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RFID LAB

"PROJECT ZIPPER"

EPC-ENABLED ITEM-LEVEL RFID SUPPLY CHAIN BRAND / RETAILER DATA EXCHANGE STUDY

PHASE 1: JUNE 2017 – JULY 2018

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1 Acknowledgements

This research would not be possible without the support of GS1 US®. We would like to thank the following individually for their invaluable contributions:

Michelle Covey
Julie Hansberry
Kaitlin Friedmann
Patrick Javick

For a detailed executive summary of this paper as well as interviews with participants, webinars, links, and other resources please visit:

www.gs1us.org/projectzipper

We also acknowledge the very valuable contributions of Zebra Technologies, Mojix, Inc., and Microsoft for their equipment, resources, and domain expertise.

Finally, we would like to thank Dr. Jack Crumbly at Tuskegee University for his insight, assistance, and his dedication to his students and the Tuskegee team: Clarnetta Madden, Ashley McCain, and Takyshia Woods.

We appreciate and applaud these companies for sponsoring research that benefits retailing, supply chain, and manufacturing.

Contents

2 Executive Summary

The goal of Project Zipper was to evaluate and analyze the benefits of Radio Frequency Identification (RFID) technology to retailers and brands through their supply chain shipping and receiving processes. This report outlines the parameters of the study, the conclusive results for Phase 1 of the project, learning opportunities drawn from findings, and return on investment (ROI) implications.

3 Abstract

Since the advent of the barcode in the 1970s, the flow of information and goods between brands and retailers has been relatively consistent—a purchase order is issued from a retailer, the brand collects the products to be sent to the retailer, an advanced shipping notice (ASN) is created, the products are shipped, the retailer receives the products, and any difference between what is ordered and what is received is reconciled. The process is straightforward and established, however, inherent errors introduced at various stages of the process are not understood.

Figure 1

In this study, we examined the flow of information between eight brands and five retailers from June 2017 to July 2018 to evaluate and analyze process errors. Three specific data streams were collected from each partner throughout the course of the study. We collected Universal Product Code (UPC or U.P.C.) data from product barcode scans at the distribution center (DC) of each brand and retailer, as well as ASN data associated with relevant orders and shipments; these two data streams comprise “legacy” supply chain data. Additionally, these products passing through brand and retailer DCs were

RFID-enabled, permitting us to collect Electronic Product Code (EPC®) data simultaneously with U.P.C. data.

Overall, the results were unexpected. We originally speculated that, given the longevity of use and the stability of the process, errors would be few. However, using solely U.P.C. data—the primary form of data capture and sharing currently—almost 70% of the orders contained an error somewhere along the supply chain process. These errors were manifested in picking, shipping, and receiving, resulting in inventory inaccuracies, at best, and claims (i.e., chargebacks) from the retailers to the brands, at worst. Interestingly, we found that brands and retailers generally accept the inherent errors in the process, and that they attempt "workarounds" which often result in additional errors. Conversely, for those brands using RFID tags to capture information and reconcile shipments, order accuracy was greater than 99.9% (only one order had an error). During this study, claims from the retailer were eliminated for those using RFID technology.

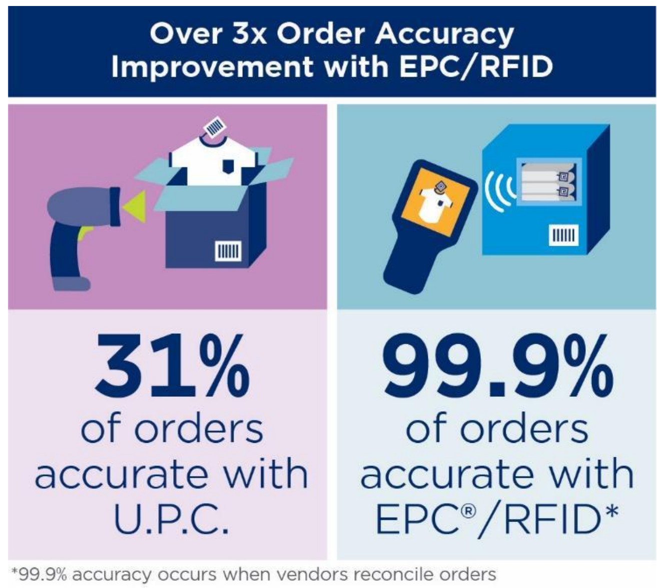

Figure 2

The results from this preliminary study should not be considered representative of the entire population of brands and retailers. However, given that all of the study participants are major retailers and brands and that the study spanned over a year, the dramatic results we observed should be granted due consideration. In an era of omnichannel retail—which demands high inventory accuracy—the errors created in the supply chain propagate downstream and ultimately impact a retailer's ability to meet customer demand in a timely manner. As our results suggest, several of these errors found at the store or in direct shipments to the consumer via a retailer's fulfillment center are caused by the upstream disparity between the information flow and the physical product flow amongst brands and retailers. Furthermore, as demonstrated in this study, RFID technology eliminates the errors commonly found in the process, ensuring the accurate flow of information and products.

4 Overview

This paper is divided into several sections. Participants and Partner Pair matching is explored in Section 4, and some terminology is introduced regarding the concepts of EPC pick reconciliation vs EPC pick monitoring. Sample orders are introduced to show the matching process for legacy ASN systems vs item level RFID shipping and receiving. Opportunities for improvement are explored in depth, including some basic best practices for properly deploying item level monitoring in the supply chain. Analysis focuses heavily on the current state of accuracy achieved through traditional supply chain practices, and the impact of RFID on these traditional practices is compared. ROI is discussed. Finally, next steps for research are included in the Conclusions section.

5 Participants

The data capture portion of the Project Zipper study included eight brands and five retailers. As part of the study parameters, each brand and retailer was asked to identify and enable one DC with RFID technology. In general, brands have fewer DCs in the U.S. than their retail trading partners. For example, a large denim manufacturer may have five or less DCs, while a large retailer may have twenty or more. The RFID-enabled DCs were chosen based on geographic alignment to optimize EPC data capture between retailer and brand. On the brand side, outbound order data was captured and recorded on its way to the retailer, where inbound order information was collected and used to compare against upstream brand data sets.

