other unforeseen events such as product contamination and adulteration, shortages, border closings and strikes by ports, made firms more aware of the vulnerability of their supply chains, and encouraged them to seek ways to reduce risks of such unforeseeable situations and increase stability along their supply chain.

Some of the initiatives taken by the U.S. government to assess and minimize the risk involved in international transportation of goods, include, among others, the Container Security Initiative (CSI), the Customs-Trade Partnership Against Terrorism (C-TPAT), the Advanced Manifest Rule (AMR) and the Free and Secure Trade initiative (FAST). Other initiatives, which took place outside the United States, include the publication of the ISO/PAS 28000:2005 standard “Specification for security management systems for the supply chain” by the International Organization for Standardization (ISO); the development of the Framework of Standards to Secure and Facilitate Global Trade by members of the World Customs Organization (WCO); a series of measures that were presented by the European Commission to accelerate implementation of the WCO Framework, including the Authorized Economic Operator (AEO) program; as well as various initiatives that were taken by the World Trade Organization (WTO) to better facilitate trade.

In addition to these government activities, businesses are also proactively seeking ways to mitigate similar risks. For example, in order to achieve organizational resilience, some companies choose to increase flexibility of their operations (e.g., by using interchangeable or generic parts, cross-training employees, postponing differentiating process steps to a later point in the production process, or diversifying their supplier base and portfolio of locations) and/or to make changes in corporate culture (e.g., encourage continuous communication among informed employees, and empower employees to take necessary actions in the face of unexpected events). Other companies improve their facilities design to protect against infrastructure loss and enable faster recovery from natural disasters.

While these and other initiatives allow companies to maintain their level of operations and/or to reduce risks, they require significant levels of investment. Unfortunately, so far many organizations have found it difficult to provide a business case to justify security investments, and are therefore reluctant to invest in security beyond the minimum necessary. In our opinion, one of the main reasons for this reluctance is that companies have been focused largely on direct expenses related to security initiatives, and not on the collateral benefits that can be realized from such investments, such as:

- Higher supply chain visibility;
- Improved supply chain efficiency;
- Better customer satisfaction;
- Improved inventory management;
- Reduced cycle and shipping time; and
- Cost reduction following the above-mentioned collateral benefits.

In fact, when properly leveraged, investments in supply chain security may not only be offset to some extent by benefits such as the ones listed above but, in fact, can be outweighed by such benefits, and can overall have a positive impact on a company's bottom line.

To demonstrate this point, the Stanford Global Supply Chain Management Forum, together with The Manufacturing Institute and IBM, conducted the study summarized in this paper. The goal of the study was to help companies understand the business value of supply chain security investments by identifying collateral benefits security initiatives can bring to companies, and whenever possible quantifying the level of benefits that can be realized.

The study was based on inputs from 11 manufacturers and 3 Logistics Service Providers (LSPs) that are considered “innovators” in supply chain security, and clearly demonstrated that investments in supply chain security can provide business value.

Some of the more significant benefits participating manufacturers reported included the following:

- Improved product safety (e.g., 38 percent reduction in theft/loss/pilferage, 37 percent reduction in tampering);
- Improved inventory management (e.g., 14 percent reduction in excess inventory, 12 percent increase in reported on-time delivery);
- Improved supply chain visibility (e.g., 50 percent increase in access to supply chain data, 30 percent increase in timeliness of shipping information);
- Improved product handling (e.g., 43 percent increase in automated handling of goods);
- Process improvements (e.g., 30 percent reduction in process deviations);
- More efficient customs clearance process (e.g., 49 percent reduction in cargo delays, 48 percent reduction in cargo inspections/examinations);
- Speed improvements (e.g., 29 percent reduction in transit time, 28 percent reduction in delivery time window);
- Resilience (e.g., close to 30 percent reduction in problem identification time, response time to problems, and in problem resolution time); and
- Higher customer satisfaction (e.g., 26 percent reduction in customer attrition and 20 percent increase in number of new customers).

LSPs also reported a variety of collateral benefits they realized in each of the identified areas. For example, various security initiatives taken in particular lanes resulted in such benefits as 90 percent reduction in theft/loss/pilferage and in tampering, 50 percent reduction in damages, 75 percent reduction in inventory and 90 percent cost savings attributed to improved visibility for those particular lanes.

While the results of this study should not be considered as any type of industry average, they clearly demonstrate that in addition to lower risk and higher security, investments in supply chain security can provide significant business value to organizations by helping them to improve internal operations, strengthen relationship with their customers and increase their profitability. Therefore, we strongly urge companies not to consider security investments as a financial burden, but rather as investments that can have business justification, that can result in operational improvements, and that ultimately may promote cost reduction, higher revenue and growth.

It is important to remember that such benefits are not realized automatically. Companies need to be creative in determining ways—often times in collaboration with their business partners—to gain the most benefits from their security investments.

Introduction

The term 'supply chain' describes an overall process that results in goods being transported from the point of origin to their final destination and includes the movement of the goods, the shipping data and the associated processes as well as a series of dynamic relationships. International supply chains can involve many entities such as producers of the goods, logistics management firms, consolidators, truckers, railroads, air carriers, marine terminal operators, ocean carriers, cargo/mode/customs agents, financial and information services and buyers of the goods being shipped. If the imported goods are used for production, the associated supply chain may include—in addition to the purchase of goods and their transportation from the point of origin to the production facilities—the use of the goods in the production/assembly process, storage and shipment of the final products to distribution centers and ultimately to customers and end consumers.

Though 'supply chain disruptions' bring to mind man-made disasters like the terrorist attacks of 9/11 and natural disasters like Hurricane Katrina, these events seem to be only the tip of the iceberg. Supply chain disasters come in various forms—product contamination and adulteration, shortages, border closings, strikes by ports and a host of other problems that can cause disruptions in the supply chain. Adequately preparing for, and taking steps to minimize the impact of such unforeseeable situations is clearly important to the stability and well being of countries and businesses alike.

Terrorist attacks have revolutionized the way we trade. International trade is no longer just about moving goods quickly and cheaply. In this age of global terrorism, there is a third element: it's about moving goods quickly, efficiently and securely.¹ Firms are incurring new costs and adapting new technologies to ensure safe transit of their products across international borders. Some of the implications of the 9/11 events include an increase of 15 percent in airfreight costs², and an increase of 20 percent in the costs of commercial insurance premiums to about \$30 billion per year³. U.S. Customs and Border Protection (CBP) now requires a more detailed disclosure of information, sometimes well in advance of the goods entering the United States, and companies are required to make significant investments to enhance security throughout their supply chains in order to reduce screening of their imported cargo.

Similarly, Hurricane Katrina not only left thousands of people suffering, but also affected many firms financially, even those that did not have operations in the areas where the hurricane struck. The Gulf of Mexico region is an important energy hub and normally makes up a quarter of U.S. oil and gas production. However, due to damage to rigs and refineries caused by the hurricane, more than 91 percent of oil production and 83 percent of gas production in the region was shut down, and was not completely restored six months after Katrina: As of Feb. 28, 2006, daily gas production in the Gulf of Mexico has been restored to 85 percent and daily oil production has been restored to 76 percent⁴. These interruptions in production resulted in unprecedented spikes in prices for oil and natural gas. The soaring fuel prices had a substantial financial impact on the airline industry, which also suffered from significant loss of revenue due to the collapse of New Orleans' tourism and the cancellation of hundreds of daily flights to the area. Furthermore, Katrina laid waste the vital Gulf Coast ports, which are major gateways for U.S. agricultural exports, as well as for imports of such

¹ Bonner, Robert C. (2005), *Supply Chain Security in a New Business Environment Conference*, Miami, Fla., April 2005.

² Chandler, Charles (2002), "After 9/11: Supply Chain Implications in International Trade for U.S. Firms," *globalEDGE*, February 2002. http://globaleledge.msu.edu/NewsAndViews/views/papers/supply_chain_implications_international_trade.pdf

³ UBS Warburg, 2001.

⁴ Department of Homeland Security Web site; <http://www.dhs.gov/interweb/assetlibrary/katrina.htm>.

goods as steel, rubber, coffee and fresh fruit. Freight transport companies were estimated to be losing \$3 million to \$4 million a day while the ports were closed, and manufacturers who increasingly rely on the “just in time” provision of components saw disruption to their assembly lines⁵. In addition, Katrina caused an estimated \$38 billion to \$50 billion in private insured losses⁶. And so although such events seem impossible to predict and have a low likelihood of occurrence, given their significant impact on many sectors of the U.S. economy, ignoring them may be too high a risk to take.

