# Cost Benefits Analysis of Container Tracking for the Automotive Supply Chain

CENTER FOR AUTOMOTIVE RESEARCH

**Prepared for: Surgere, Inc.**


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## Acknowledgments

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CAR's mission is to conduct independent research and analysis to educate, inform and advise stakeholders, policymakers, and the general public on critical issues facing the automotive industry, and the industry's impact on the U.S. economy and society.

## Research Objective

Surgere is a software company with a mission to create supply chain visibility through the power of highly accurate data and industry-wide collaboration. Surgere provides software and hardware to track and manage mobile assets such as shipping containers accurately and on time. Surgere's container tracking and management program generate packaging activity data to track returnable containers through each stage of the supply chain. Surgere contracted CAR to study the container loss problem in the automotive supply chain and estimate the return on investment (ROI) for Surgere's container tracking system which includes hardware and software.

## Research Method

CAR performed an extensive literature review of the publications to understand the scope of container losses in the automotive industry and the history of container tracking technologies. CAR interviewed several experts as well at automakers, leading tier-1 suppliers, and logistic companies (carriers) to gain real-world insights on the loss of returnable containers. Also, CAR reviewed numerous supplier loss-related cost claims (seeking reimbursement from automakers) for lost containers, expendable packaging, and expedited freight. CAR then created a spreadsheet model to estimate the system-level cost impact for automakers, suppliers, and carrier systems. These costs were extrapolated to estimate loss costs in the North American automotive ecosystem. The ROI is calculated using the estimated system costs (i.e., cost savings opportunity) and the current cost of Surgere's radio-frequency identification (RFID) tracking equipment and software, as of November 2019.

The list of companies interviewed for this research is below. Additional companies' loss claims data was reviewed; those firms are not listed.

- General Motors
- Honda
- Nissan
- FCA
- Denso
- Penske Logistics
- Ceva Logistics
- U.S. Farathane

# Introduction

The automotive industry has a complex supply chain. Multiple companies work together to manufacture a vehicle that has more than 2,000 components and 30,000 parts (MacDuffie & Fujimoto, 2010). Most high-volume automakers assemble hundreds of vehicles per day. Therefore, the efficient and timely movement of vehicle parts between suppliers and automakers is critical. For decades, automakers have sought to fashion a “just-in-time” pipeline for the flow of parts to the production line. Vehicle parts not only need to arrive on time at the automaker’s assembly plant and in pre-planned sequential order, but they also need to arrive without damage. The assembly plants often have limited inventory to counter delays in part arrivals from suppliers.

The automotive industry uses two types of packaging for shipping parts – Expendable packaging and Reusable containers.

## Reusable Packaging

Reusable packaging is designed to be used for multiple trips and long-term storage, and are typically designed for the life of the vehicle program. Reusables commonly used in automotive manufacturing include handheld and bulk containers, racks, pallets, and lids, as well as reusable dunnage or internal packaging designed to facilitate part protection. Reusable containers have several benefits. Not only are they built specifically to protect the products they hold, but they also cut costs and reduce waste, helping to promote sustainability (Moses, n.d.). Automotive manufacturing utilizes both standard containers and dunnage sets, as well as custom packaging. Due to the vast range of part sizes, finish, and geometries, custom sizing is often a requirement (Leblanc, 2018).

Containers are used to transport and deliver parts throughout the entire distribution system. The same package may be used from the beginning of production at the supplier to the final installation on a vehicle or other automotive parts. Containers are used repeatedly, returned, and cycled through the system, with the intent of reducing packaging expenditures and waste (Chism, 2010). CAR research found that automakers typically reserve around 10 percent of annual container budget for replacement, including normal wear and tear, as well as losses.