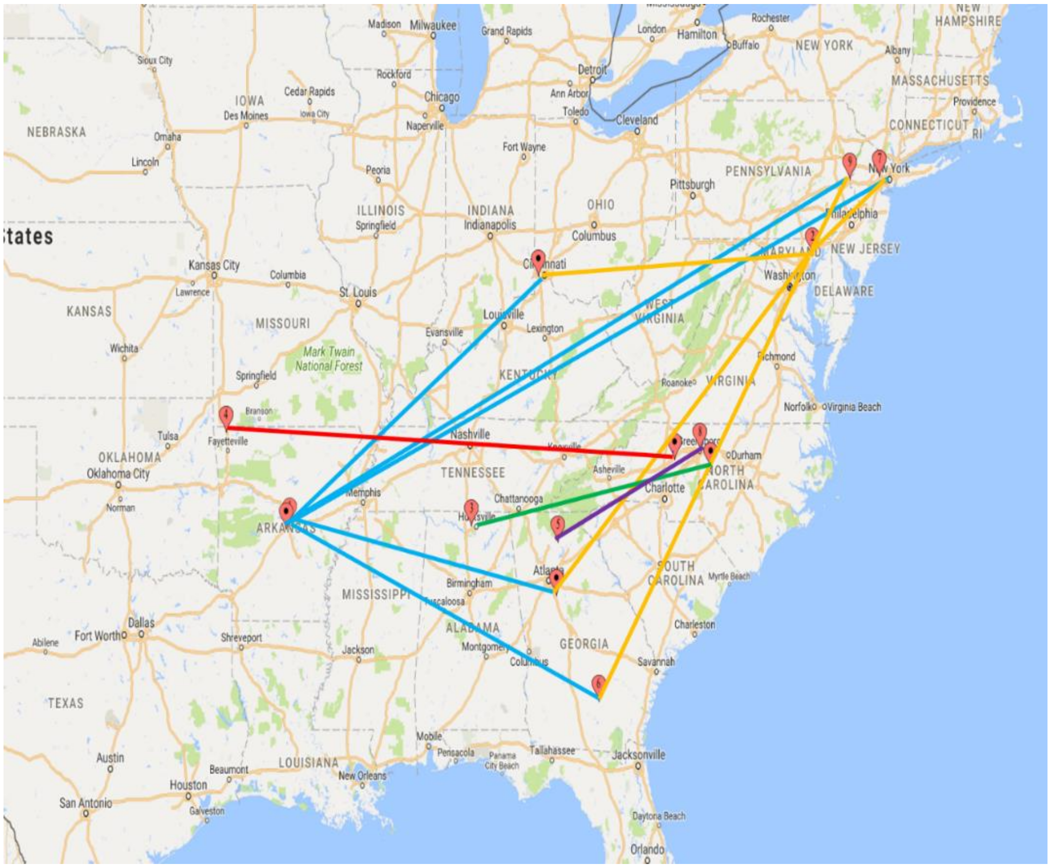

Figure 3 - DC Partner Pair Mapping

5.1 Brands and Retailers

The brands and retailers that were selected for the study volunteered based on their interest in EPC data exchange. Not all participating brands had a trading relationship with all the participating retailers, and some participants only had a single partner in the study. Most of the products chosen for study were already EPC tagged at the source for current industry programs, so temporary tagging solutions were not required. The majority of the products included in the study were apparel products.

5.2 Selecting Partner Pairs

The brands and retailers in the study naturally aligned themselves in "partner pairs", meaning that a pre-existing trade relationship existed between a brand and a retailer, and that relationship was utilized for the purpose of the study. Because there were more brands than retailers in the study, some retailers were matched with multiple brands and belonged to several partner pair relationships. Partner pairs were generally selected between brands and retailers that would yield the greatest volume of actionable data. There were eleven partner pairs in the study.

6 Pilot Program Order Reconciliation

There are two methods of using EPC to validate orders leaving a brand DC: EPC Order Reconciliation and EPC Order Monitoring.

EPC Order Reconciliation is a method for validating EPC-enabled orders in which the brand picks the items for shipment as they normally would using a barcode scan, but they also capture the EPC information on a case level during the picking process. If the EPC pick data and the barcode pick data do not match, then the case is held, and the picker is required to investigate and re-pack the case until the barcode data and the EPC data are in full agreement.

EPC Order Monitoring occurs when the case is picked using a barcode scan system. After a case is picked and sealed, the case is scanned with an EPC scanner and its internal contents are recorded. If the EPC scan and the barcode scan are not in alignment, the discrepancy is noted but the case is not reopened or reworked.

During Project Zipper, two of the brands used EPC Order Reconciliation, while the remaining six brands used the EPC Order Monitoring method.

6.1 Failure Analysis

Ideally when an order is prepared, the picklist matches the legacy barcode pick scans, which should also match the EPC scan, and this congruent information is populated onto the ASN. In practice, all of these data fields do not necessarily align. Several sources of failure are listed below, and they are treated in-depth in the Appendix.:

1. Item Not Picked – Case Short
2. Item Over-picked – Case Long
3. Item Mis-picked – Case short on 1 SKU (stock keeping unit), and long on 1 SKU
4. No EPC Tag
5. Multiple EPC Tags - Double or more EPC tags on same item
6. Incorrect EPC Tag – EPC tag data doesn't match legacy barcode information
7. Incorrect EPC Encoding or Serialization
8. EPC RFID Non-performing – EPC tag is present but was not captured on RF scan

7 Data Reconciliation

Following is a sample of an order including comparison and analysis of brand barcode scans, brand EPC scans, ASN, retailer barcode scans, and retailer EPC scans. A sample order is included to understand the different types of issues encountered. The table below illustrates the designation of these data streams to their appropriate owners, as well as the ASN information that is shared between the brand and the retailer.

Brand		ASN	Retailer	
EPC	U.P.C./Barcode (Legacy System)	ASN	EPC	U.P.C./Barcode (Legacy System)

A common goal for both brands and retailers is to accurately send and receive the same number of cases, SKUs, and items per shipment. In order to measure the effectiveness of this goal, each of the five data streams were monitored independently (brand EPC, brand barcode, ASN, retailer EPC, and retailer barcode) and compared by case, SKU, and item.

7.1 Example: Order 417582

Order 417582 is an example of an ideal order for a brand and retailer. First comparison is the outbound shipment accuracy from the brand.

Brand Shipping Accuracy

According to the brand barcode data for this order, there were 72 Cases, and included in these Cases were 197 SKUs with 751 items. This data was confirmed by both the ASN and brand EPC data in Figure 4. Generally, in most of the orders that were processed in the project, the brand barcode data matched the ASN, as was also true for this example.