The security challenges facing companies become apparent as global trade expands. More than 200 million containers are shipped between the world’s seaports annually⁷, with the United States receiving approximately 17,000 containers per day⁸. With increasing security concerns since 9/11 came the realization that physical inspection of all imported goods is untenable. In fact, as of 2004 only 6 percent of the containers imported to the U.S. were physically inspected⁹. Most companies and the government recognize the need to implement comprehensive and integrated end-to-end security that extends beyond asset protection. This has led to several initiatives on the part of the U.S. government to assess and minimize the risk involved in the transportation of goods. They include:

- The Advanced Manifest Rule (AMR)/Advance Cargo Information (ACI), instituted by U.S. CBP in conjunction with the Trade Act of 2002, and fully implemented in 99 percent of the ports by January 2005. It requires detailed cargo data for all modes to be submitted to U.S. CBP prior to arrival. An ocean container is allowed into the United States only if detailed contents information has been provided electronically to Customs at least 24 hours before the container is loaded on the ship at the foreign port of origin. The information is useful for pre-screening questionable containers prior to arrival to U.S. ports and for selecting containers for inspection at ports of departure and entry¹⁰.
- The Container Security Initiative (CSI). With the CSI, the U.S. government and more than 25 trading partner governments are pursuing supply chain security by pushing inspections and screening upstream to originating ports¹¹. This calls for pre-screening of containers coupled with fast tracking when the cargo reaches the U.S.¹².
- The Customs-Trade Partnership Against Terrorism (C-TPAT). C-TPAT was launched in November 2001 with the guiding principles of voluntary participation and jointly developed security criteria, best practices and implementation procedures. In exchange for the security investments they had made, C-TPAT partners receive “...reduced inspections at the port of arrival, expedited processing at the border, and other significant benefits, such as ‘front of line’ inspections and penalty mitigation.”¹³

⁵ Plummer, Robert (2005), “U.S. Counting the Cost of Katrina,” *BBC News*, September 1, 2005. <http://news.bbc.co.uk/1/hi/business/4204900.stm>

⁶ Hsu, Spencer S. (2006), “Insurers Retreat from Coasts,” *Washingtonpost.com*, April 30, 2006. <http://www.washingtonpost.com/wp-dyn/content/article/2006/04/29/AR2006042901364.html>

⁷ Closs, David J.; McGarrell, Edmund (2004), “Enhancing Security Throughout the Supply Chain,” *IBM Center for Business of Government*, April 2004.

⁸ Lee, Hau L. and S. Whang (2005), “Higher Supply Chain Security with Lower Cost: Lessons from Total Quality Management,” *Int. Journal of Production Economics*, Vol. 96, no. 3, pp. 289-300, June 2005.

⁹ U.S. Customs and Border Protection Web site (2004), “Cargo Container Security—U.S. Customs and Border Protection Reality,” October 2004.

¹⁰ Lee, Hau L. (2004), “Supply Chain Security—Are you Ready?,” *Stanford Global Supply Chain Management Forum*, GSCMF-W1-2004, September 2004.

¹¹ *Ibid.*

¹² Closs, David J.; McGarrell, Edmund (2004), “Enhancing Security Throughout the Supply Chain,” *IBM Center for Business of Government*, April 2004.

¹³ U.S. Customs and Border Protection (2006), “Supply Chain Security Best Practices Catalog,” pp. iii, January 2006.

- The Emergency Planning and Community Right-to-know Act (EPCRA). EPCRA was passed by the U.S. Congress in response to concerns regarding the environmental and safety hazards posed by the storage and handling of toxic chemicals¹⁴. Among other things, it requires detailed information regarding hazardous materials to be given to the people in the community¹⁵.
- The Free and Secure Trade (FAST) initiative. It allows low-risk goods transported by trusted drivers via trusted carriers for trusted firms to pass rapidly through border crossings while reserving inspection resources for unknown or high-risk shipments.
- The Smart and Secure Trade-lanes (SST) program. This initiative was established in October 2002 by the container shipping industry to ensure the security of cargo containers globally. SST's objective is to rapidly deploy a baseline infrastructure that provides real-time visibility, physical security through non-intrusive, automated inspection and detection alerts, as well as a complete audit trail of a container's journey from origin to final destination¹⁶. In May 2003, the International Organization for Standardization (ISO) formally became involved with the SST program to gain insight to set international supply chain security and visibility standards.

Multiple security initiatives are also taking place outside the U.S. One of them is the publication in 2005 of the ISO/PAS 28000:2005 standard, "Specification for security management systems for the supply chain" by the ISO. The standard outlines the requirements to enable an organization to establish, implement, maintain and improve a security management system, including those aspects critical to security assurance of the supply chain. These aspects include, but are not limited to, financing, manufacturing, information management and the facilities for packing, storing and transferring goods between modes of transport and locations¹⁷. In addition, the World Trade Organization (WTO) seeks to facilitate trade by moving controls and inspection to the export stage and through the sharing of uniform information among government agencies, firms, suppliers, carriers and customers.

The World Customs Organization (WCO), a Brussels-based consortium of 169 customs administrations, which represent 99 percent of global trade, promotes trade facilitation by developing and promoting guidelines to help customs administrations work together to promote rapid clearance of low-risk cross-border shipments, and has also been developing standard sets of customs data elements and guidelines for member countries to enable advanced electronic transmission of such data¹⁸. Specifically, WCO members have developed the Framework of Standards to Secure and Facilitate Global Trade (SAFE Framework), which outlines a strategy that aims to secure the movement of global trade in a way that does not impede but rather facilitates the movement of that trade¹⁹. By June 2006, a total of 135 countries have expressed their intention to implement the WCO SAFE Framework, including 25 member states in the European Union (E.U.)²⁰. In 2003, the E.U. launched a reform package for customs controls, which is designed, among other things, to ensure higher standards of security

¹⁴ U.S. Environmental Protection Agency Web site, "EPCRA Overview," February 2006.

http://www.cbp.gov/linkhandler/cgov/import/commercial_enforcement/ctpat/ctpat_best_practices.ctt/ctpat_best_practices.pdf

¹⁵ Sheffi, Yossi (2001), "Supply Chain Management under the Threat of International Terrorism," *International Journal of Logistics Management*, Vol. 12, No. 2, 2001.

¹⁶ Hudson, Scott (2006), "Smart and Secure Tradelanes (SST)," *Supply Chain Resource Consortium*, February 21, 2006. <http://scm.ncsu.edu/public/security/sec060221.html>

¹⁷ ISO Web site, <http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=41921>

¹⁸ Gillis, C. (2002), "Customs Agencies Turn Attention to Exports," *American Shipper*, pp. 10-13, August 2002.

¹⁹ World Customs Organization (2005), "Framework of Standards to Secure and Facilitate Global Trade," June 2005. <http://www.wcoomd.org/ie/en/press/wco%20-%20framework%20final%20en%2023-8.pdf>.

²⁰ WCO Web site, <http://www.scoomd.org/ie/En/en.html>, under "List of Members who have indicated their intention to implement the SAFE Framework of Standards."

while trying to ease import and export flows. As part of this initiative, the European Commission presented a series of measures to accelerate implementation of the WCO SAFE Framework security-related provisions, including the Authorized Economic Operator (AEO) program. The implementing provisions for this program are expected to be approved in 2006.

In addition to these government initiatives, businesses have also proactively been seeking ways to mitigate supply chain risks, where risk can be viewed as the frequency of a disaster happening times its consequence^{21,22}. To achieve organizational resilience—the ability to successfully confront the unforeseen and quickly bounce back from a large disruption—some companies took steps to increase flexibility of their operations, and/or made changes in corporate culture²³. Means to increase flexibility include the use of interchangeable and generic parts in many products, relying on similar or identical plant design and processes across the company, and postponement of differentiating process steps and cross-training employees. Keeping products in semi-finished “vanilla” form provides flexibility to move products from surplus to deficit areas, and to better fill customer demand. To avoid potential disruptions in the flow of incoming goods, some companies modified their procurement strategy. The preferred solution, however, differs from company to company—some companies prefer to rely on a small group of key suppliers and develop an intimate relationship with each of them, in order to better detect potential problems; while others prefer to diversify their supplier base to distribute the risk. In addition to diversified supplier base, companies are trying to gain flexibility by diversifying their portfolio of locations²⁴ and distribution systems.

Corporate culture is a key factor in determining the duration and costs associated with a recovery after a major supply chain disruption²⁵. Some key ingredients of successful corporate cultures include continuous communication among informed employees—which helps employees make better decisions in the face of unforeseen disruptions; distributed power, so that teams and individuals are empowered to take necessary actions; and passion for work, based on employees’ understanding of the importance of their work, which encourages them to be creative in finding ways to overcome unexpected disruptions. Various managerial articles point out the shared cultural traits between resilient organizations such as Dell and UPS²⁶, and the importance of management commitment to security measures²⁷.

In addition to increasing flexibility and changing corporate culture, companies have also been improving their facilities design to protect against infrastructure loss and enable faster recovery from natural disasters²⁸. Another way that companies have thought to improve their freight security is through the establishment of the Technology Asset Protection Association (TAPA), which was founded in the United States in 1997 and now has chapters in Europe and the Asia Pacific. TAPA was formed by several high-technology companies that sought to establish consistent Freight Security Requirements (FSRs) that could be implemented across the industry. Today, TAPA also provides its members a common, centrally located and continually updated pool of information related to criminal activities.

²¹ Stauffer, David (2003), “Supply Chain Risk: Deal With It,” Harvard Business School *Working Knowledge* Newsletter, April 2003, <http://hbswk.hbs.edu/pubitem.jhtml?id=3442&t=operations>

²² Stauffer, David (2003), “Risk: The Weak Link in Your Supply Chain,” *Harvard Management Update*.

²³ Sheffi, Yossi (2005), “Building a Resilient Supply Chain,” *Harvard Business Review*, Vol. 1, No. 8, October 2005.

²⁴ Bovet, David (2005), “Balancing Global Risk and Return,” *Supply Chain Strategy*, Vol. 1, No. 3, August 2005.

²⁵ Sheffi, Yossi (2005).

²⁶ Byrnes, Jonathan (2005), “Learning to Manage Complexity,” Harvard Business School *Working Knowledge* Newsletter, November 2005. <http://hbswk.hbs.edu/item.jhtml?id=5079&t=dispatch>

²⁷ Case, John (2002), “Supply Chains are Tighter but There’s Still Too Much Slack,” *Harvard Management Update*, April 1, 2002.

