White Paper

Analysis of Automatic Identification Technology-enabled Business Process Benefits

Procter & Gamble

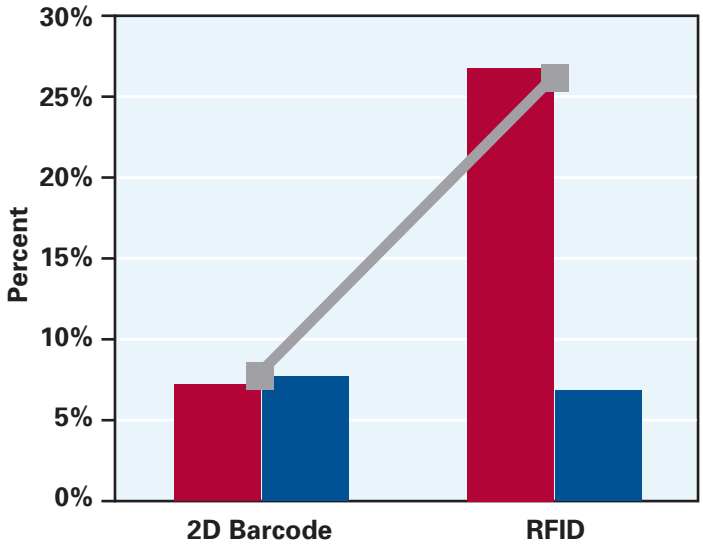
1.0 Executive Summary

The goal of the Analysis of AIT-enabled Business Process Benefits project was to model a discrete set of supply chain operations within Procter & Gamble (P&G) in order to identify the benefits and investment required to integrate two Automatic Identification Technology (AIT) alternatives, Passive UHF Radio Frequency Identification (RFID) and 2D Barcode. A key motivating factor for performing this analysis is the emergence of ePedigree legislation that requires electronic tracking of controlled pharmaceutical products. Both technology alternatives provide the necessary capability to comply with ePedigree legislation and can provide competitive strategic advantages through improvements in the supply chain process and in data management.

The RFID Solutions Center (RSC), XIO Strategies (XIO), and Edaptive Computing Inc. (Edaptive) began the project by working with P&G stakeholders to model and simulate a subset of the existing Actonel 35mg supply chain, from the packaging facility through the warehouse/distribution center. This is known as the As-Is Model. Using EDAptive® Syscape™, and P&G historical supply chain data, the team was able to develop an executable As-Is model that captured key supply chain metrics, including order cycle time; average process time; and overages, shortages, and damages (OSD). Upon completion of the As-Is model, the team defined both 2D barcode and RFID implementation models for tagging at the item, case, and pallet levels. Using Syscape™ the team was able to simulate these models and quantitatively analyze the costs and benefits of 2D barcode and RFID technologies for the Actonel 35 mg supply chain.

For the 2D Barcode model, required process time was reduced by 8%, while OSD was reduced 67%. In the case of RFID, required labor time was reduced by 26% and OSD was reduced by 67%.

In addition to the process improvements captured in the models, a number of other processes were identified as providing opportunity for benefit, including scrap count and annual inventory. The automatic identification and data capture enabled by the two technologies also provides a greater level of asset visibility, which can improve the returns process, the recall process, and shorten cycle times, which in turn can reduce required safety stock levels and associated holding costs. Greater visibility of the items and associated data provide management with the ability to be more responsive to business functions, through alignment of supply and demand, more responsive customer service, and process improvement.



Overall, the flexibility and scalability of the Edaptive Syscape™ modeling tool demonstrates the ability to quickly build a business process model. For this specific supply-chain subset, the team was able to create an initial executable simulation in less than a month. The resulting model reflects current operations and provides strategic insights through simulated potential improvement programs.

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2.0 Background Information

2.1 Project Team

Procter & Gamble

Three billion times a day, P&G brands touch the lives of people around the world. The company has one of the strongest portfolios of trusted, quality, leadership brands, including Pampers®, Tide®, Ariel®, Always®, Whisper®, Pantene®, Mach3®, Bounty®, Dawn®, Pringles®, Folgers®, Charmin®, Downy®, Lenor®, Iams®, Crest®, Oral-B®, Actonel®, Duracell®, Olay®, Head & Shoulders®, Wella®, Gillette®, and Braun®. The P&G community consists of over 135,000 employees working in over 80 countries worldwide.