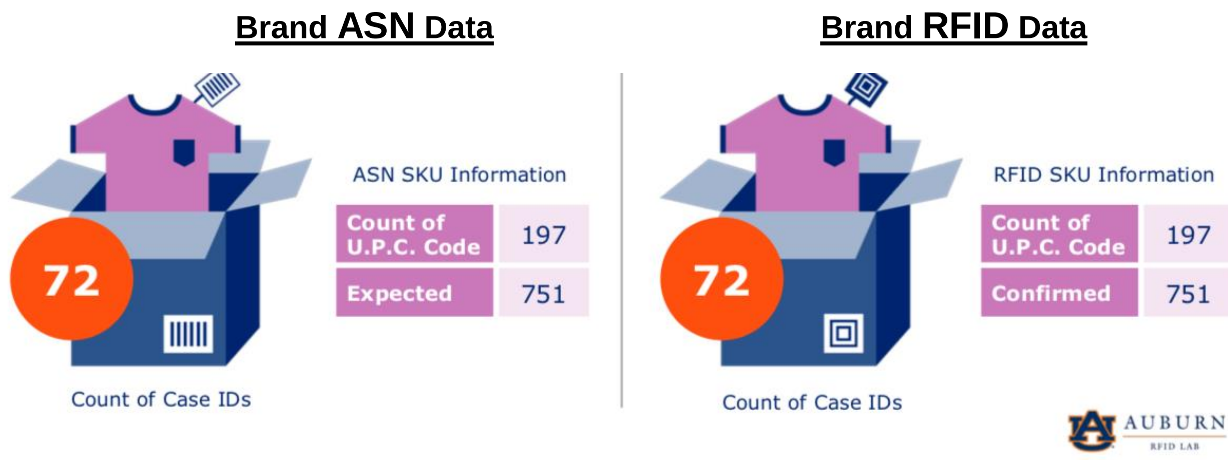

Figure 4

Overall, these visualized data sets communicate that the brand confirms that all ASN, RFID, and barcode counts at the case, SKU, and item levels match up perfectly before they are shipped. Figure 5 shows that on the brand's side, the number of SKUs expected in the ASN and the number of SKUs confirmed by RFID were the same. Order accuracy is often measured by how many SKUs are inaccurate, and to what degree, however that was not an issue in this instance.

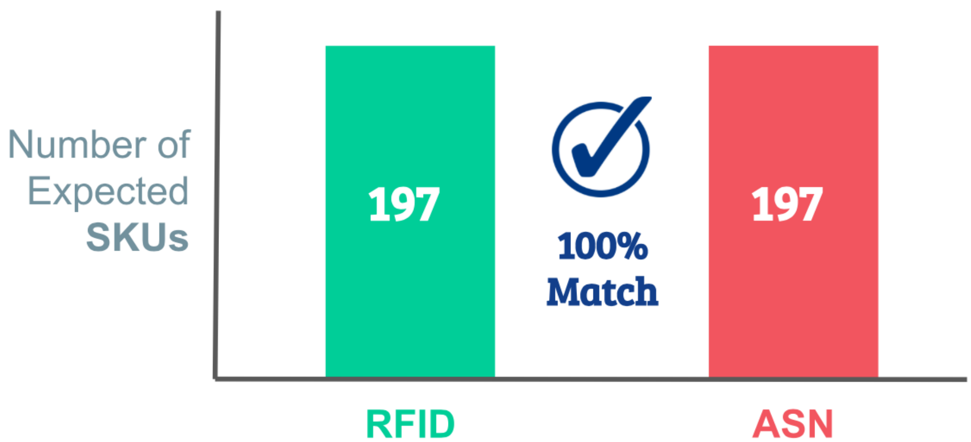

Figure 5

All SKUs, or unique U.P.C.s, are accounted for and confirmed by RFID and ASN data.

Retailer Receiving Accuracy

Introducing the retailer barcode data and the retailer EPC data allows us to compare the reconciled brand shipment for retailer accuracy. The data below in Figure 6 compares the brand's EPC item count to the retailer's EPC item count. The brand counted 751 total items for this order. Since order quantities can be extremely large, a common industry practice is for the retailer to audit around 5% of the total inbound shipments that they receive. For this order, the retailer's EPC data recorded 35 items, which correlates to the 5% order auditing process.

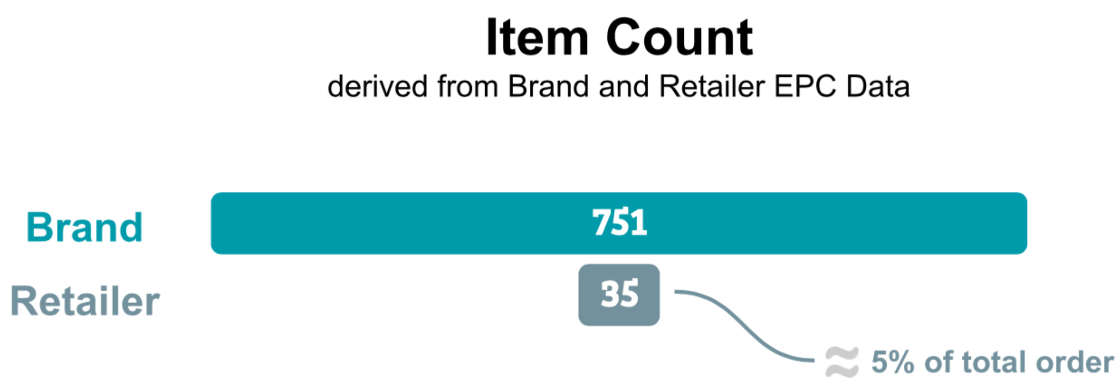

Figure 6

The 35 matching RFID items between the brand and the retailer in this order correlates with the retailer audit explanation above, indicating that this order was accurately received.

This data strongly suggests that all cases and SKUs are accurately accounted for between the brand and the retailer.

Pulling It All Together

Out of the total amount shipped from the brand to the retailer, the data below shows that the 5% audit from the retailer consisted of 3 cases, 12 SKUs, and 35 items. This subset of the brand's RFID data is included in Figure 7 for a relative comparison to the retailer's RFID data.

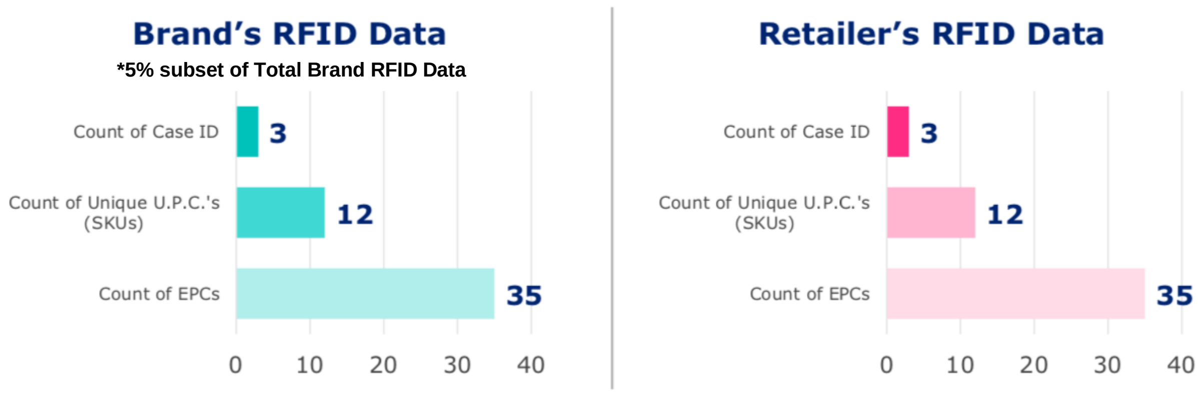

Figure 7

For the retailer's U.P.C. data in Figure 8, their barcode scanner only reads the case ID's, so the expected item count was provided by the retailer. Once more, the brand's matching ASN data was extracted for comparison purposes to reflect the retailer's 5% order audit process.