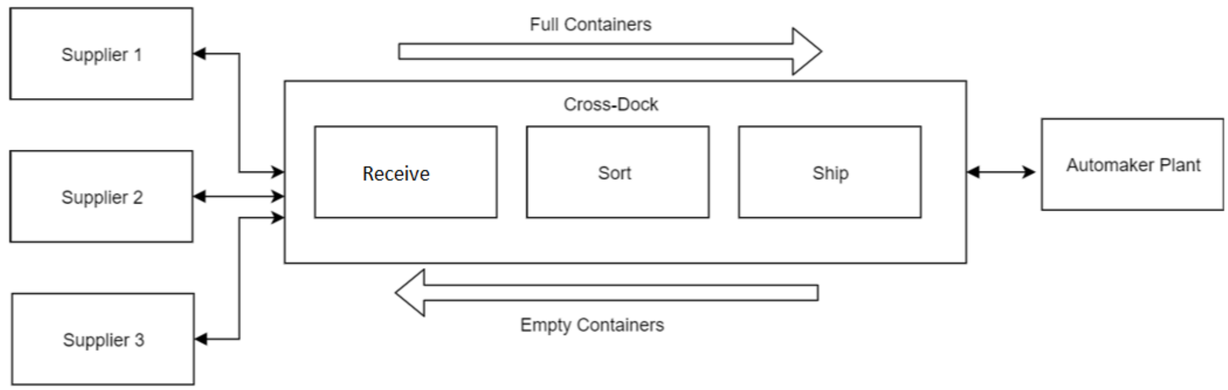
## Expendable Packaging

Expendable packaging is designed to be used for one-way trips and short-term storage. Most of such packaging is made out of cardboard or plywood. The containers are usually disposed of and recycled after use. Expendable packaging is a commodity product that is available for use globally. Such packaging is used most often when reusable packaging is not available. The supplier usually needs prior approval from the automaker to use expendable packaging in place of reusable because of the cost incurred.

## The Flow of Containers in the Automotive Industry

The flow of reusable containers is circular. The full containers arrive at the automaker’s cross-dock from various suppliers where they are sorted and shipped to automaker plants. Automakers return the empty containers in the same way to the suppliers. This process is repeated. In few cases such as expedited shipping, full containers from the suppliers can skip the cross-dock and arrive at the automaker’s plant directly.

*Figure 1: Container Flow Process*




## Challenges of Managing Reusable Containers

For efficient vehicle production, the parts need to be available at the desired location, date, and time. Managing the inbound and outbound flow of reusable containers can be a challenge, and getting containers back where they're needed requires robust processes and a supply chain that is operating exactly as designed (Moses, n.d.). Some of the common problems companies experience in this system include the following (Lowry Solutions, 2015):

- Loss, theft or damage to containers
- Inability to accurately track the shipment and return of reusable containers which can include:
  - Reuse of containers by the receiver
  - Stockholding by the receiver
  - Misdirection of containers to another supplier
- Increase in labor costs related to finding and allocating assets
- Delay in shipments due to container shortages

The shipping process is filled with uncertainties. Until now, most containers could be tracked only with paper forms and manually-scanned barcodes. The data is then entered into logistics management systems (Marcellino, 2018). This method is labor-intensive and lacks sufficient automation; thus, for better management of reusable containers, hands-free tracking technology is recommended.

## Technology to Track and Manage Containers

Shipping container tracking technology is made up of three things: sensors, connectivity, and software. Sensors make it possible to know the location of containers, and the connectivity transmits that location data back to a computer software system.

Different tracking solutions combine these three elements in different ways. The solution could provide the exact location of the container in real-time, or confirm the last location before being loaded on a trailer. Below are the common sensors used for container tracking:

- **Barcodes** - A barcode is a method of representing data in a visual, machine-readable form. Barcodes have been in use for several decades for tracking inventory and are currently considered a traditional technology. Barcodes are lightweight, cost-effective, and accurate. However, barcode scanners need a direct line of sight to the barcode to be able to read it, and the scanner should be less than 15 feet from the tag. Barcodes must be scanned individually and thus are very labor-intensive. Moreover, barcodes are more easily damaged (accidentally or intentionally in cases of theft) as the printed bar code has to be exposed to the outside of the product.

- **Radio-frequency identification (RFID)** - RFID uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. The RFID technology is divided into three categories – Passive, Semi-passive (also called battery-assisted passive or BAP), and Active – based on how the tags obtain power and how they use it to communicate with the interrogator. The passive RFID tags have no internal power source, and they draw the power from the RF waves sent by the interrogator. The active tags, on the other hand, have their own power source (a battery) and a transmitter and use these two components to broadcast the information to the interrogator. This type of tag can communicate over hundreds of feet and have a very large memory capacity to store information. Semi-passive tags are somewhat of a hybrid of these two types of technology. They have a power source, but no transmitter and the battery is used to aid the communication (Dua, 2019). Compared with barcode, RFID tags can be read from a greater distance, don't need to be positioned in a line of sight with the scanner, and can be read at a faster rate than barcodes. However, RFID involves assembling and inserting a computerized chip, which works out to be more expensive than barcodes. (Adaptalift Group, 2012).
- **Global Positioning System (GPS)** – GPS is a satellite-based radio navigation system that can intercept the location coordinates of any object on earth equipped with a GPS tag. The tag does not require connectivity to triangulate the location but needs it to transmit the location to the server. The GPS container tracker follows items easily throughout the supply chain, even when the items are in motion in a trailer. GPS tracking is better than barcode and RFID as it provides better visibility with minimum labor. However, GPS tags are expensive and battery life is an issue. Batteries can last 1-4 years; the life of the battery depends on the number of times GPS tags transmit the location information to the servers.