RFID Solutions Center

The RFID Solutions Center (RSC) was the sole sub-recipient of the grant and provided overall program management as well as significant support for training, integration facility support, and RFID solution engineering support. The RSC provides UHF Radio Frequency Identification (RFID) services to customers in retail, consumer goods, manufacturing, defense, transportation and logistics, pharmaceuticals and other industries. The RFID Solutions Center (RSC) is the most advanced facility devoted entirely to the application of RFID technology. Open to enterprises, government agencies and their partners, the Center comprises 23,000 square feet of educational, R&D and real-world implementation resources designed to enable the global RFID community to tap the potential of RFID technology.

Edaptive Computing, Inc.

Edaptive Computing, Inc. (Edaptive) is an eleven year old small, 8(a) certified business based in Dayton, Ohio. Edaptive has developed intuitive, flexible and scalable business process simulation software called EDAptive® Syscape™, which combined with its professional services, enhances the strategic decision making required to comply with mandates, efficiently improve processes, and generate competitive advantage. Custom and rapid analysis results may include but are not limited to analysis of performance, cost, schedule, return-on-investment, resource requirements, process configurations, technology alternatives, and process changes. Military and aerospace customers of Edaptive include Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and their Prime Contractors who design or deploy large System-of-Systems. Commercial customers include organizations with interest in optimization of their supply chains or business processes.

XIO Strategies

XIO is a small, woman-owned business based in McLean, VA. XIO specializes in providing end-to-end supply chain management and change management consulting services for government, military and commercial organizations. XIO focuses on helping organizations realize the benefits of automatic identification technologies such as RFID and IUID. XIO currently supports multiple initiatives within the Department of Defense, including the Office of the Secretary of Defense in developing RFID and IUID policy and guidance, and the Navy AIT Program Office in RFID implementation planning and execution.

2.2 About Passive UHF Radio Frequency Identification

Radio frequency identification is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. Utilizing radio frequency waves, an RFID tag can be applied to or incorporated into a product for the purpose of location and identification. UHF Passive RFID can be read from several meters away and beyond the line of sight of the reader. Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a (RF) signal and can also be used for other specialized functions. The second is an antenna for receiving and transmitting the signal.

RFID technology is in increasing use in enterprise supply chain management, improving the efficiency of inventory tracking and management. Many major corporations are implementing systems to test the ability of this technology to improve asset visibility, product integrity and readiness throughout the supply chain.

The use of RFID in the pharmaceutical and retail supply chains has the potential to provide real benefits in inventory management, asset visibility, and interoperability in an end-to-end integrated environment. RFID encapsulates the data accuracy advantages inherent in all types of automatic identification technology (AIT). Additionally, RFID is a totally non-intrusive methodology for data capture (requires no human intervention), is non-line of sight technology, and is a technology that possesses both read and write options within the same equipment item.

RFID addresses a key challenge that has been noted at every node within the pharmaceutical supply chain – lack of visibility of item data and electronic pedigree (ePedigree). As an integral aspect of the overarching suite of AIT capabilities, RFID will become a key technology enabler for the pharmaceutical logistics business transformation and will support long-term integration of the Electronic Product Code (EPC) and ePedigree into the pharmaceutical end-to-end supply chain. RFID enables ePedigree and pharmaceutical companies to:

- Provide near-real time in-transit visibility for all classes of pharmaceuticals
- Provide "in the box" content level detail for all classes of pharmaceuticals
- Provide quality, non-intrusive identification and data collection that enables enhanced inventory management
- Provide enhanced item-level visibility
- Provide a method of verifying the authenticity and source of the smallest selling unit of the pharmaceutical

2.3 About 2-D Barcode

Two-dimensional (2D) barcodes are the next evolution of the barcode, providing greater capabilities than the more familiar linear barcode. The following are some examples of 2D barcodes.

Aztec

Data Matrix

MaxiCode

PDF 417

The Data Matrix is the selected barcode symbology within the Department of Defense for their Item Unique Identification (IUID) initiative. The MaxiCode is used by UPS for tracking and managing the shipment of packages. The PDF417 is widely used for shipping and postage, and is prominent in military shipping labels within the Department of Defense. The PDF417 is actually a stacked linear barcode, but falls within the category of 2D. For purposes of this discussion, we will consider the 'matrix' type of 2D barcodes.

Each of the different types of symbols provides greater data capacity than a standard linear barcode, and in many of the symbols has the capability to be read even if damaged. For the matrix barcodes, the symbol can be read from any direction – there are specific attributes that help the imaging device orient itself (such as the squares and circles in the middle of the Aztec and MaxiCode, or the left and bottom solid lines in the Data Matrix).

Similar to RFID technology, 2D barcodes are increasingly being use in enterprise supply chain management, improving the efficiency of inventory tracking and management. One of the key benefits of the 2D capability is the expanded data capacity, which allows greater information about the item, and helps enable item-level identification. Another benefit is the ability to use 2D barcodes in most environments and with most items.