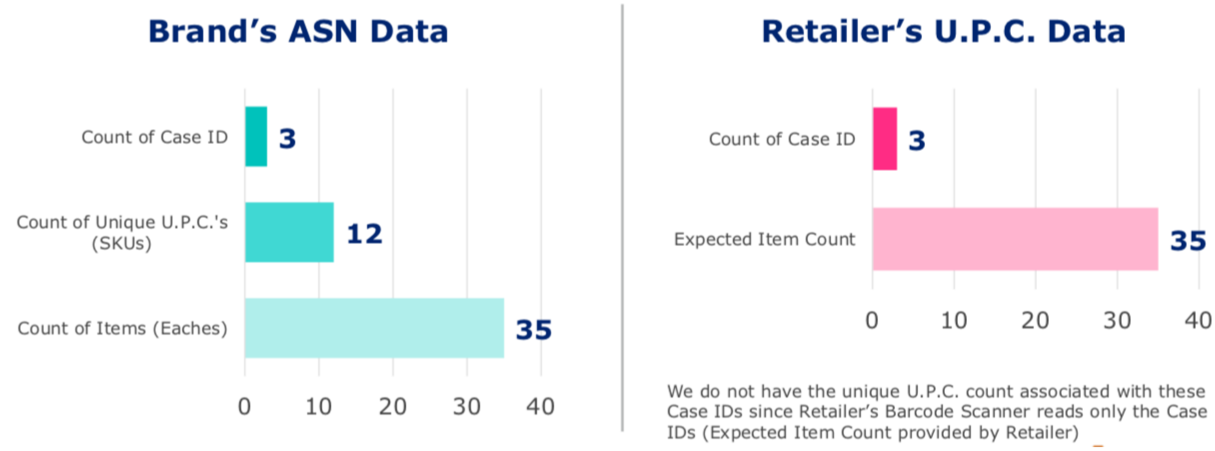

Figure 8

Because of the implementation of RFID, everything that was supposed to be shipped from the brand made it successfully to the retailer, and corresponding item-level data was available to support this claim. Overall, RFID technology was essential in precisely tracking all cases, SKUs, and items during transportation from the brand to the retailer, and this order's success reflects that.

7.2 Example: Order 006251413

Order 006251413 is an example of a more complicated order with mismatched data.

Brand Shipping Accuracy

Figure 9 shows the brand RFID data and the ASN data that matched outbound from the brand DC. There were 42 Cases, and included in these Cases were 168 U.P.C.s with 1170 items.

ASN-Tagged SKU Information

Count of U.P.C. Code	Quantity
168	1170

Figure 9

Basically, this data displays the brand's ASN case count, SKU count, and item count before the order was shipped.

Figure 10 shows that 168 SKUs matched between the ASN and brand RFID data, and 157 of these SKUs were an exact quantity match. However, for this particular order, some SKUs were overstated (ASN count of items in the SKU was greater than RFID), and some were understated (ASN count of items in the SKU was less than RFID). Five SKUs were overstated by one item, three SKUs were overstated by two items, and two SKUs were overstated by three items. Finally, only one SKU was understated by one item.

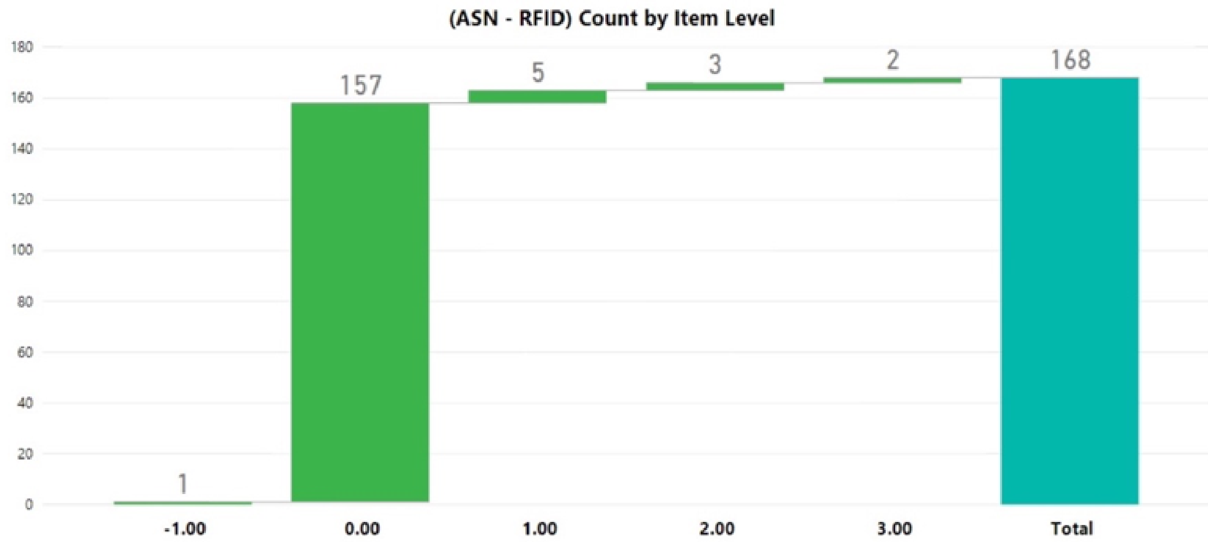

Figure 10

The majority of these SKUs (157) were an exact item quantity match, meaning the brand's expected ASN SKU counts and RFID SKU counts were correctly accounted for. Some of the SKU counts were overstated, simply meaning that when the expected SKU counts between the Brand's ASN and RFID data were compared, the ASN item count was higher than the RFID item count. There are several possible causes for this, which are discussed in depth in the Appendix under Failure Analysis. Similarly, one SKU was understated, which means that for some reason the scanner read more RFID tags than items listed on the ASN. Reasons for understated SKUs are discussed in the Appendix as well, but it is important to note that overstated and understated SKUs often come in pairs. If an item is mis-picked, for example a medium shirt is accidentally picked instead of a large, that creates two errors. The first error is that the large is now overstated because the case has one fewer large than expected, and the second error is that the medium item is now understated because there are too many of that SKU in the case. In this example, due to the fact that this order was captured early in the deployment of RFID in the DC, it is likely that there may have been some untagged inventory. In early deployments, it is not unusual to find 1-2% of the inventory untagged until all of the untagged inventory is flushed out of the supply chain in the steady state of long term RFID tagging.

Retailer Receiving Accuracy

Figure 11 compares the RFID item counts between the brand and retailer, and shows that the brand's item match from the RFID data was 1156 items.