Connectivity is mostly achieved via cellular networks. Connectivity is needed for GPS but is not an issue for barcodes and RFID-based tracking since both methods involving scanning at predefined nodes in the supply chain.

The application software acts as a virtual manager, thus, playing a critical role in the functioning of container-tracking technology, performing various tasks using the location data collected through sensors. These tasks include controlling sourcing, packaging specifications, planning for every part, location, motion and disposition, and loop balancing. For example, Surgere provides an internet-based (cloud) application for container tracking which uses artificial intelligence to monitor critical container levels, reporting widgets that offer real-time program statistics and alert users when actions are required.

## Summary of Findings from Interviews

CAR interviewed various experts with direct knowledge of and experience with container losses, including supply chain executives, managers, purchasing agents, and engineers, in order to gain insights and gauge the extent of problems associated with container loss in the automotive supply chain. Below are the important findings:

## Lost Container Types

CAR research found that the majority of container losses involve empty containers, notably commonly used injection-molded containers. This is due to the fact that generic containers can be interchangeably used with other automaker parts, or for non-automaker customers, and can easily be grinded and recycled by resin companies. Specialty container/racks loss is rare. Some industry estimates state that between 15 – 20 percent of the total container stock is stolen and/or lost each year (Savi). CAR research shows that typical losses range from 3 to 10 percent of total container stock per year.

## Common reasons for lost containers

There are multiple reasons for lost containers, such as theft, misrouted shipment, damage in transit, and containers lost from sea vessels. Misrouted shipment is the top reason, according to survey respondents, followed by theft. In particular, suppliers along the US/Mexico border have a higher rate of container loss because containers passthrough additional touchpoints like cross-docks and drop yards, as well as due to theft. CAR research found that all suppliers and carriers expressed concerns over the lack of visibility and transparency within the supply chain for reusable containers overall. Furthermore, the CAR team heard multiple instances of container loss with no known cause.

## Container Responsibility

Automakers either buy the reusable containers directly for the suppliers and/or ask the suppliers to include the container cost in the part cost. In most cases, suppliers and carriers are responsible for temporary expendable packaging, dunnage, replacement of lost containers, and expedited shipment. The supplier can claim reimbursement from the automaker for the cost incurred due to lost containers. On average, automakers allocate 10 percent of the initial fleet cost annually for repair and replacement of containers, of which 5 percent is specifically for container losses.

## Part Shipment and Lost Containers

When container loss is experienced by the supplier, the parts are usually shipped in expendable containers in order to maintain vehicle production schedules. If there is a delay in procuring expendable packaging, the shipment is expedited to the automaker plants. The lost containers are eventually replaced by ordering new containers. Therefore, the impact on vehicle production schedules is minimal. However, there is a cost associated with expendable packaging, expedited shipment, and replacement of lost containers.

## Current Tracking Technology Trends & Hurdles

CAR research found that there is currently no universal process for tracking containers in the automotive industry. Processes can vary plant-by-plant within the same company and range from manual spreadsheets, container-based tracking, to advanced GPS tracking. All respondents cite mixed results using sensor-based tracking technology thus far. They cite process variation and lack of consistency within the supply chain as the primary issue. In general, companies prefer tracking using GPS over RFID or manual container tracking. However, GPS is cost-prohibitive for most companies, and there are product life-cycle issues; for example, GPS tags last only one to two years depending on the frequency of use. Respondents also acknowledge that RFID and GPS tracking technologies will not likely completely eliminate the problems of container loss and theft; however, they still foresee potentially significant benefits from reduced occurances and improved visibility throughout the supply chain overall.

All automakers interviewed reported current use of RFID and/or GPS technology tracking, or pilot programs currently underway and/or have tried RFID and GPS tracking in the past. They all cited tangible benefits seen in the areas of expedited freight and expendable packaging; however, none would quantify the results citing early-stage and preliminary results. Regardless, all expressed interest in pursuing additional testing in the future.

When asked about remaining challenges, all ranked initial investment (#1) and scalability (#2) as the most significant hurdles in container-tracking technology implementation. Respondents cite a large, complex supply-base, which must also participate to realize the purported cost savings. Also, they anticipate 'data gaps' as suppliers roll out the tracking technology across their respective manufacturing plants and existing container fleets (requiring retrofitting).

Overall, automakers agree that logistics and shipping is not a competitive advantage because suppliers, logistics carriers, and consolidation centers are shared across the industry. The consensus is that improved management and container tracking systems will help everyone within the supply chain.