²⁸ Harrison, Keith and Cath Malseed (2006), “Forces of Business or Forces of Nature: Building an Agile Supply Network,” *AMR Supply Chain Executive Conference*, June 1, 2006.

Another source of risk for companies, especially those that make extensive use of global sourcing, are longer lead times and extended delays due to tighter security procedures for imported goods. While they have little control on the actual duration of such delays, companies can prepare for these delays by incorporating them into their forecasting cycles. For example, when GM experienced an increase in the average delay time from one hour to three hours for parts that arrive from its Canadian plants, it factored this change into its forecasts.

With intensifying competition in the marketplace and continuous pressure from shareholders to maintain profitability, companies now cannot afford to miss a single product cycle and blunt their competitive edge. The overarching concern to maintain production capabilities and be able to meet customer needs in the face of disasters drives investments in security measures. A private-sector analysis conducted by the International Monetary Fund (IMF) estimates the increase to business costs due to higher security costs at \$1.6 billion per year, the extra financing burden of carrying 10 percent higher inventories at \$7.5 billion per year²⁹. Another study estimates an increase in commercial insurance premiums of 20 percent at about \$30 billion per year³⁰. New security measures following 9/11 are estimated to cost the U.S. economy alone more than \$150 billion, of which \$65 billion is for changes in supply chains^{31,32}. Companies differ greatly in their expectations of returns on their investments in new security technologies, from 100 percent incremental in one year to 100 percent in three years³³. In general, there has been no consensus on the returns and how to quantify them, making it more difficult to formulate a business case for such investments. To date no formal study that we are aware of has been conducted to quantify these returns.

Based on inputs provided to us by companies that participated in the study summarized in this paper, it can be concluded that companies have been investing more in security in recent years, either to comply with trade initiatives mandated by the government, or in an effort to reduce risk through voluntary initiatives. While these initiatives allow companies to maintain their level of operations and/or to reduce risks, they require significant levels of investments. Unfortunately, so far many organizations have found it difficult to provide a business case to justify the required levels of investment. One of the main reasons for this reluctance to invest in security is that companies have been focused largely on direct expenses related to security initiatives, and not on the collateral benefits that can be realized from investments, such as:

- Higher supply chain visibility;
- Improved supply chain efficiency;
- Better customer satisfaction;
- Improved inventory management;
- Reduced cycle and shipping time; and
- Cost reduction related to the above-mentioned collateral benefits.

Most of the existing literature and studies conducted to date have not been very helpful in explaining and quantifying the potential positive impact of security investments on business performance.

²⁹ IMF Web site, "World Economic Outlook: The Global Economy After September 11," December 2001. <http://www.imf.org/external/pubs/ft/weo/2001/03>

³⁰ UBS Warburg, 2001.

³¹ Bernasek, A. (2002), "The friction economy: American businesses just got the bill for the terrorist attacks: \$151 billion a year," *Fortune*, Vol. 145, No. 4, pp. 104-110.

³² Damas, P. (2001), "Supply Chains at War," *American Shipper*, November 2001, pp. 17-18.

³³ Lee, Hau L. (2004), "Supply Chain Security—Are you Ready?," *Stanford Global Supply Chain Management Forum*, GSCMF-W1-2004, September 2004.

A report completed recently by Rice and Spayd³⁴ discusses security initiatives such as collaboration among supply chain parties, building organizational awareness and proactively investing in technology, that have shown promise to create collateral benefits. This report highlighted the need for additional research to quantify the relationship between investments in security and improved business performance. Our study, summarized in this paper, aims to close this gap, identify collateral benefits companies can potentially realize, and whenever possible, quantify the level of benefits that can be realized based on the experience of leading organizations in the industry.

The remainder of the paper is organized as follows. The Methodology section provides an overview of how we developed the study. Sections on Manufacturers and Logistics Service Providers summarize the findings of our study. They describe the type of security initiatives taken by these industries, as well as the collateral benefits they have realized as a result. Finally, there is a Summary and Conclusions section.

³⁴ Rice, James B. and Philip W. Spayd (2005), "Investing in supply chain security: collateral benefits," IBM Center for The Business of Government, *Special report series*, May 2005. <http://www-03.ibm.com/industries/government/doc/content/bin/RiceReport.pdf>

Methodology

As a first step, the areas that organizations can expect to be improved once enhanced supply chain security initiatives are put in place were identified, based on information available in the literature combined with the knowledge and experience of the team members. Five such areas of improvement were identified:

- Inventory Management and Customer Service;
- Visibility;
- Efficiency;
- Resilience; and
- Customer Relationships.

Next, we constructed a detailed list of potential benefits for each of the identified areas of improvement. For example, under Inventory Management and Customer Service, such benefits as reduction in incorrect quantity received, reduction in excess inventory, reduction in defective products delivered, reduction in counterfeiting and reduction in theft/loss/pilferage were included. Based on the list of potential benefits, a questionnaire was prepared, which lists all the identified potential benefits and asks respondents to state for each of these benefits whether their company has realized such a benefit following their supply chain security investments, and if so, what magnitude of improvement they experienced. In addition, respondents were asked to describe the supply chain security initiatives that their company has implemented over the years. For a copy of the questionnaire and a complete list of all identified benefits, please see the Appendix.

In parallel to developing the questionnaire, the project team selected a small number of companies that are considered “innovators” in the efforts they are making to strengthen the security of their own supply chain to participate in the study. Our hope was that based on the experience of these innovative companies, the study would demonstrate the potential business benefits of security investments, and in doing so would help other companies to identify ways in which they can use their security investments to improve their business performance.

We set a goal of recruiting a total of 10-15 companies to take part in the study. Such a number was sufficiently small to allow us to study in detail each of the companies’ security initiatives and the benefits they have realized, but at the same time was large enough so that we could still obtain a relatively wide range of responses. We were successful in recruiting 11 manufacturers and 3 ocean carriers/logistics service providers.

The participating manufacturers came from a wide variety of industries, including chemicals, consumer electronics, consumer goods, engines and motors, food, information technology, semiconductors, software, toys, automotive parts, and industrial and commercial process controls. Each of the participating companies received a copy of the questionnaire, which they were asked to complete and return. Once the written responses were received, we conducted a follow-up phone interview with each company, to discuss in detail their responses, and to gain a better understanding of the relationship between the security initiatives that were taken and the benefits that were realized.

The next step in the study was analysis of the data collected from the participating companies. We conducted both a quantitative and a qualitative analysis, to determine the most common types of benefits realized by companies, their magnitude, and if possible—which of the security initiatives contributed to the realized benefits. The quantitative analysis focused on the percent improvement

rather than on the dollar value of the benefits realized. There were two reasons for this approach; first, companies in general are reluctant to disclose the dollar value of any investments and cost savings realized. A second, and more important reason, is that we felt that presenting the improvements as a percentage will be of more value to other organizations—which may vary greatly in their size and business volume—when trying to estimate the business value of security initiatives for their companies based on the findings of this study. It is important to note that due to the relatively small number of companies that participated in the study, and due to the wide range of industries they represent, the results should not be considered as representative of a “typical company” or as an industry average. The information received from the participating companies, as well as the results of the data analysis, is summarized in the Manufacturers and Logistics Service Providers sections.

Manufacturers

Overview of Security Initiatives

The participating manufacturers consisted of a wide variety of companies, each of which had different motives for implementing supply chain security measures. Many of the companies interviewed were pioneers in supply chain management within their respective industries and had already implemented various initiatives that strengthened the security of their supply chains for a long time.

Some of these companies implemented those initiatives specifically to strengthen the security of their supply chains. For example, companies that operate in the high-tech industry often times manufacture goods characterized by a small size and high value. Such goods are a likely target for theft, and so it has traditionally been essential for these companies to secure the goods to prevent theft and consequent sale in the black market, as well as to prevent diversion of products to the gray market.

Similarly, software companies are likely to face a problem of piracy. To mitigate this problem, one of the participating companies has been taking multiple steps that focus on identifying bogus products and protecting genuine products, such as the development and deployment of built-in anti-piracy features and activation procedures for new software owners. In addition, they reassessed their vendors to ensure their reliability and that they are not taking advantage of their access to the company's software products to resell them in the black market.

Other frequent targets of theft are fast-moving consumer goods manufacturers. Hence, one of the participating companies has had in place for many years various physical site security mechanisms, such as fencing, ID badges, access limitations, etc. For different reasons, chemicals companies—especially those that deal with hazardous and flammable materials, also invest heavily in physical site security, personnel security, as well as cargo and transportation equipment security controls.

Other companies implemented various measures that were intended to improve their business performance and only later realized that as a byproduct the security of their supply chain had been improved as well. For example, one company told us that because of the large number of carriers they have been working with, they decided to implement a track and trace tool, to provide them with more visibility about their goods while in transport. While the motivation for putting this tool in place was to gain such benefits as reduced inventories, improved on-time deliveries and fewer incidents of stockouts, as a byproduct, the track and trace capabilities also improved the security of their supply chain.

All the companies that participated in the study took further security-related initiatives following 9/11. These initiatives included measures that were taken to comply with government regulations (such as various security and safety regulations imposed by the U.S. Department of Transportation), and participation in voluntary government and industry security initiatives, such as the U.S. C-TPAT and the Canada Partners in Protection (PIP) security initiative. Complying with such voluntary initiatives was important for the manufacturing companies in order to prevent delays due to higher inspection rates and to speed up the clearance process for imported goods at the ports of entry, as pointed out by many of the companies that participated in this study.