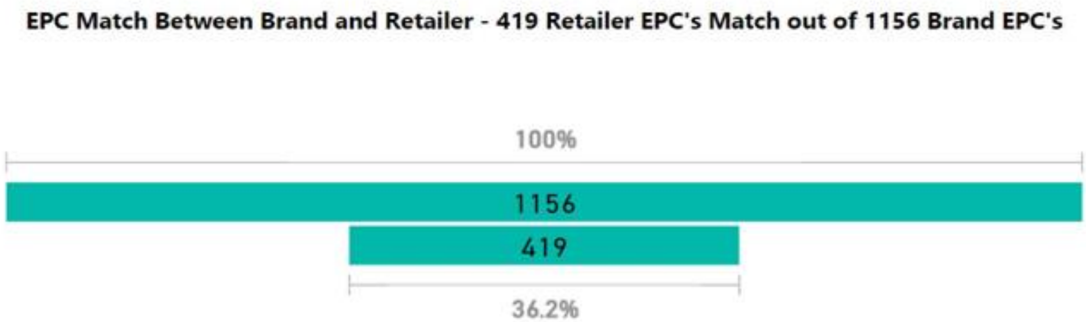

Figure 11

Figure 11 also shows that the inbound RFID readers at this retailer's distribution center only recorded around 36% of the total inbound shipment, which was 419 items. As with the previous order, this is most likely due to the retailer's receiving lanes not being fully RFID deployed, so some cases on inbound did not pass by RFID scanners. We were able to identify that the 419 items matched from the retailer's RFID data were distributed among 17 unique cases. We focused the brand to retailer comparison on these 17 cases, as we can confirm that they passed through RFID enabled outbound tunnels from the brand, as well as RFID enabled inbound tunnels from the retailer. A second potential cause of the lower RFID matches by the retailer is that the retailer's RFID scan portals were not yet fully performance optimized.

Pulling It All Together

The data in Figure 12 confirmed that 17 Case IDs were accounted for by both the brand and the retailer. Figure 12 shows that the Brand's ASN data recorded 72 U.P.C.s and the Retailer's U.P.C. data recorded 69 U.P.C.s.

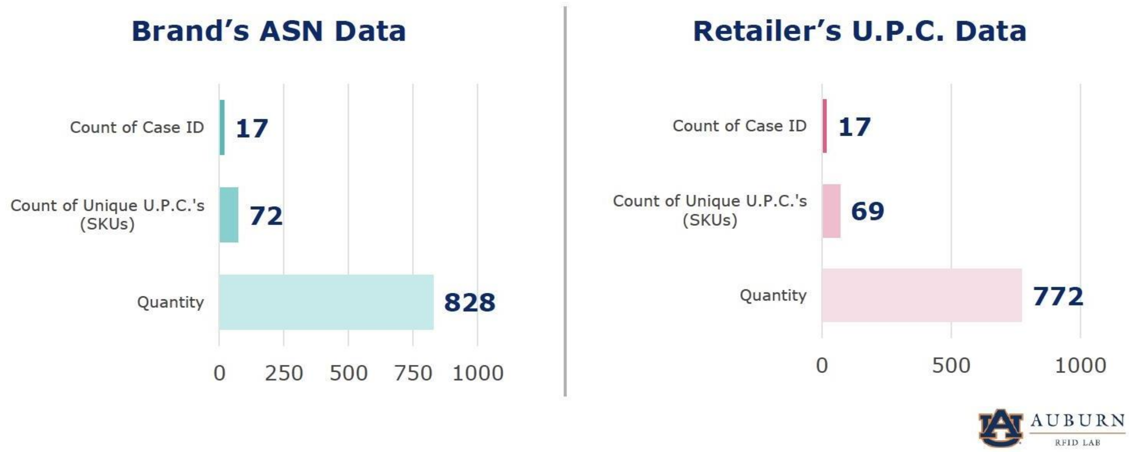

Figure 12

It also shows that the brand U.P.C. count was 72, while the retailer's U.P.C. count was 69. It is important to note that this comparison does not yet include RFID data. In this order, using legacy shipping and receiving processes, the retailer counted three fewer SKUs and 56 fewer items than the brand confirms they shipped. This means that the order is mis-matched. This type of mis-match is the current industry basis for generating a claim or chargeback.

Figure 13 shows the RFID data streams from the brand and the retailer for these same 17 cases. The brand RFID item count is slightly smaller than the ASN count, and the RFID item count on the retailer side is significantly smaller. This difference is due to the need for optimization of the retailer's RFID tunnel.

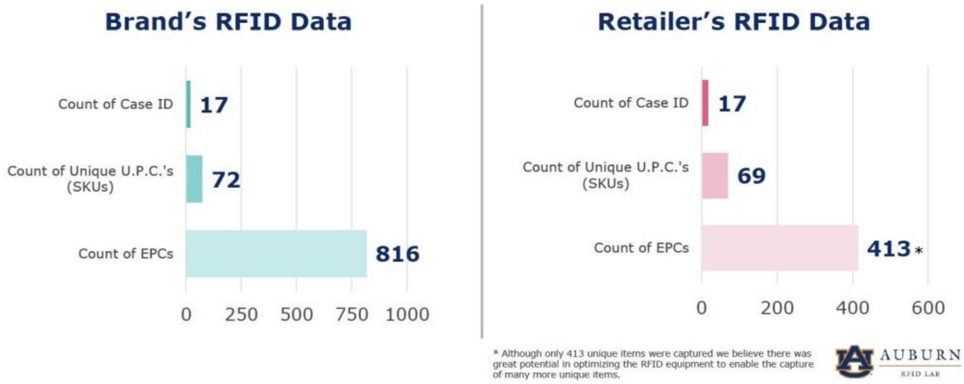

Figure 13

Figure 14 combines Figures 12 and 13 to allow for an easier comparison of the Quantity counts.

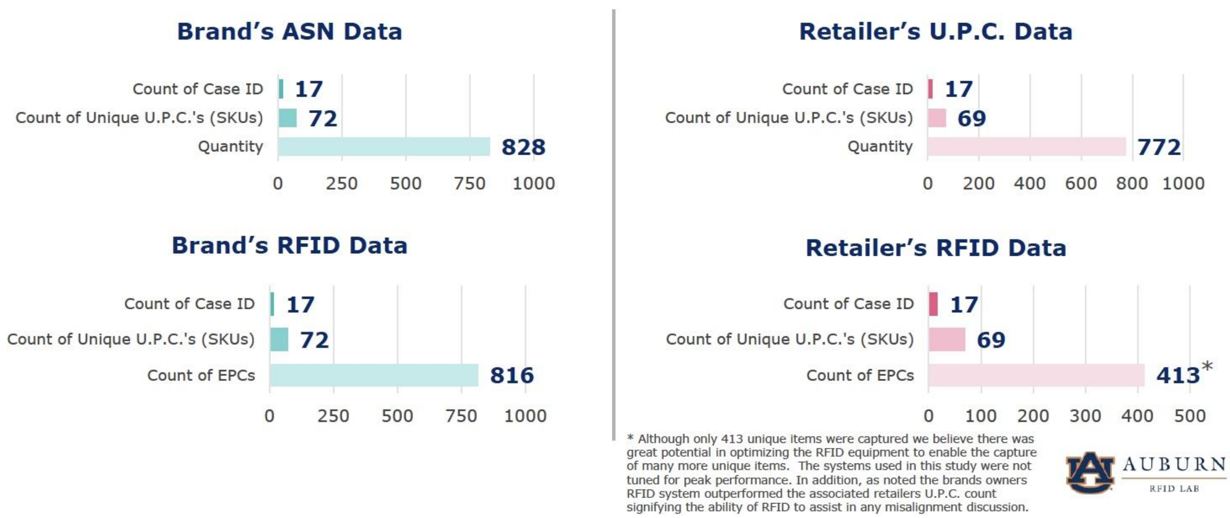

Figure 14

Several things are apparent from these discrepancies. First, because the ASN item count and the RFID item count doubly confirm the presence of 816 items, it is highly likely that all of these items were actually included in the shipment. Second, the retailer's barcode receipt data is significantly lower than the brand's ASN information as well as the brand's RFID data, which strongly indicates that the retailer miscounted the item and SKU quantities on receipt with barcode receiving. Prior to RFID, this would have generated an erroneous claim. Finally, we can see that even when RFID scanning equipment is not perfectly optimized, the data it generates can still be more accurate than legacy barcode count processes.