## Container Loss Claims

Typically, suppliers notify automakers of instances of lost containers and expendable packaging requirements. Suppliers file a loss claim, which then kicks-off an often-lengthy resolution process. The process involves audits, review of receipts and purchase orders, tracking history if available, and validation of claims. The purpose of the investigation is to identify the root cause and route loss according to fault.

The annual claims and related loss amount vary greatly between the automakers and appears to be a function of annual production, the number of plants, and the location of plants, e.g., proximity to the US/Mexico border. For example, Automaker A indicates that it receives approximately $1 million of claims annually from the suppliers and carriers. Automaker B spends $12 - $15 million annually to replace containers and $1.8 million related to damaged containers (three percent of $61-million annual container spend).[1] Loss claims are usually in the range of $15,000 to $350,000 each, with some covering multiple years (ranging from one to three years). Suppliers indicate that only 15 to 20 percent of the claims are successfully resolved in their favor. This often involves negotiated settlements whereby the supplier receives partial reimbursement.

Suppliers claim that lack of container tracking and visibility makes it difficult to prove fault and get the claim resolved with the automaker. For example, approximately 75 percent of claims are resolved favorably under best-case scenarios, according to supplier respondents, as compared to 15 to 25 percent under worst cases. On the other hand, automakers complain that it's too easy for suppliers to file claims. Furthermore, automakers cite instances when suppliers have misused packaging or haven't honored purchasing commitments and yet the supplier still filed a claim. Conversely, suppliers complain that without transparency they can't file claims sooner (improving their chances of resolution).

Container loss-related costs are incurred universally at each level of the supply chain; however, the burden depends upon who owns and bears responsibility for containers. For example, Automaker A assigns responsibility in most cases to suppliers (charged back via piece price); whereas, Automaker B

[1] All dollar values are in USD throughout this report.

and Automaker C purchase their own containers and are responsible for repairs (with some exceptions). CAR research found suppliers bearing the most costs related to container loss, primarily on account of reimbursement processes in place. Suppliers cite 'burden of proof' and lack of visibility as the primary factors.

According to respondents, loss claims incurred are erratic and very difficult to predict. The analysis of supplier claims data suggests that automakers can go for periods of several days to weeks, without incurring a significant loss claim, but could then experience a single large supplier claim for $100,000 to $200,000, seeking relief retroactively.

### Types of the costs incurred due to container loss

There are two broad categories of the cost incurred by the supply chain due to container loss – direct and indirect. Direct costs are the cost of containers (including lost containers, container replacement, and any parts that are lost with them), as well as expendable packaging, dunnage, expedited freight, additional sorting (in-house and third party), and part damage as a result of expendable packaging. Indirect costs are those incurred for performing audits, tracking, and filing/processing loss claims, as well as lost production, if applicable.

According to respondents, these loss costs incurred are episodic and difficult to predict. Costs, in most cases, involve expendable packaging, dunnage (if necessary), and container replacement. In the worst cases, they also include expedited freight and/or parts damage as a result of expendable packaging. No respondents cited lost vehicle production volumes. All reported overhead costs associated with loss claims, audits and resolution.

## Specific Examples of Container Loss

**Example-1**

In one particular case, the supplier-owned empty standard bulk bins (sized 48 x 45 x 34 inches) were lost in transit to the supplier back from the automaker. The intended route included six stops in a closed-loop system. The supplier filed a loss claim with the automaker, seeking to recover the cost of lost returnable containers along with expendable packaging. The claim was $96,000 for lost containers (60 percent of total) and $64,000 expendable packaging (40 percent of total), a total of $160,000. The claim followed the customary audit process by the automaker, whereby the supplier had to prove container purchases, i.e. purchase approvals and invoices. The audit results indicated a total of 60 percent bulk bins had been lost over a period of four years. As a result, the automaker initiated a broad investigation to look into the root cause of the problem. Select bulk bins were then equipped with GPS trackers, which revealed that containers were out-of-network for greater than three days and ended up at unknown businesses with no ties to the automotive industry.

The supplier loss claim is still unresolved and has been ongoing for more than two years; it will likely result in a negotiated settlement between the automaker and the supplier.

This case emphasizes that to avoid such situations, there is a need for an intelligent application that can alert both the automaker and the supplier on a real-time basis.

**Example-2**

Another expert cited a three-year issue between the automaker and supplier involving missing returnable containers. The parts were originally shipped from the supplier's Mexican plant to the customer's (automaker) domestic assembly plant. The containers went missing somewhere during the return route. The supplier filed a $1 million claim, i.e. $300,000 dollars per year. Roughly one-half of the standard 48x45 containers fleet had to be replaced (approximately 1,400 containers). The supplier claims that the automaker's shipment records were inaccurate, i.e. signed-off on within the Electronic Data System but never occurred. Therefore, there was no clear evidence available to support the supplier's claim. After negotiation, the automaker settled with the supplier for $300,000 dollars (30 percent of total $1 million in claims; 2/3 for replacement containers, and 1/3 for expendable packaging).