In addition, many companies decided in the last few years to take voluntary steps to enhance security within the four walls of their organizations. The companies that participated in our study mentioned a variety of such initiatives, ranging from personnel background checks and advanced training programs

for all employees, to changes made to the packaging of the products and the implementation of container sealing standard procedures to ensure lesser instances of break-ins. One company mentioned the development and deployment of a Risk Assessment tool to quantify and address unacceptable risks in the supply chain, as well as an Expected Loss forecast tool that analyzes historic losses and predicts future losses, so as to help the company to set realistic goals to mitigate risk. Another company started to attend various conferences to learn about best practices related to security, and figure out how their own security practices can be improved.

To minimize disruptions along the supply chain, in addition to security initiatives taken within the four walls of the organizations, companies have also been working with their business partners to improve the security of their operations. For example, one of the participating companies mentioned that they now place more explicit requirements on their suppliers, and list those requirements in detail in their contracts. Another company has adopted the TAPA freight security requirements as minimum security standards in supplier contracts. Yet other companies mentioned development and usage of a risk assessment model to select, qualify and evaluate their suppliers. As for downstream security, a certain chemicals manufacturer mentioned the development and adoption of a customer screening and qualification process for security-sensitive products.

In terms of internal organization, several companies decided to form special security teams to identify ways to address current and future supply chain vulnerabilities, and to set up security standards for internal operations as well as for co-manufacturers, suppliers and logistics service providers. Those standards could be procedural, physical security standards, or contractual language that holds the suppliers to a standard. Often times, the security teams were established as a central operations organization, which is chartered to work across all regions and all lines of business. However, in large and diverse organizations it is likely that different divisions may also initiate independently separate security projects and procedures.

Several companies mentioned other government acts such as Sarbanes-Oxley, which are not directly supply chain-related, but require companies to be more vigilant in those matters.

As for the costs associated with supply chain security measures, some companies explained that given the numerous security initiatives that they have taken over the years, they were required later to make only a few changes to their security practices in order to comply with post-9/11 regulations and voluntary security initiatives such as those mentioned earlier. In contrast, other companies reported that they still had to significantly increase their security-related expenditures in recent years. These companies cited an increase in annual security-related expenditures of up to 50 percent compared to five years ago, and are expecting this level of investment to be maintained or to further increase in the near future.

Overview of Collateral Benefits

This section summarizes the collateral benefits—that is, other benefits in addition to improved security—participating manufacturers derived from their security investments. While the majority of the companies reported a wide range of benefits, three of the participating companies explained that since they already had robust security systems in place for many years, and/or have taken over the years numerous steps to improve the efficiency of their internal operations, they could report very few collateral benefits following the adoption in recent years of government regulations or voluntary initiatives.

One of these companies already had a robust security system in place for at least 10 years, and so hasn't experienced any fundamental shift in its security practices or in the impact they had on its business following 9/11. The major benefits they could report as a result of their C-TPAT certification were fewer and less intrusive inspections at the ports, which also provided less opportunity for damage to the imported goods. Two other companies pointed out that most of the benefit areas investigated in the study have been a subject of long-established company practice for efficient business processes. Therefore, obtaining the C-TPAT certification did not result in sizable cost savings because most of the major process obstacles had already been improved by that time. The benefits they have cited are "Front of Line" priority inspection, as well as the ability to join the FAST program, where C-TPAT is a prerequisite. In addition, one of these two companies mentioned that they expect the C-TPAT implementation to heighten security awareness throughout the company, and to consequently result in a better terrorist security incident reporting.

The remainder of this section describes the benefits reported by the other eight participating manufacturers. The discussion is organized by the five benefits sections in the questionnaire.

Inventory Management and Customer Service

Participating companies reported a number of improvements in their inventory management practices due to their security investments, which also had a positive impact on the service provided to their customers:

- **INTERNAL INVENTORY MANAGEMENT OPERATIONS:** In the receiving process of incoming material, 38 percent of companies reported a reduction in incorrect quantity received. In addition, 38 percent of companies were able to reduce their inventory levels, and all of these companies expect to see further reduction in inventory in the future.
- **PRODUCT SAFETY/GENUINENESS:** Better security practices allowed the companies to be more successful in protecting their products; 75 percent of companies reported a reduction in theft/loss/pilferage; 50 percent of companies saw a reduction in tampering; and 25 percent of companies were able to reduce the magnitude of damage to their goods. Furthermore, 38 percent of companies were successful in reducing the magnitude of fraud, while 25 percent were successful in reducing the magnitude of counterfeiting.
- **CUSTOMER SERVICE:** Service level to customers was improved in a number of ways; 38 percent of companies improved their reported on-time deliveries. In addition, 13 percent of companies reported an increase in item fill-rate and a reduction in each of the following areas:
 - the number of back-orders;
 - the frequency of cancelled orders; and
 - defective products delivered.
- **COST SAVINGS:** 38 percent of companies reported cost savings associated with improved inventory management, but only one of them was able to quantify those benefits, and estimated a 5-10 percent cost savings.

Charts 1a and 1b show the average percent improvement related to inventory management and customer service, based on data provided by those companies that were able to quantify the magnitude of benefits they realized (not all companies that reported benefits were able to quantify them). Based on Chart 1a, the most significant levels of improvements were related to theft/loss/pilferage (38 percent) and tampering (37 percent), which is logical since these benefits

are most closely related to security investments. Also impressive are the 14 percent reduction in excess inventory and the 12 percent further expected reduction in inventory, which—depending on the size of the company and their average inventory levels—can have a significant impact on the bottom line.

Chart 1a: Benefits Related to Inventory Management & Customer Service (Part I)

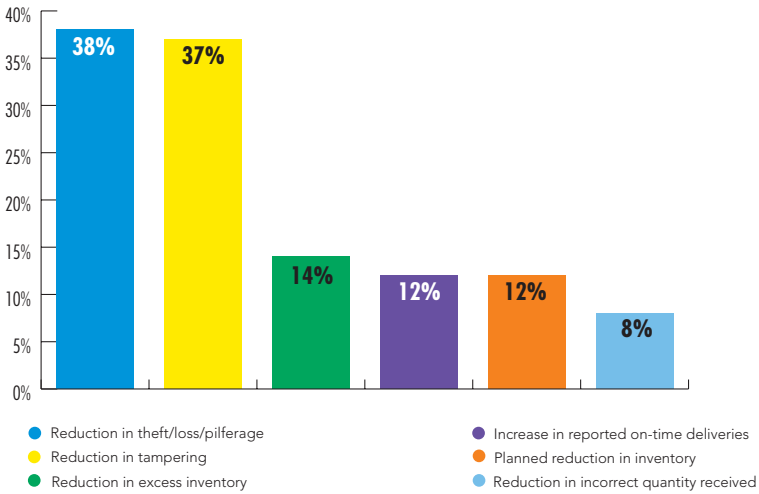


Chart 1b: Benefits Related to Inventory Management & Customer Service (Part II)



There are various ways in which companies were able to realize the benefits summarized earlier. For example, with the security standards one of the companies put in place they now receive in advance for most of the raw material arriving at their production facilities such information as its expected time of arrival, expected quantity and ordering party. This information allows them to control the ordering and receiving processes more tightly, and to better manage their inventory. In addition, this company keeps track of the materials until they are used in the production process, which helps them to ensure that the materials cannot be tampered with or changed. A few companies have set up standards for inspection of security and integrity of the material when it arrives at their facilities, before use, which help reduce fraud and tampering.

Another company experienced hijacking of high-value products, which were later sold in the black market. To counter this problem, the company made a number of investments in security, such as the use of Global Positioning System (GPS) and Radio Frequency Identification (RFID) to keep track of containers and trucks, use of locks and high-security bolt seals on containers, driver background checks, use of driver teams rather than a single driver and use of two-way cellular/satellite communications. These investments were extremely successful, resulting in complete elimination (100 percent decrease) of theft.

A software manufacturer has set up hotlines to keep track of customers calling in about counterfeiting, which helps it get some intelligence about errant suppliers. Its Web site also has a link about how to tell if your product is genuine or not.

One of the other participating companies mentioned that by having a more robust process for transferring product through land ports, and by following their container consolidation program, they were able to solidify the process and gain more consistency, which resulted in significant reduction in inventory.

Nearly all the companies interviewed faced a problem of tampering, and pointed out that it was labor intensive to inspect every container. Of the companies surveyed, 50 percent saw improvements after taking measures such as replacing tamper-evident seals with very strong high-security cable seals that require a special tool for removal. Certain companies changed the packaging to avoid misuse of the contents, and to also deter the introduction of unauthorized objects into the package.

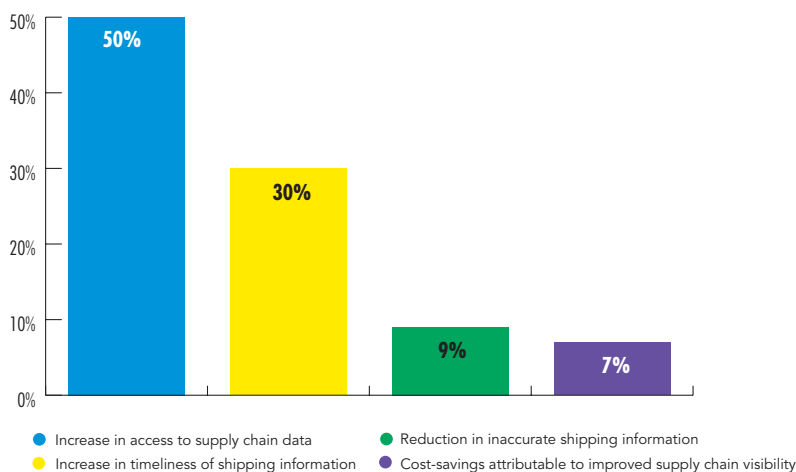
Visibility

Following their investments in supply chain security, all interviewed companies were able to improve their visibility to the location and condition of their goods as they move along the supply chain. In particular, the following benefits were reported:

- **ACCESS TO DATA:** 75 percent of companies improved their accessibility to supply chain data.
- **TIMELINESS OF DATA:** 100 percent of companies reported an improvement in the timeliness of shipping information.
- **DATA ACCURACY:** 63 percent of companies reduced inaccuracies in shipping information.
- **COST SAVINGS:** 75 percent of companies realized cost savings that they can attribute to improved supply chain visibility. Two of these companies were able to quantify these savings, and reported an average savings of 7 percent.