8 Opportunities

During the study, we identified several areas such as supply chain operations, shipment management, and data handling methods where significant improvements could be made as a result of the project findings.

8.1 Legacy Data Availability

In an ideal setting, when a brand picks a case for an order, they would verify the individual items placed into the case. A typical case pick operation would involve scanning the serialized case code, which will then retrieve the picklist associated with that case. The picker will then find each item on the picklist and scan the barcode of that item as it is inserted into the case. Once completed, this process will verify the entire picklist. After the pick operation is finished, the scanned item data from the picking process is uploaded to the ASN of the designated order as it is prepared to ship from the facility.

Additional measures are frequently implemented to verify that the order was picked correctly. One example is the use of weigh scales during the picking process, which are used to weigh each case and compare it with the pre-calculated weight of a full case. Also, manual case audits are performed. Commonly, 5% of packed cases are diverted to a manual audit station, where the boxes will be opened and counted a second time to verify that the case has been accurately assembled.

For the purposes of this study, each brand was asked to provide the pick barcode scan data for each case after it was packed. EPC data was also collected from the case after the pick process for comparison. Finally, ASN data was requested to enable an additional level of analysis concerning the barcode data used to populate the ASN, while the EPC data was utilized to assess both legacy data streams.

We frequently found that the barcode data from the pick process was not available for export. In many cases, this level of barcode scan data was deleted within a day or less after the pick was completed. Access to this data to verify against other data streams, or to assess errors when they are found further downstream would be valuable.

Also, this barcode data from the pick process should be used to directly populate the ASN. However, in some instances we found that the ASN was being generated beforehand and was then used to populate the picklist for each case, with the expectation that an incorrectly-picked case would be manually corrected before the case is added to the final shipment. This results in the order being populated directly into the ASN, and any mis-picks are not reflected in the ASN.

Direct access to the item-level barcode scan data would highlight any order discrepancies prior to the ASN, and it would also help to quantify the amount of labor that is being spent on correcting inaccurate picks.

8.2 Hardware Setup

Multiple RFID hardware setups with varying sophistication levels were used by trading partners. Some brands and retailers are using dedicated RFID tunnels or scan locations that were designed to isolate EPCs that pass through the portal and assign them to individual cases which have their own serialized case codes. With proper calibration and appropriate tag selection, achieving 100% case scan accuracy is entirely possible (see the order data regarding EPC reconciling brands).

In other instances, due to the exploratory nature of the project, it was not possible to install RFID portals that were capable of isolating EPCs to individual cases for the purposes of the study. We were able to capture large volumes of EPCs and compare them to the day's orders, but it was often difficult to isolate and resolve exactly which case(s) contained each item. This made it challenging to reconcile the EPC data stream against the barcode data streams.

Based on the results of the study, it is strongly encouraged for brands and retailers to invest in an RFID solution that will allow for case pack isolation.

8.3 Outbound Reconciliation

From the data reported, it is clear that it is highly preferable to validate case picks with an RFID solution before the case is sealed. It is possible to verify the EPC reads after the case is sealed, but this process usually requires a case to be diverted to a separate line where it is then corrected. The simpler corrective action is to simply resolve the error as the case is packed, rather than creating separate processes to diagnose the error and perform the corrective action after the pack process is complete.

8.4 Case Level Validation

In many of the datasets, it was not possible to reconcile the EPCs to the matching serialized case codes. For example, a pallet of 50 cases is packed and ready to ship, and is scanned with a handheld EPC scanner. This method would provide the total quantity of EPC-tagged items on the pallet, but if there is a discrepancy within the order, it may not immediately identify the specific case that contains the error. If possible, isolating EPC scans to a specific case code yields more precise and actionable results, especially when it comes to resolving issues.

8.5 ASN Mismatch

Occasionally, a brand's pick data does not match the related ASN information. Also, in a few instances the retailer's ASN information did not match the brand's ASN information for the same order. For most retailers, providing ASN data for a particular order was a fairly complicated task. One reason for this difficulty is that the ASNs are modified with other information, including unknown adjustments to expected SKU or item quantity. This may be due to split shipments (the order was split into two shipments on different dates due to logistics) or other unknown factors. Some retailers were unaware of how many internal systems had access to modify this ASN information or did not retain records of when or why it was modified. It is important to compare the ASN information between the brand and retailer to ensure they are working from the same set of information, and it is also important to note all of the different ways that an ASN can be adjusted or altered prior to shipment and on receipt.

8.6 Source Tagging

All of the RFID tagged items captured in the study were tagged at the source (point of manufacture). However, not all of the SKUs monitored in the study were RFID tagged, as not all brands and retailers are currently at 100% RFID source tagging for every SKU. This led to several instances where a single case included both EPC-enabled and non-EPC SKUs. For the most part, it is trivial to isolate the case data by SKU to discount the items that are not in the EPC program for the purposes of this study. However, to unlock full value for order accuracy and claims compliance, RFID source tagging across a company's full range of SKUs is recommended.

9 Analysis

Initial data from the study focused on the issue of current order shipment accuracy. Legacy systems typically consist of a case pack validation via barcode, weigh scale, or other measurement devices, and associate the item SKU counts with the serialized case ID. This information is used to inform the ASN, which is then shared with the retailer as the order is shipped. Retailers validate receipt of orders by weight and barcode at the case level against these ASNs.

How Accurate are our Legacy ASN Systems?

The first analysis of interest was the match accuracy between the legacy ASN data from the brands, and the barcode receipt data from the retailers. The initial data set was from the partner pairs in which the brands were EPC Order Monitoring (see Section 6). We found that in only 31% of the orders, the ASNs from the brands were fully matched by the inbound barcode data from the retailers. The other 69% of the orders had an inaccuracy where the brand ASN did not match what the retailer scanned inbound.