## Estimating Annual Cost of Container Loss

CAR developed a spreadsheet model to estimate the annual cost of container losses and calculate the potential return on investment for Surgere's container tracking technology.

### Data Collection

CAR interviewed supply chain/logistics professionals with direct knowledge of and experience with container losses to obtain model inputs. The project team developed a survey to obtain high-level cost impact data to determine the potential return-on-investment (ROI) for RFID tracking. The survey also asked for examples of container loss supplier claims, for purposes of both output and validation (to improve model output accuracy). The survey was used to capture wide-ranging viewpoints across the entire supply chain, including automakers, suppliers and logistics carriers. In total, data was collected data from four automakers (domestic and international), eight suppliers, and two logistics carriers. Each survey respondent provided data, which was aggregated for purposes of deriving cost estimates and model outputs. At the request of the respondents, all names and company-specific details were omitted from the model and summary report findings.

### Model Variables

Automakers track as many as 18 metrics related to supply chain performance, e.g., total cost, transportation efficiency, packaging costs, container loss, as well as expedited freight. CAR evaluated the automaker matrices to determine the best measures specifically related to container loss. These variables included supplier loss claims (in cases when suppliers own the containers, i.e. reimbursed through normal course of business via parts piece price), reported losses (both estimated and actual), expendable packaging spend, expedited freight charges, and damage awards as a result of expendable packaging. Data collected on these variables were used to calculate direct costs.

CAR estimated indirect costs, i.e. for the handling of loss claims, by multiplying a 'fully-loaded' wage rate (assumed $75,000/year 'fully loaded' to include health care benefits) by percent time spent on container-related loss issues, as reported by survey respondents. Direct and indirect costs were summed together to derive estimated total container loss costs. Return on Investment (ROI) was estimated by using standard industry ROI calculations. CAR relied upon Surgere's pricing data for initial investment requirements (which is zero dollars under the company's current subscription model), monthly software subscriptions (based upon the number of doors per portals by plant), and other fees.

## Assumptions

CAR inquired with automakers about their experience to-date with RFID technology for the purposes of developing relevant performance discount factors, i.e., success probability outcomes. Automakers and suppliers all reported prior and ongoing RFID pilot programs, using closed-loop transportation systems, and shared qualitative data about their experiences. However, they were reluctant to share quantitative or verifiable data results citing ongoing testing. Also, respondents were reluctant to provide their cost for container tracking technology, including RFID and GPS systems used for performing audits and resolving container loss claims. Therefore, the model relies on Surgere's pricing data, which may or may not be consistent with other container tracking technology suppliers.

Experts interviewed argue that due to the complex supply chain, there will likely be gaps in the container tracking technology implementation, which might limit the savings realized in the initial years. Savings will increase as the technology implementation scales to the enterprise level. Also, retrofitting existing containers with sensors is a significant undertaking because approximately only 10 percent of containers are replaced annually. Integrating RFID tags on new containers is easiest; however, companies will also need to retrofit existing containers to scale faster. For maximum savings, there is a need for full deployment of RFID tracking technology across all of a company's major supply chain participants, i.e. package is scanned at all nodes to achieve all purported benefits. Partial deployment would provide only partial benefits and result in additional model/forecasting complexity. Keeping these arguments in mind, CAR believes that sensitivity analysis can allow insight into approximate partial, or phased-technology deployment, e.g. assuming 20 percent confidence level is equal to approximately 20 percent deployment of container tracking technology across the supply chain. Therefore, CAR performed a sensitivity analysis of the model data output for various confidence intervals.

CAR research also identified significant secondary cost savings opportunities afforded by tracking technology (beyond reduced dollar loss claims). Respondents believe such opportunities could provide incremental, meaningful productivity gains (dollar savings) via increased visibility throughout the supply chain. These include dynamic re-rerouting of containers/materials, reduced loss reserves (current is around 10 percent of total annual container spend), reduced dwell times, and improved warehouse utilization, particularly in cases of shared cross-docks. All respondents acknowledge potentially significant opportunities for secondary cost savings; however, there isn't enough data currently available to model these benefits with sufficient confidence.

Model inputs are a combination of estimates and actual results, as provided by survey respondents. To improve model output, CAR examined over 20 individual supplier loss claims, i.e., 'real world' examples of suppliers seeking cost recovery for missing containers, expendable packaging, and expedited freight.