The greatest operational benefits from using 2D barcodes derive from either 1) automatic identification and data capture, which saves time and reduces errors and 2) improved data management and asset visibility when coupled with an Automated Information System. However, there are some limitations to be aware of with 2D barcodes, include the following:

- Line-of-sight: while data can be captured electronically, the imaging device still needs to be pointed at the actual 2D barcode. For packaged or palletized items, items may not be accessible to be scanned.
- Write Once, Read Many: The 2D barcode cannot be "reprogrammed". If new or additional data is required, a new barcode will need to be generated.
- Multiple standards, multiple barcodes and readers: To operate successfully, specific standards have to be adhered to across the supply chain. Unless all parties know and agree upon the standard, data capture can be limited. A good example where this works is the adoption of the UPC as the standard within the grocery industry.

2D barcodes are being widely used and adopted in many industries, predominantly in defense, transportation, aviation, and automotive. It is also making inroads into healthcare and pharmaceuticals. Within the pharmaceuticals industry, off-the-shelf products are beginning to be marked with 2D barcodes. 2D barcodes will also be one of the options to addressing the e-Pedigree requirements as they unfold. The greatest challenge with 2D barcodes would be in the scenario where inference is not allowed. In this case, the line-of-sight requirement will create significant material handing time and effort in order to confirm the contents of pallets and packages.

3.0 Introduction and Purpose

The RFID Solutions Center ("RSC" or "project sponsor") contracted with Edaptive Computing, Inc. ("Edaptive") and XIO Strategies (XIO) to provide support for analysis of internal operational benefits of RFID technology to a supply chain and to help determine the most cost effective method for ePedigree compliance. Edaptive provided modeling and simulation expertise and its rapidly customizable software, namely EDAptive® Syscape™. XIO served as the subject matter experts ("SME") to support the development of this supply chain analysis. As SME, XIO acted as liaison between P&G and Edaptive to gather the required data in order to assist Edaptive in the development of the test case model. The Supply Chain description (hereon called Supply Chain Test Case), including its processes, work flow between processes, process key performance parameters, metrics for its performance evaluation and its As-Is and To-Be configuration without and with AIT respectively, was provided by XIO and RSC through collaboration with Procter & Gamble (P&G) Company.

P&G as the Business partner supplied information and metrics on the existing supply chain test case for this engagement. The supply chain test case model began at P&G's contract packaging facility and ended at the loading docks of P&G's warehouse/distribution facility for the select product, Actonel 35mg. At the packaging facility, metrics were supplied by P&G for the following supply chain process steps - packaging, staging, quality assurance (QA) and loading. The supply chain process steps at the distribution facility for which metrics were provided for by P&G were – delivery (receipt from packaging facility), storage, order build, staging, and loading. The existing supply chain test case process was modeled with the proper metrics identified and key performance parameters quantified. From this existing model, new models were created to represent how the supply chain could be modified to comply with the ePedigree requirement for item-level tracking. For the product of interest, a To-Be model was created for a 2D barcode implementation and for an RFID implementation. The overall impact of utilizing each technology on the supply chain model for item, case, and pallet tagging was evaluated and compared by Edaptive. Edaptive performed the analysis by developing a Business Process Modeling Notation (BPMN) model of the As-Is and To-Be supply chains and simulating it for a period of 12 months using its Syscape software. The simulation results provided an assessment of the supply chain's performance and cost under varying conditions. We report results of this assessment in the following sections.

Note: The supply chain test case originally focused on two items in P&G's pharmaceutical supply chain, Actonel 35mg and Actonel 35mg with Calcium (AWC). AWC was selected because of it is picked by the each, while the Actonel 35mg is picked by the case and pallet. However, through discussion and data collection, the team determined that the low volume of AWC and minimal differentiation between the two items within the performance metrics did not warrant the inclusion of the second item in the analysis. No impacts to the order picking process were identified for either RFID or 2D barcode.

4.0 Analysis Models

The following summarizes the models that were used as the basis for analysis and comparison. For complete details on these models, please see the Supplement.

4.1 As-Is Models

To understand the impact of ePedigree compliance and the potential time and cost savings that may result, the existing supply chain process was modeled first. As shown in Figure 1, the scope of this process was from the packaging line at the packaging facility to the shipping dock of the warehouse distribution facility.