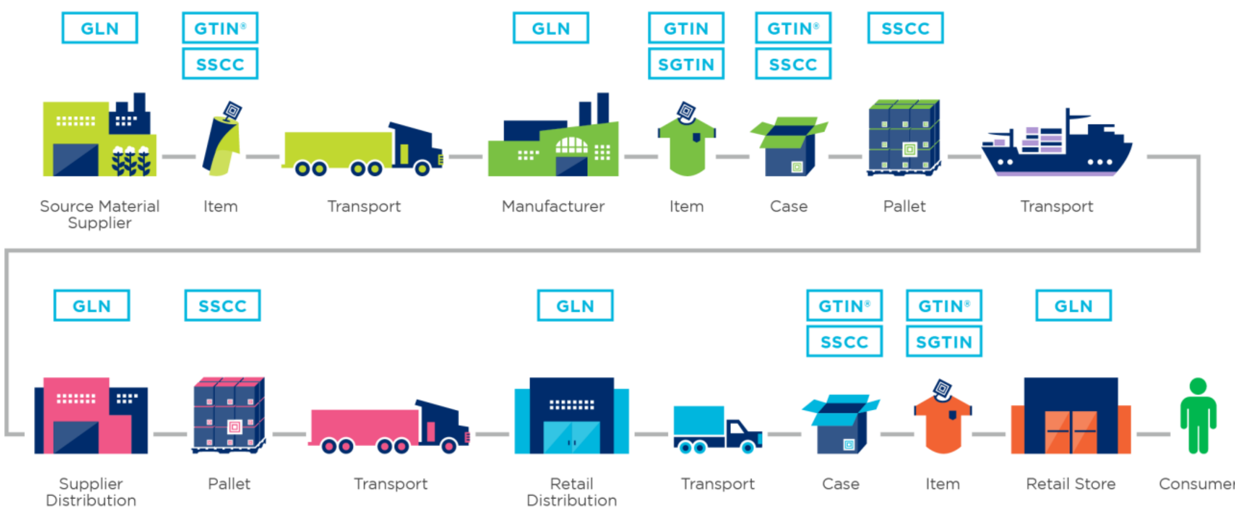

Figure 15 – Data Standards in the Global Supply Chain

It is important to note that this does NOT indicate that 69% of the orders shipped by brands were inaccurate. It simply means that the barcode counts of the brand and the retailer didn't match, and either party may be at fault. Consensus was not achieved. For this reason, we refer to orders where the ASN matches the retailer's barcode receiving as "aligned", and orders where the ASN does not completely match the retailer's barcode receiving as "misaligned". In general, barcode case pack auditing processes were found to be more rigorous at the brand DCs than the retailer DCs. Additional metrics regarding order accuracy are included below:

	Total Orders	Aligned Orders	Misaligned Orders
Average Number of Cases Per Order	18.47	11.3	21.52
Average U.P.C.s Per Order	69.37	38.5	82.57
Average Items Per Order	293.6	126.9	365.05

This trend is logical, as it is statistically more likely that larger orders contain more inaccuracies than smaller orders.

Additional analysis of the misaligned orders uncovers the following:

Average Magnitude of Inaccuracies by Order		
Cases	**SKUs**	**Items**
0.05	5.35	17.8

This indicates that when orders are misaligned, the inaccuracies tend to include multiple SKUs and multiple items. Data trends indicate that the larger errors may not be due to inaccurate shipments, but due to inaccurate auditing counts. The inference is that when mistakes are made in the auditing process, they are usually not simple miscounts but misses for larger number of items, for example, prematurely ending a case count. Alternatively, if the error was created due to an actual mis-pick of the items, when an incorrect SKU is picked, this causes inaccuracy in two SKUs at the same time (one overstated and one understated), and it also involves multiple items.

In short, there are huge opportunities for improvement in ASN order accuracy, and there appears to be a disconnect between the items that are actually shipped vs the items that are actually counted in the auditing process.

How Does RFID Reconciliation Improve Order Accuracy?

During the study, 14.7% of the orders were shipped from brands that are reconciling their outbound shipments by EPC. In over one year of data collection, the study discovered only a single error for a single item for these brands. In the last 10 months of the study there were no errors, and 100% ASN reconciliation between brand and retailer.

How Does RFID Reconciliation Compare with Legacy ASN Order Accuracy?

Legacy ASN match accuracy is currently around 31% by order for brands and retailers who aren't using RFID reconciliation for shipments.

For brands and retailers that are using RFID reconciliation, ASN match accuracy is 99.9+%. RFID reconciliation for picked orders eliminates mis-shipments and claims, and vastly improves ASN consensus between brands and retailers.

10 Conclusion

The study found that calculating ROI is a much simpler process than previous EPC implementations in retail sales environments. The equation is simply the cost of RFID tags plus RFID outbound reconciliation equipment and software, directly compared to the cost of claims for the shipments of that DC. A proper RFID reconciliation process will eliminate the claims cost.

Figure 16

Failure analysis requires more investigation and will be treated in depth in Phase 2 of the study. Best practices for efficient corrective actions based on failure analysis are also under development. Data is currently being collected to update this study's results regarding order shipment accuracy, which will also be updated in Phase 2. Finally, additional use cases for traceability, authenticity, and data exchange will also be investigated in the Phase 2 report.

11 History of RFID in Retail

In 2004, the Retail Sector began discussing adding RFID to its supply chain and brick-and-mortar stores. In late 2008, several leading retailers and their trading partners began rolling out and testing item level RFID. Since then RFID has been transforming global commerce, but it has also been subject to many myths and rumors. Today, leading retailers are embracing the new constant state of change with innovative ideas to win over digitally-savvy consumers. These consumers are using a smartphone to pinpoint the exact aisle where an item is located even before they step through the retailer's door. They can buy online and pick up in store, or instead have their purchases shipped home. They can search for an item from a dressing room mirror or consult with a mobile device armed sales associate who can expertly suggest different sizes, colors, or add-on items.

EPC enabled item level RFID is the critical technology underpinning these digital and physical experiences in retail today. Item level RFID tagging can help retail operations run smoother, faster, and with more agility. retailers are maximizing the benefits of item level RFID to generate new levels of customer satisfaction, leveraging it not only for greater inventory accuracy, but also for the ability to improve point-of-sale, decrease out-of-stocks, improve loss detection, boost sales margins and expedite returns.

In addition, major retailers are attributing cost savings and increased sales to RFID technology; the numbers simply don't lie. RFID technology:

- *Raises inventory accuracy from an average of 63% to 95%*
- *Reduces retail out-of-stocks by up to 50%*
- *Cuts cycle count times by 96%*

From display audit compliance, to multi-location customer order fulfillment flexibility, to improved replenishment execution—these use cases have shown the tangible results of item level RFID technology, proving its value in improving item level inventory accuracy and availability.