Chart 2 shows the average percent improvement in visibility based on data provided by several of the participating companies. Clearly, the most significant benefits companies saw were in access to supply chain data (50 percent improvement) and in timeliness of shipping information (30 percent improvement).

Chart 2: Benefits Related to Visibility



Several companies cited the 24-hour advance manifest regulation, which was instituted by U.S. CBP in conjunction with the Trade Act of 2002 and requires transmission of certain cargo data to U.S. CBP 24 hours before the cargo is laden aboard a ship bound for the United States at a foreign port, as one of the drivers for improved timeliness of shipping information. For example, one of the participants said that in the past they were lucky if all documentation arrived at the docks two days ahead of time. Now all documentation arrives five days before a ship docks, thus resulting in more than a 50 percent increase in timeliness of information. Another company was able to gain 5-10 percent improvement in both timeliness and accuracy of shipping information following their joining the C-TPAT program.

In addition to government initiatives, other voluntary steps taken by different companies helped them to improve visibility. One company has implemented RFID and/or GPS systems to keep track of rail-cars, truck and container locations. The information is updated hourly, resulting in a 90-100 percent improvement in both access to supply chain data and in timeliness of shipping information.

A second company implemented an Information Technology (IT) visibility tool, which allows them to share information electronically with their third-party logistics providers and suppliers. With this tool, the company was able to tremendously improve its visibility and the timeliness of the information it receives. In addition, it helped them to detect data inaccuracies earlier in the process. Once this solution is implemented across all divisions of the company, they expect total ocean shipping costs to drop by 30-50 percent.

A third company put together a design and transportation security team, which is concerned, among other things, with improving accessibility to information. Consequently, this company was able to gain significant improvements in all the visibility areas listed in our questionnaire.

A track and trace system implemented by another company provided them with complete visibility to the location of ocean containers. This capability is viewed as a significant plus, as it allows the company to know its containers are not sitting in unsecured areas, are not “off course,” are moving without unexplained delays, etc. With these capabilities they were able to achieve more “bottom-line” results, in addition to ensuring a secure supply chain.

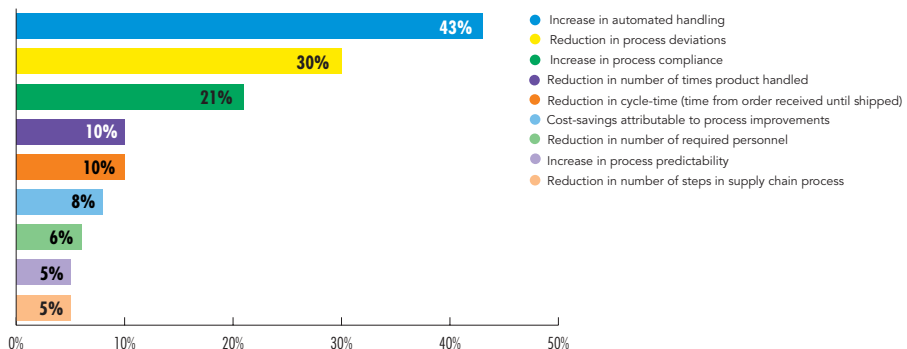
Efficiency

The Efficiency section in the survey focused on both process improvements as well as improvements in transportation and in the customs clearance process. Participating companies reported the following efficiency-related improvements as a result of their security investments:

- **IMPROVED PRODUCT HANDLING:** 38 percent of companies increased automated product handling, while 25 percent of companies reduced the number of times a product is handled. Such improvements are likely to lower the number of working hours required for these activities, and to reduce the chances for errors in the process or damage to the goods.
- **PROCESS IMPROVEMENTS:** Companies reported multiple improvements in their processes. 75 percent of companies increased process compliance, 50 percent were able to reduce process deviations, and 25 percent saw an increase in process predictability. Furthermore, 50 percent of companies reduced the number of steps in their supply chain process, while 38 percent of companies were able to reduce cycle time (measured as the time from order receipt until it is shipped), which is likely to result in higher customer satisfaction in addition to internal benefits.
- **REQUIRED PERSONNEL:** 25 percent of companies reported a reduction in required personnel.
- **COST SAVINGS:** 38 percent of companies reported cost savings that can be attributed to process improvements. One of these companies was able to quantify them, and reported 5-10 percent cost savings.

Chart 3a shows the average efficiency benefits related to process improvement based on data provided by several of the participating companies. The most significant reported improvements are in automated handling (43 percent improvement), in process deviations (30 percent improvement) and in process compliance (21 percent improvement).

Chart 3a: Efficiency Benefits Related to Process Improvement



One of the most significant improvements in this area was realized by a company that adopted an RFID solution to track cargo container export shipments and railcar shipments within the United States. With this solution in place, the company was able to automate a process that was previously extremely labor intensive, thus increasing automated data handling by 80 percent. Consequently, human data entry errors were eliminated, which significantly reduced process deviations and increased process compliance.

Similarly, another participating company pointed out that security technology they brought into their production and distribution processes, such as RFID tagging and certain anti-counterfeiting measures they put into their products and packaging, helped them to improve their internal processes in a number of ways, increase automation, and reduce the number of required personnel. These improvements also resulted in quantifiable cost-savings.

Other companies were able to reduce process deviations and increase process compliance by establishing global testing practices to ensure compliance to global requirements, and by working more closely with their suppliers on these issues.

As for efficiency improvements related to transportation and the customs clearance process, the following benefits were mentioned by the companies that took part in our study:

- **CARGO INSPECTION AND CUSTOMS CLEARANCE:** Most companies saw improvements in this area, with some of these improvements reaching very significant levels. 88 percent of companies saw a reduction in cargo inspection, while 63 percent experienced a reduction in inspection delays and 38 percent of companies improved the predictability of these inspections. In addition to fewer inspections, the ones that took place seemed to be less extensive, which is one of the reasons for the reduction in time it takes to clear customs reported by 63 percent of companies.
- **SPEED IMPROVEMENT:** 50 percent of companies reduced the delivery time window, and/or saw a reduction in the duration and/or variance of transit time, while 38 percent of companies experienced fewer shipping delays. In addition, 13 percent of companies reported a reduction in lead-time, from activity initiation to completion.
- **COST SAVINGS:** 50 percent of companies reported cost savings that they could attribute to speed improvement at the ports of entry and in transportation. One of the companies was able to quantify these benefits, and provided an estimate of 10 percent cost reduction.

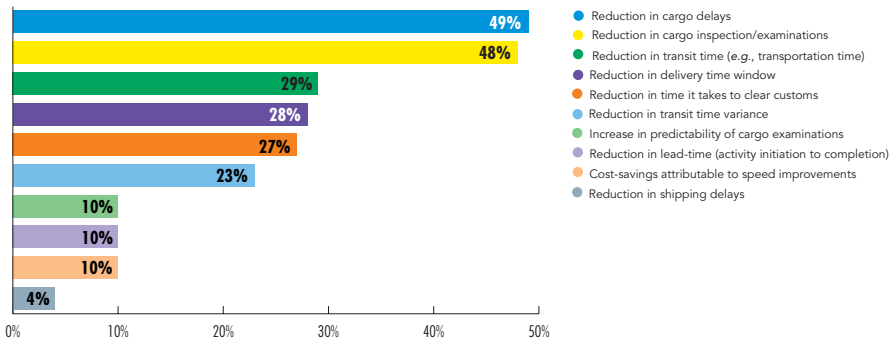
Chart 3b shows the average efficiency benefits related to speed improvement based on data provided by participating companies. The most significant improvements were in the number of cargo inspections and the level of delays associated with these inspections (48 percent and 49 percent improvement, respectively).

Following their participation in the C-TPAT program, nearly all companies experienced a reduction in the total number of cargo inspections, and in the number of intrusive/intensive inspections. In addition, for some of these companies it became easier to predict the number of inspected containers. The level of these improvements, however, varied widely: some companies saw the number of inspections drop in 2005 by 85-90 percent, and one company even reported zero inspections in that year, while other companies reported only a 5-10 percent reduction in the number of inspections. These differences may be explained, among other things, by such factors as the type and origin of the imported goods, and different status of the importing companies (some of them have a low-risk importer status).

The improvements in the number and intensity of cargo inspections, combined with the qualification many of the companies have received for the FAST program, also had a positive impact on transit

time and shipping delays. Other initiatives taken by the different companies further improved total transit time. For example, the RFID-based tracking solution implemented by one of the companies provided them with greater visibility throughout the supply chain and enhanced their ability to identify and resolve transit problems, thus reducing both the average duration and the variance of transit time. Another company mentioned that their move to start having consolidated containers, as opposed to having partial loads waiting at yards to be consolidated by the shipping company, was the main driver for the reduction they realized in transit time and variance as well as in delivery time window.