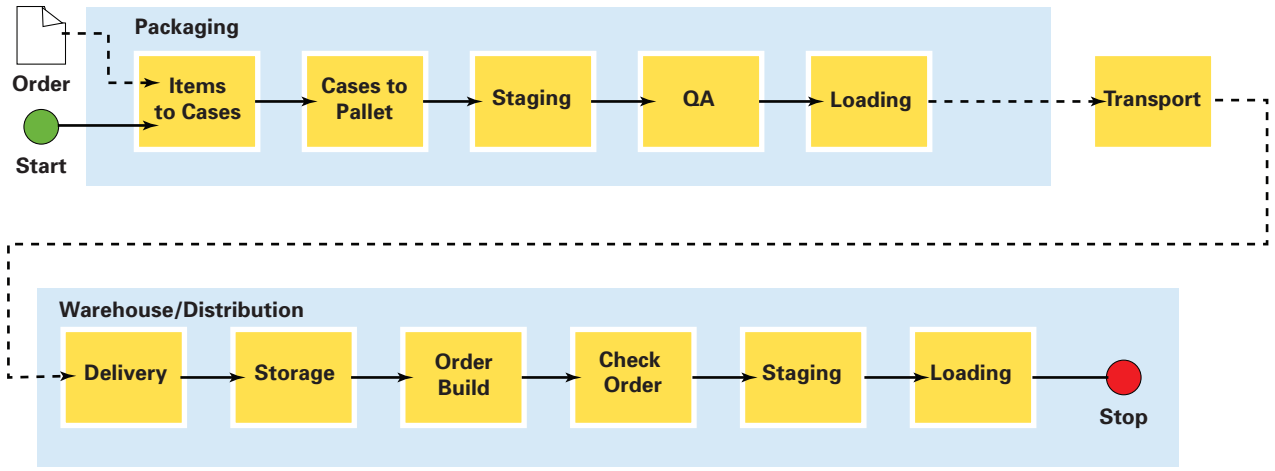

Figure 1: Top Level As-Is Supply Chain Model

For the As-Is model, several metrics relating to supply chain velocity and cycle time were analyzed by simulating the supply chain over a period of twelve months. The metrics analyzed for the As-Is model are shown in Table 1. These metrics reflect the time required for the process and its accuracy. Order Throughput measures the number of orders that were completed over the course of the simulation. Order Cycle Time measures the number of calendar days needed to move from the start to the end of the process. In other words, it represents the length of time from the first item being packaged until the first order from that packaged lot is completed. Another measure of time is Average Labor Time, which represents the number of labor hours per month required to operate the process over the course of the simulation period. Finally, accuracy is measured by Total Overages, Shortages, & Damages (OSD).

Name	Unit	Category
Order Throughput	orders	Output
Order Cycle Time	days	Output
Average Labor Time	hours	Output
Total OSD	cases	Output

Table 1: Top-level Metrics for the As-Is Models

The tasks associated with the packaging facility include:

- Items to Cases, where cartons are packaged into cases
- Cases to Pallet, where cases are palletized
- Staging, where pallets are moved to the staging area
- QA, where items from packaging are tested and the product lots are approved for release
- Loading, where the lot of pallets is loaded onto a truck.

Tasks associated with warehouse/distribution include:

- Delivery, where the product is unloaded and recorded
- Storage, where the product is moved to high-rise storage
- Order Build, where orders are picked
- Check Order, where the order is confirmed
- Staging, where the order is moved to the loading area
- Loading, where the order is loaded onto a truck.

For each task, specific key performance parameters have been defined, as shown in Table 2. Please see the Glossary in the Supplement for a definition of each metric. Certain parameters, such as OSD, only apply to certain tasks, such as loading. These parameter values can be changed in Syscape easily through a spreadsheet-like interface. The values for these parameters were determined through interactions with P&G, and the assumptions and computations have been documented in the Supplement.

Name	Unit	Category
Mean Task Time	min (sid)	Input
Task Time Deviation	min (sid)	Input
Expected OSD	%	Input
Objects Entered		Output
Objects Exited		Output
Total OSD	cases	Output

Table 2: Key Performance Parameters for As-Is Process Tasks

4.2 To-Be Models

The following describes the To-Be models that were created to analyze the impact of ePedigree compliance. For the item of interest, two To-Be models were developed: one using RFID and one using 2D barcodes. Figure 2 depicts the To-Be model for Actonel 35 mg with RFID. Tasks are colored coded to represent the impact of RFID. Purple represents tasks where RFID will be needed for ePedigree compliance but may not impact the time to complete the task. Green represents tasks where RFID can result in potential time savings. Yellow tasks are not impacted. The RFID symbol indicates process steps where tags are read. Figure 3 depicts the To-Be process model enhanced with 2D barcode technology.