## Results

The model is based on detailed feedback from two automakers and two suppliers.[2] The input variables include total annual container losses ranging from $1 million to $13 million for automakers, reflecting significant differences in scale and manufacturing footprint. Suppliers indicated losses ranging from $247,000 to $667,500, also reflecting similar differences. These losses include the direct costs associated with lost and replacement containers, expendable packaging, expedited freight, as well as estimated

[2] CAR interviewed several automakers and suppliers, but received detailed numerical data from two automakers and two suppliers. The case studies from other companies are used to validate the results.

indirect costs for overhead (for tracking and loss resolution), and GPS tracking for claims resolution. See Table 1.

The model calculates ROI by applying total container loss costs (annualized), i.e., dollar saving opportunities, against the cost of implementing Surgere's RFID tracking technology. Surgere has a monthly subscription model (zero upfront investment cost) for container tracking, the cost of which is different for automakers and suppliers as a result of manufacturing footprint differences, i.e., number of doors per facility. The monthly fee includes the equipment for scanning RFID tags and the data analytics software.[3] Typically, suppliers have three doors per facility and automakers have 80 to 120 doors at each production facility.

*Table 1: Model Inputs and Cash Flow (ROI) Output Based on Data from Interviewees*

| | Automakers | | Suppliers | |
|---|---|---|---|---|
| | **#1** | **#2** | **#1** | **#2** |
| Manufacturing Plants - # | 2 | 9 | 2 | 3 |
| **Container Losses (Direct Costs):** | $1,000,000 | $12,547,619 | $200,000 | $600,000 |
| Including:<br>Lost Containers/Replacement<br>Expedited Freight<br>Third Party Sorting<br>Expendable Packaging | | | | |
| **Overhead (Indirect Costs):** | $92,500 | $624,750 | $47,000 | $67,500 |
| Including:<br>Personnel (Fully Loaded basis)<br>Claims Resolution/Audits | | | | |
| **Total Container Loss Impact / Savings Opportunity** | $1,092,500 | $13,172,369 | $247,000 | $667,500 |
| *Less: Avg Tracking Technology Costs [1]* | $728,640 | $3,278,880 | $36,000 | $54,000 |
| **Cash Flow Impact - Year #1 (ROI)** | **$363,860** | **$9,893,489** | **$211,000** | **$613,500** |

*Source: CAR Research*

CAR performed sensitivity analysis (for year #1 of technology implementation) on each example at various confidence levels, given limited 'real world' data available regarding RFID technology performance and based upon respondent feedback regarding scalability hurdles.  Also, sensitivity analysis addresses respondent feedback that, RFID tracking technology, while offering substantial

[3] CAR used average costs for automakers and suppliers, as provided by Surgere, which can differ based upon company size and number of locations.

promise for cost savings via reduced occurrences of container theft and loss, will not completely eliminate these issues (impacting 'real world' cost savings captured).

*Table 2: Cash Flow (ROI) Sensitivity Analysis by Company in Year #1*

| | | Confidence Intervals | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | # Plants | 0.00 | 0.20 | 0.40 | 0.60 | 0.80 | 0.95 | 1.00 |
| Automaker #1 | 2 | -$728,640 | -$510,140 | -$291,640 | -$73,140 | $145,360 | $309,235 | $363,860 |
| Automaker #2 | 9 | -$3,278,880 | -$644,406 | $1,990,068 | $4,624,542 | $7,259,015 | $9,234,871 | $9,893,489 |
| Supplier #1 | 2 | -$36,000 | $13,400 | $62,800 | $112,200 | $161,600 | $198,650 | $211,000 |
| Supplier #2 | 3 | -$54,000 | $79,500 | $213,000 | $346,500 | $480,000 | $580,125 | $613,500 |

*Source: CAR Research*

At full implementation (100 percent confidence level) and all savings realized, the results show significant positive cashflow opportunities within the first year alone for both automakers and suppliers. They show a positive ROI within the first year in all cases regardless of company size and scale.

The results suggest that RFID tracking technology could also still yield positive cash flow within the first year of operation if Automaker #1 (at three plants with supplier-owned containers) achieves 80 percent of projected savings (loss reduction). Automaker #2 could achieve positive cashflow during the same time period if 40 percent of projected savings are achieved, because of greater savings opportunities (by comparison nine plants and a much higher mix of automaker-owned containers). Whereas, for suppliers, RFID could yield positive cashflow within the first year if even less than 20 percent of projected savings is secured because of lower technology subscription costs. The degree to which the cost savings benefits will accrue to each company, however, will ultimately depend upon who owns the container (containers typically account for 40 to 60 percent of total loss claims according to respondents) and who is incurring the costs for packaging and expedited freight (the remaining 40 to 60 percent of loss claims).