Chart 3b: Benefits Related to Speed Improvement



Resilience

This section of the survey studied the relationship between the security measures taken by the different companies and their ability to identify, respond to and resolve problems—especially problems that are related to breaches in security or to delays and other issues companies may face while their goods are in transportation. Many companies saw improvements in this area, as summarized below:

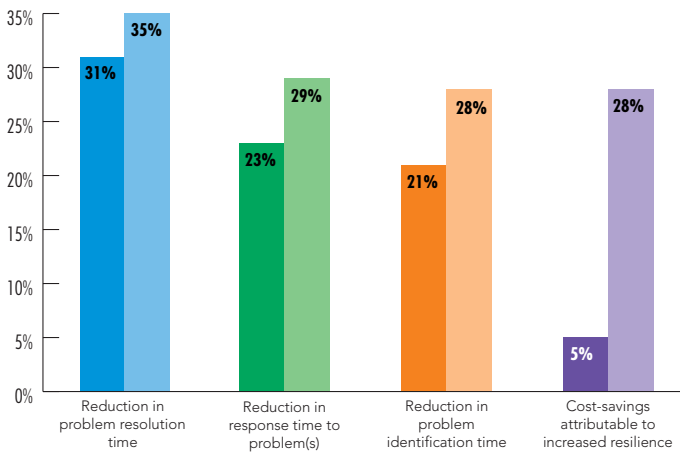
- **RESILIENCE—ACTUAL BENEFITS:** 63 percent of companies reduced the problem identification time, while 50 percent of companies reduced response time to a problem and 38 percent shortened problem resolution time. One company was able to tie these improvements to actual cost savings.
- **RESILIENCE—EXPECTED BENEFITS:** All the companies that saw some benefits in this area expect to see further improvements in the future; 63 percent of companies expect to see a reduction in problem identification time and in response time to problems, while 50 percent of companies expect to reduce problem resolution time. Thirty-eight percent of companies expect to realize cost savings that can be attributed to these improvements.

Chart 4 shows the actual and expected resilience-related benefits based on data provided by several of the participating companies. Most of these improvements are quite significant, ranging from 20-35 percent.

The benefits reported are mostly a result of voluntary initiatives taken by the companies. For example, one of the companies implemented several years ago a major security incidence protocol which applies to high-value theft. With tighter reporting and continued enforcement, they have seen a reduction in the number of and response time to such problems. By using an advanced tracking

system, another company gained improved visibility to the goods in transit, which allowed it to identify problems, respond to them and reach a resolution much faster. A third company put in place a dedicated team that focused on various transit issues. Consequently, while in the past they could start responding to a problem only after it occurred, now this team is proactively looking at bottlenecks and potential problem areas, and determining possible ways to resolve these problems before they happen. Also, being aware of the potential problem areas helps them to identify problems much faster. One of the other participating companies mentioned that an educational program they put in place, which encourages all employees to report anything that looks unusual, is helping them to identify existing or potential problems and take steps to mitigate them.

Chart 4: Benefits Related to Resilience



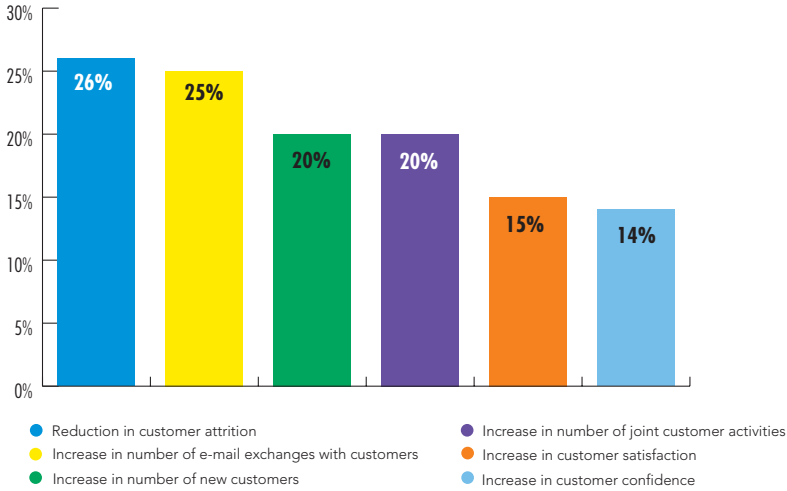
Customer Relations

Some of the participating companies were able to improve the relationship with their customers and improve customer satisfaction, as indicated by the results summarized below:

- CUSTOMER SATISFACTION:** 63 percent of companies saw an increase in customer satisfaction, while 50 percent of companies observed higher customer confidence. As for the size and stability of their customer base, 25 percent of companies saw a reduction in customer attrition, and 13 percent of companies increased the number of new customers.
- COMMUNICATION/COLLABORATION WITH CUSTOMERS:** 13 percent of companies reported an increase in the number of joint customer activities, which indicates a tighter relationship with these customers. In addition, one company (13 percent of participants) saw an increase in the number of e-mail exchanges with customers, but this change, which most companies do not consider necessarily as a measure of improvement, is expected to be temporary.

Chart 5 shows the improvements in customer relationship based on data provided by several of the participating companies. While not all companies were able to realize such benefits, those that did saw quite significant levels of improvement.

Chart 5: Benefits Related to Customer Relationship



Even though many of the companies felt that their security initiatives had a positive impact on customer satisfaction, for most companies it was difficult to measure the exact percent improvement that can be attributed to these initiatives. One company estimated a 20 percent improvement in customer satisfaction due to improved quality and consistency, and given their customers' ability to get more timely and accurate information about their goods. The same company also believes that this ability helped them to acquire new customers, especially those that are interested in products imported out of Asia.

Another company, which measures the level of customer satisfaction through a survey distributed on a quarterly basis, saw an increase of more than 20 percent in customer satisfaction and customer confidence. While they could not determine precisely what portion of these improvements is attributable to their security initiatives, they were confident these initiatives did play a role in improving customer satisfaction. A third company had customers asking about their security measures, which indicates that these initiatives do matter and are appreciated by customers.

As for communication with customers, most companies did not view the factors listed in the survey, such as an increase in the number of phone conferences or e-mail exchanges as necessarily a measurement of improvement. Only one of the participating companies reported an increase in the number of e-mail exchanges, but then explained that this is due to a new service they started providing to their customers, in which they can electronically receive timely information about the status of their ordered goods. While working with the customers on connecting them to this new visibility service the number of e-mail exchanges has increased, but this number is expected to drop once the transition phase is over.

Logistics Service Providers

Overview of Security Initiatives

Because of the nature of their business, all of the ocean carriers and Logistics Service Providers (LSPs) interviewed had advanced security measures in place for many years. These security measures helped them to keep track of and protect their clients' products as they moved through their system, which is a necessity for service providers in this industry. In addition, ocean carriers and marine operators have been regulated for many years, and so were always required to have certain security practices in place.

Still, all the companies that participated in our study took further security initiatives after 9/11. Some of these initiatives were taken to comply with mandatory regulatory requirements, such as the International Ship and Port Facility Security (ISPS) code, pre-notification of import and export freight to customs, cross-border protocols that specified the way for notifying customs whenever goods were transferred across the border, employee background checks and additional physical security. Complying with these regulatory requirements required, among other things, investment in IT systems and changes in working procedures.

In addition, the LSPs and ocean carriers decided to take part in voluntary programs like C-TPAT or TAPA. However, at least some of the companies we interviewed explained that such security measures were adopted more as a "business imperative" rather than purely to enhance security. For example, many of the large customers of the participating companies required them to become C-TPAT compliant in order to maintain their business, and compliance has often times been a prerequisite for participation in new bids.

Ocean carriers and LSPs also invested in security as a means to help them fulfill commitments they had made to their customers, and maintain their reputation as a premium service provider. For example, after 9/11 the time to cross the borders had gone up significantly. While not required by law, the LSPs decided to make such investments as joining the FAST program, certifying their drivers and equipment, etc., in order to shorten inspection time, and ultimately be in a position to better serve their customers.

Apart from external triggers, all participating LSPs and ocean carriers began voluntary initiatives to improve, or better control supply chain security. One area in which all companies invested in recent years is human resources. Some of the examples provided by the participating companies include an assignment of security officers to all ships and terminals, posting of additional security guards at warehouses, assignment of two drivers rather than one to high-value transportation lanes and an overall increase of security personnel.

In addition, companies developed special training programs; some for all employees while others were tailored for specific job functions (such as security officers, drivers, or marine terminal employees). These programs did not focus only on one-time training, but rather included on-going training to all employees about specific security-related topics, such as suspicious people, information security, etc.

Some of the companies also expanded their knowledge about security through an Internet site they developed, which covers a variety of security-related issues and can be accessed both by internal employees as well as the general public. To improve security at their facilities, companies increased the use of access controls, alarms, close-circuit televisions and other physical security devices. Better locking and sealing procedures and mechanisms enhanced security of goods in transport.

Similarly to manufacturers, LSPs and ocean carriers did not limit themselves only to initiatives taken within the four walls of their organizations, but rather expanded this activity to their business partners. For example, two of the LSPs we interviewed developed security evaluation and validation systems for subcontractors and vendors, and updated contracting requirements accordingly. Another company plans to expand its security-awareness training program to include external contractors with whom they have long-term relationships.