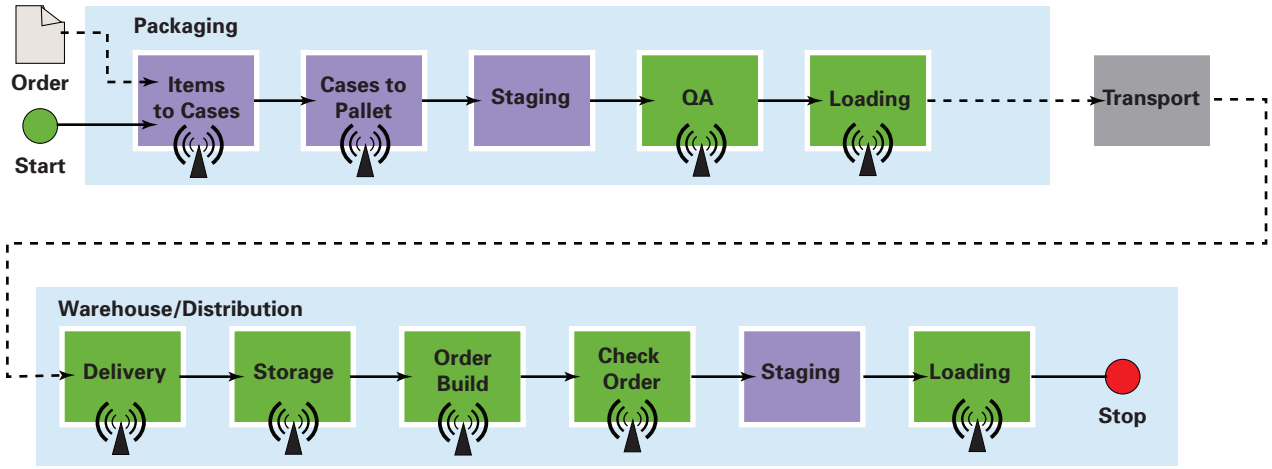

Figure 2: RFID To-Be model for Actonel 35 mg

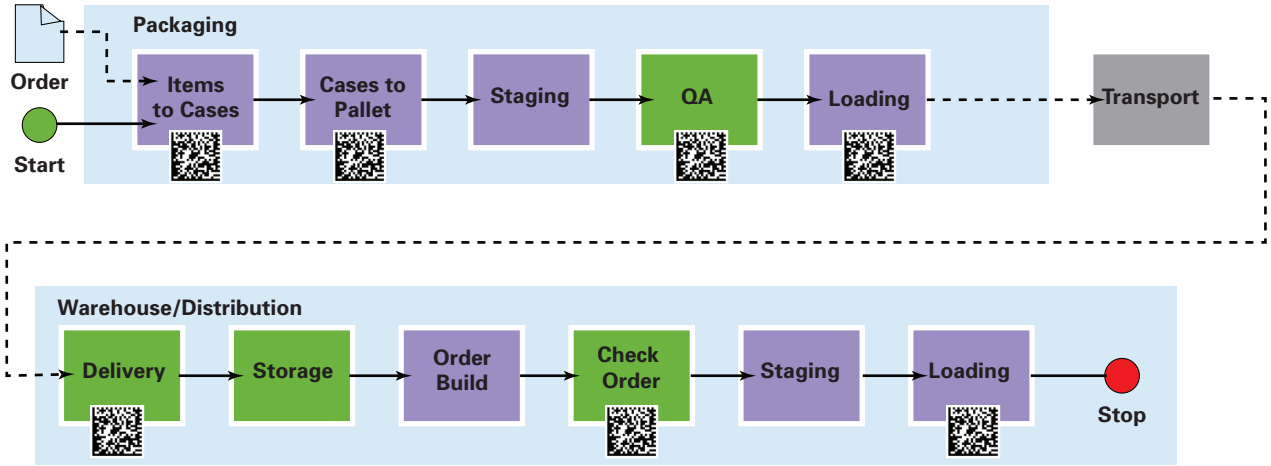

Figure 3: 2D Barcode To-Be model for Actonel 35 mg

For each technology, additional parameters were added to the model to represent fixed and variable costs associated with respective implementations. Further, the impacts of each technology were represented by modifying the new expected task times for each affected task or eliminating certain tasks where applicable. All the assumptions made have been documented to project costs involved and potential time savings in the Supplement. Table 3 shows the metrics used to quantify the overall impact of each technology on the To-Be models.

Name	Unit	Category
Orders Completed	orders	Output
Order Cycle Time	days	Output
Average Labor Time	hours	Output
Total OSD	cases	Output
Total Fixed Cost	$	Output
Total Variable Cost	$	Output
Total Cost	$	Output

Table 3: Metrics for To-Be Models

5.0 Analysis Results

The impact of each enabling technology was measured in the context of time and accuracy improvements and estimated implementation costs. These measurements provide a foundation for performing more detailed ROI analysis. The following describes the results in the context of these measurements.