Ultimately, 'real world' savings – and ROI – will depend upon how quickly system deployment can be scaled, i.e., partial or phased vs. full deployment. In practice, all respondents indicate that full deployment is not practical during the first year, and could take substantially longer, given their large and complex supply chains.

## Conclusion

According to CAR research, implementing a company-wide RFID container tracking solution can produce a positive ROI within the first year in many cases, assuming sufficient participation among the company's channel members. The total system cost of lost containers can be $1 million to $14 million for automakers, depending on size, scale, and manufacturing footprint. Whereas, annual RFID tracking costs can run between $800,000 to $3.3 million, offering potentially significant cost savings opportunities at scale, as well as secondary productivity benefits longer-term.

Mass adoption is critical to achieving estimated savings opportunities. The benefits of container tracking, however, could be further improved if automakers, suppliers, and carriers use the same system as it increases visibility potentially for all channel members. Furthermore, a common and/or open system would enable collaboration, standard processes, and, ultimately, complete supply chain visibility.

Surgere's subscription-based technology model addresses respondents' concerns regarding initial investment requirements, which would otherwise limit overall cost savings opportunities and scalability benefits. It allows both automakers and suppliers to keep up to date with the latest technology trends without sacrificing their corporate cash position.

Lastly, improvements made within the supply chain will likely accrue to all participants for years to come as learnings take hold from data received. Additional data collected over time will provide more opportunities for cost savings. With highly accurate data and supply chain visibility, companies will be able to use artificial intelligence to accelerate benefits further and make data-driven decisions.

## Future Research Recommendations

CAR recommends a future study of 'real world' applications of RFID tracking technology to explore ways to potentially accelerate scalability, i.e., savings opportunities, as well as to determine secondary cost-savings benefits. CAR research identified numerous potential secondary cost-savings benefits, including dynamic re-routing of containers/materials, reduced loss reserves and container dwell times, as well as improved warehouse utilization and container fleet planning. Quantifying such benefits may improve the model outputs and potential return on investment for container tracking technologies.

## Appendix

According to CAR analysis, automakers could theoretically achieve positive cashflow (i.e. annual savings incurred less technology subscription costs) during the first year of implementing RFID tracking beginning at ~40 percent of projected savings-levels. See Table 3.

*Table 3: Automakers: Cash Flow Sensitivity Analysis by Plant in Year #1*

| | Confidence Intervals | | | | | | |
|---|---|---|---|---|---|---|---|
| **# Plants** | **0** | **0.2** | **0.4** | **0.6** | **0.8** | **0.95** | **1** |
| **1** | -$364,320 | -$126,572 | $111,176 | $348,923 | $586,671 | $764,982 | $824,419 |
| **2** | -$728,640 | -$253,144 | $222,351 | $697,847 | $1,173,343 | $1,529,964 | $1,648,838 |
| **3** | -$1,092,960 | -$379,717 | $333,527 | $1,046,770 | $1,760,014 | $2,294,946 | $2,473,257 |
| **4** | -$1,457,280 | -$506,289 | $444,703 | $1,395,694 | $2,346,685 | $3,059,929 | $3,297,676 |
| **5** | -$1,821,600 | -$632,861 | $555,878 | $1,744,617 | $2,933,356 | $3,824,911 | $4,122,095 |
| **6** | -$2,185,920 | -$759,433 | $667,054 | $2,093,541 | $3,520,028 | $4,589,893 | $4,946,515 |
| **7** | -$2,550,240 | -$886,005 | $778,229 | $2,442,464 | $4,106,699 | $5,354,875 | $5,770,934 |
| **8** | -$2,914,560 | -$1,012,577 | $889,405 | $2,791,388 | $4,693,370 | $6,119,857 | $6,595,353 |
| **9** | -$3,278,880 | -$1,139,150 | $1,000,581 | $3,140,311 | $5,280,042 | $6,884,839 | $7,419,772 |
| **10** | -$3,643,200 | -$1,265,722 | $1,111,756 | $3,489,235 | $5,866,713 | $7,649,821 | $8,244,191 |
| **11** | -$4,007,520 | -$1,392,294 | $1,222,932 | $3,838,158 | $6,453,384 | $8,414,804 | $9,068,610 |
| **12** | -$4,371,840 | -$1,518,866 | $1,334,108 | $4,187,082 | $7,040,055 | $9,179,786 | $9,893,029 |
| **13** | -$4,736,160 | -$1,645,438 | $1,445,283 | $4,536,005 | $7,626,727 | $9,944,768 | $10,717,448 |
| **14** | -$5,100,480 | -$1,772,011 | $1,556,459 | $4,884,928 | $8,213,398 | $10,709,750 | $11,541,867 |
| **15** | -$5,464,800 | -$1,898,583 | $1,667,635 | $5,233,852 | $8,800,069 | $11,474,732 | $12,366,286 |
| **16** | -$5,829,120 | -$2,025,155 | $1,778,810 | $5,582,775 | $9,386,740 | $12,239,714 | $13,190,706 |
| **17** | -$6,193,440 | -$2,151,727 | $1,889,986 | $5,931,699 | $9,973,412 | $13,004,696 | $14,015,125 |
| **18** | -$6,557,760 | -$2,278,299 | $2,001,162 | $6,280,622 | $10,560,083 | $13,769,679 | $14,839,544 |
| **19** | -$6,922,080 | -$2,404,871 | $2,112,337 | $6,629,546 | $11,146,754 | $14,534,661 | $15,663,963 |
| **20** | -$7,286,400 | -$2,531,444 | $2,223,513 | $6,978,469 | $11,733,426 | $15,299,643 | $16,488,382 |