Overview of Collateral Benefits

This section summarizes the collateral benefits participating LSPs and ocean carriers derived from their security investments. It is important to note that while the same questionnaire was used for both manufacturers and LSPs, because of the nature of their business not all benefits listed in the questionnaire were relevant for the LSPs and ocean carriers.

The remainder of this section describes the benefits realized by the three participating LSPs and ocean carriers following the adoption of mandatory and/or voluntary security initiatives. The benefits are divided into five categories, based on the five sections in the questionnaire. Due to the limited amount of quantitative data available to us regarding the magnitude of the benefits realized, the following discussion will be mostly qualitative, with numerical data provided whenever available.

Inventory Management and Customer Service

Participating companies reported a number of improvements in this area, mainly ones that are related to keeping the goods safe and free of damage. While none of the interviewed companies could specify any cost savings attributed directly to these improvements, given their liability for any losses while the goods are in transport, it is clear that these measures can potentially have a positive impact on related costs. Below is a summary of the improvements realized by the participating companies:

- **PRODUCT SAFETY:** Product safety is a serious concern for LSPs because on many occasions they are held liable for damages or losses that occur while the goods are in their responsibility. The improvements reported by the participating companies include reductions in tampering (reported by 67 percent of companies), in theft/loss/pilferage (reported by 67 percent of companies), in fraud (reported by 33 percent of companies), in damages (reported by 33 percent of companies), and in defective products delivered (reported by 33 percent of companies).
- **CUSTOMER SERVICE:** One company (33 percent of participants) saw an increase in reported on-time delivery as a result of improving compliance programs and information flow to customs, and due to heavy investment in IT systems.
- **REDUCTION IN INVENTORY:** Contrary to popular belief, many of the instances of theft or damages to cargo take place in the warehouse and not in transit. Hence in this industry, freight at rest is considered freight at risk. One company (33 percent of participants) was able to reduce inventory levels held at its warehouses for certain customers by about 75 percent by changing delivery procedures to these customers (for example, not limiting themselves to making deliveries only during regular business hours).

Companies took various measures that led to these benefits. One company worked in collaboration with one of its large customers to change the packaging material of goods from cardboard to wood to make them more secure. The harder-to-penetrate packaging resulted in fewer defects and refused cargo, and when combined with added security forces on the ground it completely eliminated theft

and concealed losses³⁵, which were a common problem in some lanes. Another company was able to reduce theft and tampering by investing in various security measures such as fencing and guards at their warehouses. By assigning two drivers instead of one to trucks in vulnerable lanes, and ensuring that at least one driver stays in the truck/trailer at all times, one of the participating companies was able to completely eliminate theft, pilferage and tampering in these lanes.

Visibility

Two of the participants explained that they always had good track and trace capabilities, which provided them with good visibility to the location of the goods for which they are responsible—whether they are in containers on a ship, on a train, or on pallets on trucks. Consequently, they were not able to see any improvements in visibility following their investments in security measures in recent years.

With recent changes in its working procedures for high-value cargo, a third LSP was able to increase the volume of supply chain data that they share by 25 percent. With this change in place, the port-of-origin (where the goods are loaded) now has to pre-advise the destination port of the exact contents of a shipment, whereas in the past, many times this information was not available until the cargo was unloaded. Sometimes the people at the port-of-origin are even required to take pictures of the cargo and send them to the destination port, so that the recipient knows what cargo to expect. In addition to the increase in access to supply chain data, this change also made it much easier for that LSP, which is non-asset based, to file claims with the shipping airline in case the goods were damaged while on the plane. This led to cost savings of up to 90 percent for these particular shipments.

Efficiency

With regards to process improvements, participating companies were able to realize the following efficiency-related improvements:

- **IMPROVED PRODUCT HANDLING & REDUCED STEPS IN PROCESSES:** The 24-hour rule mandates that companies provide cargo information prior to loading on ocean vessels. This information has helped one of the LSPs (33 percent of participants) to plan for more efficient loading, better management of space and also cross docking—all of which has reduced handling by up to 20 percent (in some instances). Consequently, the number of steps in its supply chain processes was also reduced by about 20 percent.
- **PROCESS IMPROVEMENTS:** 67 percent of participating companies were able to reduce process deviations, increase process compliance, and increase process predictability.
- **REQUIRED PERSONNEL:** One of the participants (33 percent of participants) reported a reduction in the number of required personnel by up to 50 percent in some traffic lanes, following the implementation of such devices as electronic locks. The electronic lock creates a record whenever it is opened or closed, which eliminated the need for employees to escort the shipments, providing a positive return-on-investment (ROI) within less than one month!
- **COST SAVINGS:** 67 percent of companies realized some cost savings that can be attributable to process improvements.

³⁵ Concealed losses are damage, loss, or shortage of goods within a package, which is not apparent from its exterior condition (as defined by TechMeFinance.com).

One of the LSPs was able to improve process predictability and reduce deviations by about 20 percent by holding employees accountable for any deviations from the standard operating procedures. Another company took some steps such as joining FAST and certifying their drivers and equipment, in order to shorten the time it takes to cross the border. With these new initiatives in place, they gained about 5 percent increase in process compliance and process predictability, and 5 percent reduction in process deviations. These improvements also resulted in some cost savings for border-crossing shipments.

As for efficiency improvements related to transportation and the custom clearance process, participating companies reported several improvements, all of them related to increased speed:

- **SPEED IMPROVEMENTS:** 33 percent of companies reported a reduction in time it takes to clear customs, in the duration or variance of transit time and in shipping delays.
- **COST SAVINGS:** One of the LSPs (33 percent of participants) realized cost savings that can be attributed to speed improvements at the port of entry and in transportation.

One of the companies interviewed saw a reduction in transit time variance after adding security guards at the gates of their warehouses. The guards help direct traffic, which reduces the variance of trucker transit time and wait time at the warehouses. Another company reported a reduction in time it takes to clear customs, which also had a positive impact on total shipping time and shipping delays, following various initiatives they had taken to shorten time spent at the border. Still, this and other companies mentioned that even though C-TPAT compliance reduced time spent at the border after 9/11, this time remains longer compared to the average time spent at the border prior to 9/11. In addition, all participants concurred that customs continued to conduct random inspection in order to maintain some unpredictability of their security protocol.

Resilience

All the LSPs interviewed felt that due to a long-standing good visibility and active recovery processes, there were not many improvements in resilience they realized in recent years due to supply chain security measures. In fact, only one of the participating LSPs reported an improvement in resilience in response to our survey. Because of more awareness and fast escalation of security-related problems to higher levels, the LSP reduced by 50 percent the time to identify a problem. Consequently, it was possible for this LSP to notify customers about a problem sooner than usual, while the goods were still in transit. This made it easier for both the LSP and its customers to better prepare for these changes in plans. In addition, it was easier for the LSP to investigate the causes for the problem earlier in time, while people's memories were still fresh. Satisfied with the success of this approach, this LSP plans to further emphasize among its employees the importance of awareness to security, and expects to see a further 50 percent reduction in problem identification time and in problem resolution time.

As for the other LSPs, one of them explained that while receiving data sooner helps them to identify potential problems earlier, it does not translate to shorter response time or help problem resolution. As a ground carrier, a second LSP had long ago established multiple delivery paths that can be taken to ensure that goods are delivered on time even in the case of a problem.

Customer Relations

Improved customer relationship seems to be one of the more significant benefit areas, as all participating companies reported an improvement in the relationship with their customers following their investments in security measures:

- **CUSTOMER SATISFACTION:** 100 percent of companies realized an increase in customer confidence, while 67 percent of companies reported an increase in customer satisfaction. This also had a positive impact on the LSPs' customer base: 67 percent of companies saw an increase in the number of new customers and a reduction in customer attrition.
- **COMMUNICATION/COLLABORATION WITH CUSTOMERS:** 67 percent of companies saw an increase in the number of phone conferences with customers and in the number of joint customer activities. One of these companies (33 percent of participants) also experienced an increase in the number of e-mail exchanges with customers and in the number of face-to-face meetings with customers.

In recent years, as customers—especially the larger ones—became more aware of the importance of having appropriate security measures in place, they started asking their LSPs about security and/or required them to meet C-TPAT security criteria. This applies both to existing customers and to new ones, which now include in their Request for Quotes (RFQs) specific questions related to security. Therefore, it has become essential for LSPs to have various security measures in place, and in particular be C-TPAT certified, in order to retain their current customer base and acquire new customers. Moreover, one of the participating LSPs mentioned that the C-TPAT program has indirectly helped it to increase the volume of business with some of its existing customers. As part of the C-TPAT validation process of an importer, its senior corporate officers visit the LSP together with customs officers, to verify that the LSP's operations meet customs requirements. In the case of that particular LSP, some of these senior officers (who usually do not visit the LSPs' facilities) were so impressed with its consolidation operations that they decided to give that LSP more business. Thus, even though advantages related to improved customer relationship are difficult to quantify, they are no doubt important for LSPs.

As for collaboration/communication with customers, since security seems to be on everybody's mind these days, some of the participating LSPs saw an increase in the level of communication with customers. One of the LSPs reported a 50 percent increase in phone conferences, and a 75 percent increase in e-mail exchanges. These phone calls and e-mail exchanges tend to focus on process improvements, routing and other security-related matters. In addition, that LSP estimated a 25 percent increase in the number of face-to-face meetings and joint customer activities, including such activities as sharing of data, which was previously considered sensitive, and comparing problems, issues and best practices.