5.1 Time and Accuracy

The first analysis goal was to determine how each AIT technology impacted various time and accuracy metrics of the selected supply chain. For this analysis, the As-Is and To-Be models were simulated for a period of 12 months. The first measure of time examined was the average labor time per month spent within the process. Figure 4 compares this result in terms of hours saved for the As-Is model and To-Be models using RFID and 2D barcode technologies.

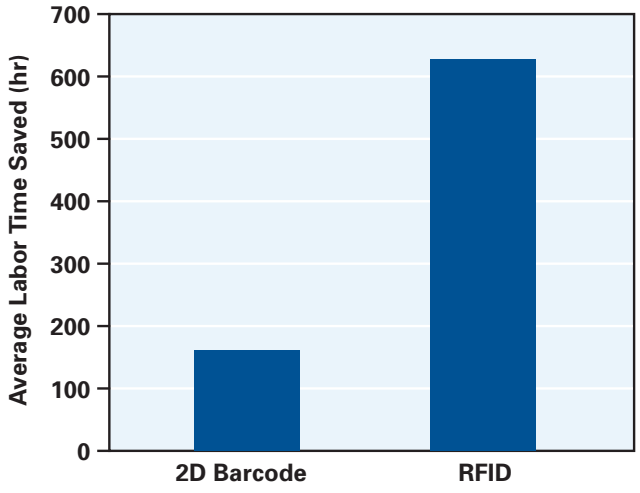

Figure 4: Monthly Average Labor Savings

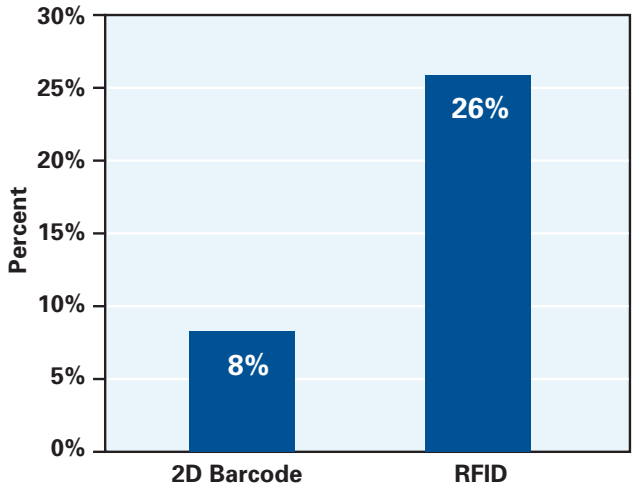

Figure 5: Labor Time Savings Comparison

In addition, Figure 5 depicts the percentage savings in labor time compared with the As-is supply chain. As shown here, each technology yields a savings in labor time, with RFID resulting in more than triple the time savings over 2D barcode.