Retailer Value Use Cases – Inventory Intelligence

Item level RFID is driving visibility and efficiency as well as playing a critical role in helping retailers create a seamless omni-channel customer experience. Retailers around the globe are using it to increase inventory accuracy, decrease out-of-stocks (OOS), and improve loss detection as well as to get more product into their customers' hands than ever before. RFID-enabled systems help retailers:

- *Reduce costs and improve labor productivity*
- *Improve inventory accuracy and customer service*
- *Increase on-shelf stock levels and improve loss detection*
- *Improve product location timeliness / reduce the number of missing display items on the sales floor*
    - *Improve display compliance, reduce lost sales and overstock conditions*
    - *Enhance customer experience and improve store floor display execution*
- *Evaluate fitting room conversion trends*

Supplier Value Use Cases

The benefits of using RFID in the upstream supply chain have received far less publicity than those benefits at the retail store level. Brands have cited receiving, pick/pack and shipping accuracy as the core business case for supplier-side RFID. For them, RFID solutions are:

- *Proving their value in helping reduce operating expenses and improve margins*
- *Streamlining the pack-out process and reducing inventory errors (with instantaneous counting)*

- *Reducing labor costs, handling errors and improving productivity (via automation of current manual inventory tracking tasks)*
- *Lowering required inventory levels, increasing working capital savings and lowering associated carry cost expenses (by optimizing inventory levels and reducing safety stock)*
- *Reducing obsolete inventory write-downs (through better planning and visibility)*
- *Improving production asset visibility, helping to track inventory locations and reducing maintenance issues*
- *Reducing claims and returns (by assuring the right goods are sent where they should be)*
- *Enabling better audit and asset control (lowering inventory shrinkage as well as helping to eliminate losses and theft by keeping better track of goods)*

12 Glossary

Advanced Shipping Notice (ASN) – a notification from a brand to retailer of pending deliveries

Claims/Chargebacks – charges issued by a retailer to a brand due to incomplete or inaccurate order delivery

Case ID – a serialized identification code assigned to an individual case

Electronic Product Code (EPC) – a code used to identify a particular retail product with a unique serial number assigned to each physical item; also contains U.P.C. information, and is leveraged by RFID technology

Legacy Data – data utilized and produced by traditional supply chain information systems, namely U.P.C./barcode and ASN

Serialization – a method for identifying specific objects or items by assigning unique values to each object

Stock Keeping Unit (SKU) – a unique numerical value that refers to a specific stock item; subset of a product's U.P.C. data

Universal Product Code (UPC or U.P.C.) – a code used to identify a particular retail product that can be captured using barcode technology

13 Appendix A – Failure Analysis

There are several scenarios in which EPC data did not reconcile with barcode data or with ASN information. There are several causes listed below, as well as ways to identify and mitigate the issue:

1. Item Not Picked – Case Short
    a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist, or both. The EPC count is less than expected.
    b. Resolution: Manual count of the SKUs in the case.
2. Item Over-picked – Case Long
    a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist, or both. The EPC count is greater than expected.
    b. Resolution: Manual count of the SKUs in the case.
3. Item Mis-picked – Case short on 1 SKU, and long on 1 SKU
    a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist, or both. The EPC count is less than expected for one SKU, and more than expected from another SKU. Alternatively, it may contain a completely unexpected SKU. This issue is most likely to occur with similar items of a varying size, color, or style. Comparison of the long and short SKUs may identify the issue prior to manual count.
    b. Resolution: Manual count of the SKUs in the case.
4. No EPC Tag
    a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist, or both. The EPC count is less than expected.

   b. Pick Resolution: Manual inspection of the SKUs in the case. This issue can be difficult to identify, especially if the items are not tagged in a location where the tag is easily visually identifiable. For example, if a manual count verifies there are 20 shoes in a case, and the EPC count for tags embedded in the sole is 19, it may not be possible to identify the shoe with the missing tag without isolating each item individually and RFID scanning it.
   c. Tagging Resolution: Clearly identify when an item is EPC tagged and when it is not. Continuously validate source tagging practices at manufacturing to ensure full tagging compliance.
5. Multiple EPC Tag - Double or more EPC tags
   a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist, or both. The EPC count is greater than expected, however, a manual count of the case validates that there are fewer items present than the EPC count.
   b. Pick Resolution: Manual inspection of the SKUs in the case. This issue may be difficult to identify, especially if the items are not tagged in a location where the tag is easily visually identifiable. For example, if a manual count verifies there are 20 boxed electronics items in a case, and the EPC count for tags inside the packaging is 22, it may not be possible to identify the specific item/s with multiple tags without isolating each item individually and RFID scanning it.
   c. Tagging Resolution: Clearly identify when an item is EPC tagged and when it is not. Continuously validate source tagging practices at manufacturing to ensure full tagging compliance.
6. Incorrect EPC Tagging
   a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist, or both. The EPC count is less than

expected for at least one SKU, however, a manual count of the case validates that all of the items of that SKU are physically present.

b. Pick Resolution: Manual inspection of the SKUs in the case. This issue may be difficult to identify, especially if the items are not tagged in a location where the tag is easily visually identifiable. Usually the wrong EPC tag was applied to the wrong item, and this may require an item by item EPC scan to resolve.

c. Tagging Resolution: Clearly identify when an item is EPC tagged and when it is not; and provide human readable information on the tag regarding the EPC encoding. Continuously validate source tagging practices at manufacturing to ensure full tagging compliance.

7. Incorrect EPC Serialization
    a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist or both. The EPC count is less than expected, however, a manual count of the case validates that correct number of items by SKU are included.
    b. Pick Resolution: Manual inspection of the SKUs in the case. This issue may be difficult to identify, especially if the items are not tagged in a location where the tag is easily visually identifiable. Usually this error occurs for multiple items within the same SKU at once, and results in multiple items with identical serial numbers. It may not be possible to identify the specific item/s with incorrect serialization without isolating each item individually and RFID scanning it.
    c. Tagging Resolution: Clearly identify when an item is EPC tagged and when it is not; and include human readable information on the tag regarding its EPC serial number. Ensure proper encoding processes and utilization of standardized procedures. Continuously validate source tagging practices at manufacturing to ensure full tagging compliance.

8. Over-read
    a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist, or both. The EPC count is greater than expected, however, a manual count of the case validates that correct count and items are included. The EPC data captured does not match the case picklist. Stray reads from adjacent cartons are captured and assigned to the wrong case.
    b. Pick Resolution: Manual inspection of the SKUs in the case. This issue may be difficult to identify, especially if the item EPCs are not already individually assigned to a case.
    c. Tagging Resolution: Ensure RFID capture equipment is capable of isolating the unique tag reads between cases. Continuously validate source tagging practices to ensure best tag performance at manufacturing to ensure full tagging compliance.
9. EPC RFID Non-performing
    a. Identification: The EPC case count does not match either the legacy barcode case count, the picklist or both. The EPC count is less than expected, however, a manual count of the case validates that all items are physically included.
    b. Pick Resolution: Manual inspection of the SKUs in the case. EPC data is not available as the tag does not respond to interrogation.
    c. Tagging Resolution: Clearly identify when an item is EPC tagged and when it is not. Ensure proper tag and inlay selection. Continuously validate source tagging practices at manufacturing to ensure full tagging compliance.