*Notes: Fixed/overhead costs allocated on a per plant basis. Average savings and cost data used.*
*Source: CAR Research.*

According to CAR analysis, suppliers could theoretically achieve positive cashflow (i.e. annual savings incurred less technology subscription costs) during the first year of implementing RFID tracking beginning at ~20 percent of projected savings-levels. See Table 4.

*Table 4: Suppliers: Cash Flow Sensitivity Analysis by Plant in Year #1*

| | Confidence Intervals | | | | | | |
|---|---|---|---|---|---|---|---|
| **# Plants** | **0** | **0.2** | **0.4** | **0.6** | **0.8** | **0.95** | **1** |
| **1** | -$18,000 | $12,483 | $42,967 | $73,450 | $103,933 | $126,796 | $134,417 |
| **2** | -$36,000 | $24,967 | $85,933 | $146,900 | $207,867 | $253,592 | $268,833 |
| **3** | -$54,000 | $37,450 | $128,900 | $220,350 | $311,800 | $380,388 | $403,250 |
| **4** | -$72,000 | $49,933 | $171,867 | $293,800 | $415,733 | $507,183 | $537,667 |
| **5** | -$90,000 | $62,417 | $214,833 | $367,250 | $519,667 | $633,979 | $672,083 |
| **6** | -$108,000 | $74,900 | $257,800 | $440,700 | $623,600 | $760,775 | $806,500 |
| **7** | -$126,000 | $87,383 | $300,767 | $514,150 | $727,533 | $887,571 | $940,917 |
| **8** | -$144,000 | $99,867 | $343,733 | $587,600 | $831,467 | $1,014,367 | $1,075,333 |
| **9** | -$162,000 | $112,350 | $386,700 | $661,050 | $935,400 | $1,141,163 | $1,209,750 |
| **10** | -$180,000 | $124,833 | $429,667 | $734,500 | $1,039,333 | $1,267,958 | $1,344,167 |
| **11** | -$198,000 | $137,317 | $472,633 | $807,950 | $1,143,267 | $1,394,754 | $1,478,583 |
| **12** | -$216,000 | $149,800 | $515,600 | $881,400 | $1,247,200 | $1,521,550 | $1,613,000 |
| **13** | -$234,000 | $162,283 | $558,567 | $954,850 | $1,351,133 | $1,648,346 | $1,747,417 |
| **14** | -$252,000 | $174,767 | $601,533 | $1,028,300 | $1,455,067 | $1,775,142 | $1,881,833 |
| **15** | -$270,000 | $187,250 | $644,500 | $1,101,750 | $1,559,000 | $1,901,938 | $2,016,250 |
| **16** | -$288,000 | $199,733 | $687,467 | $1,175,200 | $1,662,933 | $2,028,733 | $2,150,667 |
| **17** | -$306,000 | $212,217 | $730,433 | $1,248,650 | $1,766,867 | $2,155,529 | $2,285,083 |
| **18** | -$324,000 | $224,700 | $773,400 | $1,322,100 | $1,870,800 | $2,282,325 | $2,419,500 |
| **19** | -$342,000 | $237,183 | $816,367 | $1,395,550 | $1,974,733 | $2,409,121 | $2,553,917 |
| **20** | -$360,000 | $249,667 | $859,333 | $1,469,000 | $2,078,667 | $2,535,917 | $2,688,333 |

*Notes: Fixed/overhead costs allocated on a per plant basis. Average savings and cost data used.*
*Source: CAR Research*

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