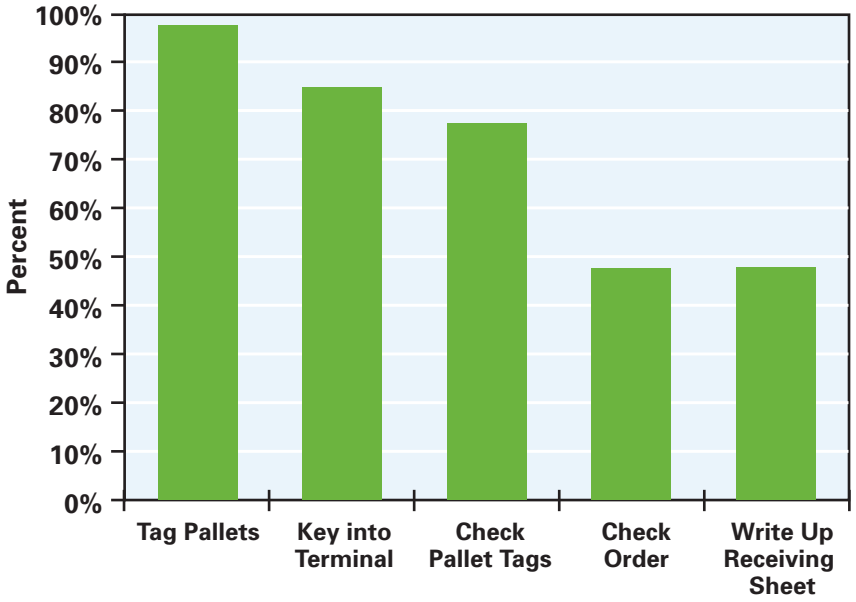

Figure 6: Time Savings by Task for 2D Barcode

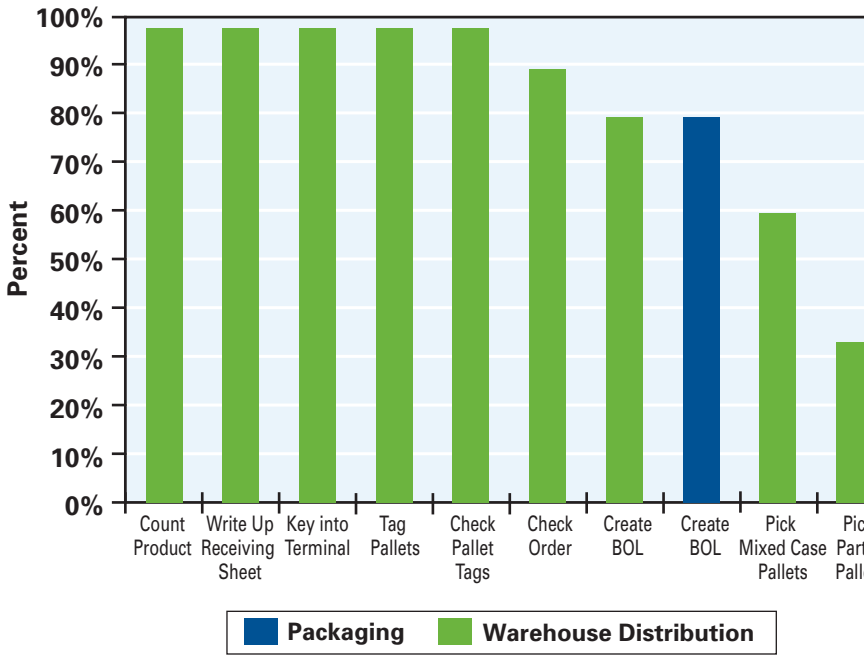

Figure 7: Time Savings by Task for RFID

A detailed breakdown of time savings per each task is shown in Figure 6 for 2D barcode and Figure 7 for RFID. Note that the vast majority of impact is found within the warehouse/distribution portion of the supply chain.

5.2 Cost

Next, the expected costs for implementing each technology were examined. As part of the analysis effort, the fixed cost of capital and the variable cost, which includes costs for 2D labels or RFID tags, and recurring software fees and maintenance costs, were modeled. The breakdowns between software and hardware fixed costs are depicted in more detail in Figure 8 and Figure 9. In addition, Figure 10 further breaks down fixed RFID hardware costs for each task.