Summary and Conclusions

Given the potentially huge financial ramifications of supply chain disruptions, many companies find that they cannot ignore these risks and must take preventive steps to increase the security of their supply chains. In addition, government authorities require importers and other companies involved in global trading such as carriers and Logistics Service Providers (LSPs) to comply with some security regulations. Failure to comply with these regulations might result in imported goods not being allowed into the country. All these mandatory and voluntary initiatives put a significant financial burden on companies, and many of them find it difficult to provide a business case to financially justify these investments.

The goals of this study were to demonstrate that investments in supply chain security can improve organizations' business performance and whenever possible to quantify those improvements. We focused on collateral benefits of security investments to manufacturers and LSPs/ocean carriers. Five major areas of improvement were identified:

- Inventory management and customer service;
- Visibility;
- Efficiency;
- Resilience; and
- Customer relations.

We received inputs from 11 manufacturers from a variety of industries and three LSPs/ocean carriers, all considered in our opinion to be innovators in the area of supply chain security. The vast majority of companies were able to realize many benefits from their security investments, with some of them reaching very significant levels. Based on these inputs, we can conclude that investments in supply chain security can help organizations to improve internal operations, strengthen relationships with their customers, and overall increase their profitability. Therefore, such investments in security should not be considered as a financial burden that should be kept to the minimum level necessary, but rather as an opportunity for improving business performance and profitability.

Furthermore, despite the diverse types of companies that took part in our study, almost all of them realized benefits in each of the five areas identified initially by the project team. We therefore recommend to other companies that are seeking ways to determine a business case for their security investments to focus on these five benefit areas identified, as it is likely that their organizations may be able to experience similar types of benefits.

Our understanding is that there exists a general concern among those interested in supply chain security policy that the benefits of increased investment in supply chain security do not necessarily flow back in direct proportion to the entity making the investment (e.g., shippers often benefit from the investments made by LSPs but the reverse is seldom true). This concern impacts the willingness of some in the private sector to make security-related investments. However, the results of our study clearly demonstrate that such claims are not totally accurate when all collateral benefits associated with security investments are considered.

In particular, while it is true that shippers are likely to benefit from investments made by LSPs, our study demonstrates that the LSPs are likely to also realize multiple direct benefits from their security investments. Furthermore, those initiatives, and the resulting benefits they provide to shippers, are likely to strengthen the relationship between LSPs and shippers and improve customer satisfaction, which will ultimately have a positive impact on the size and stability of the LSPs' customer base.

While the data provided in this paper should not be considered as any type of an industry average, it clearly demonstrates that security investments can be beneficial, and that these benefits can be quantified. We therefore recommend that companies not consider such investments solely as expenses that are required to meet government regulations and mitigate risk, but rather as investments that can have business justification, result in operational improvements, and ultimately may promote cost reduction, higher revenues and growth leading to positive ROI.

It is important to remember, however, that these benefits are not realized automatically. Companies should be creative in determining ways—often times in collaboration with their business partners—to gain the most benefits from their security investments.

The paper demonstrates the benefits of security investments. One must remember though that terrorists or criminal groups may try to exploit for their own advantage the various security measures taken by organizations. For example, companies that participate in voluntary supply chain security programs are likely to have fewer and less intrusive inspections at the ports of entry. Terrorists that are trying to bring explosives into the country or drug dealers that are trying to smuggle drugs into the country are likely to try and smuggle them in shipments with goods that belong to security program participants.

Another example is related to security measures that provide track and trace capabilities and added visibility regarding the location of goods while in transit. If such information leaks out to other people that are not meant to see it, they may take advantage of this information to identify places and times where they can, for example, steal the goods. Therefore, it is highly recommended that companies take appropriate steps to ensure that their cargo and sensitive information are appropriately secured.

We would also like to point out that some of the participating companies reported that since late 2005 they have been experiencing a significant increase in customs cargo examinations, despite participating in government-initiated supply chain security programs. Since it should be in the best interest of government authorities to encourage companies to participate in such programs and to take other voluntary initiatives to increase the security of their supply chain, it is recommended that government authorities take steps to ensure that investing in such security measures will indeed provide benefits to companies.

Another concern expressed by some of the participating companies is that voluntary government/industry initiatives seem to target mostly large organizations that *can* comply and that have already proactively taken voluntary steps to secure their supply chains, while in fact much of the vulnerability comes from small-business supply chains. Given that there are hundreds of thousands of such small businesses in the global supply chain, upon which so many companies and governments depend, it is extremely challenging to register them, identify which of them represent the highest risk and have the capability to inspect the high-risk goods they import.

Therefore, government authorities need to continually re-evaluate the effectiveness of their security initiatives, to ensure that they do reach their goal of protecting their countries and that in parallel they provide meaningful benefits to participating companies.

Appendix: Questionnaire

I. Benefits

In this section, we are interested in learning what quantifiable benefits, direct or indirect, your company may have derived from its supply chain security investments. We don't anticipate that you will be able to answer all of the questions below and understand that your company may not systematically collect all of this data and/or that each question may not be germane to your industry.

Instructions for completing the "Benefits" section. Please answer as many questions as you can (you may also wish to forward the questions to other departments/groups in your company to obtain the information). Answer the questions by checking "Yes," "No," or "Don't Know." If you answer "Yes" to a question, please indicate by how much (estimated percentage). We are interested in any improvements that you have been able to quantify, *i.e.*, able to provide a numerical estimate of the improvement. Please share with us a quantitative estimate of the improvement's magnitude (*e.g.*, 10 percent reduction or 5 percent faster). This information can be sensitive and hence it is only necessary to provide us with an estimated percent.

A. Inventory Management & Customer Service

Have your supply chain security initiatives contributed, directly or indirectly, to any of the inventory management/customer service improvements listed below?

Reduction in incorrect quantity received	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Increase in item fill-rate	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in frequency of cancelled orders	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in excess inventory	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Increase in order fulfillment	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in defective products delivered	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in back-orders	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Increase in reported on-time deliveries	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in counterfeiting	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in theft/loss/pilferage	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in shortages/stock-outs	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in damages	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in fraud	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Reduction in tampering	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Planned reduction in inventory	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Cost savings attributable to inventory management improvements	<input type="checkbox"/> Yes, by _____%	<input type="checkbox"/> No	<input type="checkbox"/> Don't know

B. Visibility

Have your supply chain security initiatives contributed, directly or indirectly, to any of the visibility/transparency improvements listed below?

- | | | | |
|---|---|-----------------------------|-------------------------------------|
| Increase in access to supply chain data | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in timeliness of shipping information | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in inaccurate shipping information | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Cost-savings attributable to improved supply chain visibility | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

C. Efficiency

Have your supply chain security initiatives contributed, directly or indirectly, to any of the efficiency improvements listed below?

- | | | | |
|--|---|-----------------------------|-------------------------------------|
| Reduction in number of times product handled | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in automated handling | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in process deviations | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in process compliance | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in process predictability | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in cycle-time (time from order received until shipped) | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in number of steps in supply chain process | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in number of required personnel | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Cost-savings attributable to process improvements | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in cargo inspections/examinations | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in predictability of cargo examinations | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in delivery time window | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in time it takes to clear customs | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in transit time (e.g., transportation time) | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in transit time variance | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in shipping delays | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in lead-time (activity initiation to completion) | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in lead-time variance | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in inspection delays | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Cost-savings attributable to speed improvements | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

D. Resilience

Have your supply chain security initiatives contributed, directly or indirectly, to any of the resilience improvements listed below?

Actual

- | | | | |
|--|---|-----------------------------|-------------------------------------|
| Reduction in response time to problem(s) | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in time it took to identify a problem(s) | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

- | | | | |
|---|---|-----------------------------|-------------------------------------|
| Reduction in problem resolution time | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Cost-savings attributable to increased resilience | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

Expected

- | | | | |
|---|---|-----------------------------|-------------------------------------|
| Expected reduction in response time to problems | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Expected reduction in problem identification time | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Expected reduction in problem resolution time | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Expected cost-savings attributable to resilience improvements | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

E. Customer Relationship

Have your supply chain security initiatives contributed, directly or indirectly, to any of the customer relationship improvements listed below?

- | | | | |
|-------------------------------------|---|-----------------------------|-------------------------------------|
| Increase in customer satisfaction | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in customer confidence | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in number of new customers | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Reduction in customer attrition | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

Communication/Collaboration with Customers

- | | | | |
|--|---|-----------------------------|-------------------------------------|
| Increase in number of phone conferences with customers | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in number of joint customer activities | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in number of e-mail exchanges with customers | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Increase in face-to-face meeting with customers | <input type="checkbox"/> Yes, by _____% | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |

Are there any other improvements that you attribute to your supply chain security initiatives? If yes, please list and provide magnitude (estimated percent): _____

II. Supply Chain Security (SCS) Measures

In order for us to fully understand the benefits that you have derived, we are interested in learning more about the supply chain security initiatives that your company has implemented. Please describe and/or list the initiatives with which you are familiar (you may also wish to forward the survey to other departments/groups in your company for this information). [Instructions for completing the "SCS Measures" section](#) of the survey: You may submit your response to this question using whatever format is easiest for you such as e-mail (sept_lesley@gsb.stanford.edu), writing on a hard copy of the survey, using a separate sheet of paper, etc., and faxing (650) 723-4487 or mailing (Lesley Sept, Stanford University, 518 Memorial Way, Room 398, Stanford, CA 94305).

III. Submitting Your Completed Survey

You may submit your completed survey via e-mail (sept_lesley@gsb.stanford.edu), fax (650) 723-4487, or mail (Lesley Sept, Stanford University, 518 Memorial Way, Room 398, Stanford, CA 94305).



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