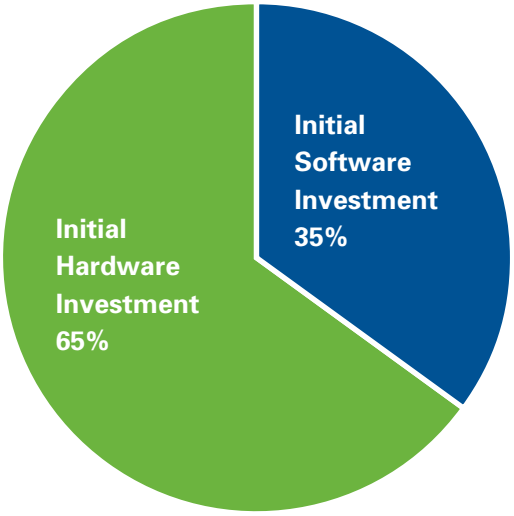

Figure 8: RFID Fixed Cost Breakdown

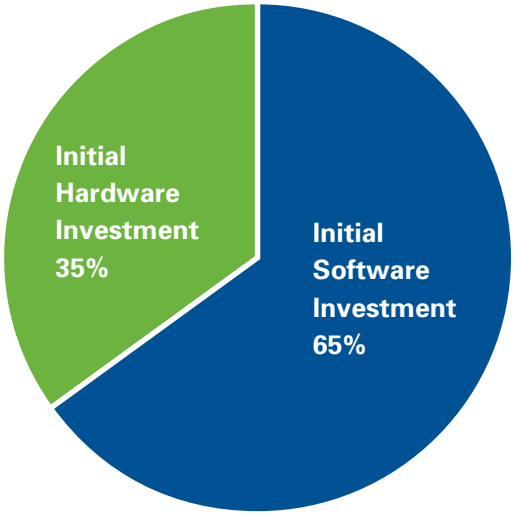

Figure 9: 2D Barcode Fixed Cost Breakdown

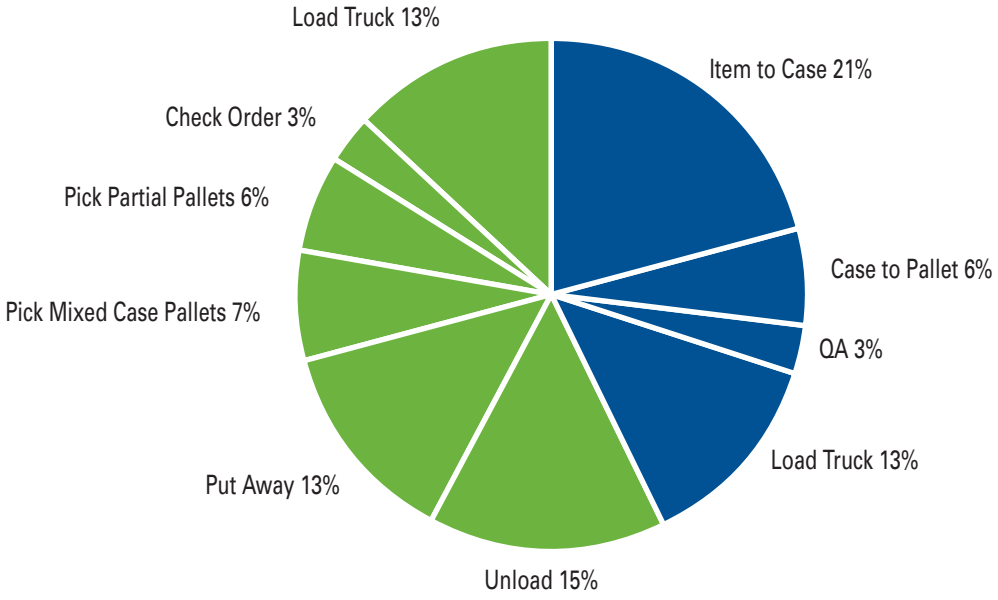

Figure 10: Fixed Cost breakdown by Task for RFID

Finally, Figure 11 details the cost components for each technology. As shown here, both require a similar amount of capital investment. RFID incurs a higher variable cost due the current price of tags.

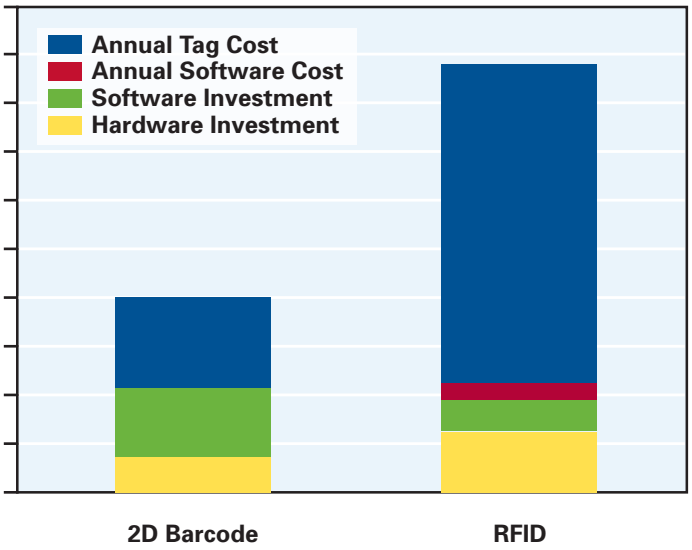

Figure 11: Total Variable Cost Comparison

5.3 ROI Analysis

The following tables summarize the key performance results in terms of cost and expected time savings. Table 4 and Table 5 compare the improvements in time and accuracy for each technology to the As-is results. Again, note that each technology reduces average labor time, with RFID resulting in a greater reduction. Because the majority of time savings is found within the Warehouse/Distribution portion of the supply chain, the order cycle time is not significantly impacted.

Metric	Unit	Improvement
Order Cycle Time	days	0.12%
Average Labor Time	hours	8%
Annual Order Throughput	orders	0.08%
Annual OSD	cases	67%

Table 4: Time and Accuracy Improvements for 2D Barcode

Metric	Unit	Improvement
Order Cycle Time	days	0.37%
Average Labor Time	hours	26%
Annual Order Throughput	orders	0.15%
Annual OSD	cases	67%

Table 5: Time and Accuracy Improvements for RFID

In addition, an initial ROI analysis, based on a range of product costs, was also performed. Specifically, the following ROI incorporates the fixed and variable costs for each technology and the savings in labor hours and OSD calculated by the model as reported in the above tables. The ROI also includes the savings in labor hours dedicated to scrap count and annual inventory and the potential inventory holding savings (see Section 6). A national average for the hourly wage of production workers was used to estimate labor hour cost savings. Figure 12 and Figure 13 depict an estimated first year ROI for 2D barcode and RFID, respectively. These results represent the ratio of first year cash flow to the total initial investment.

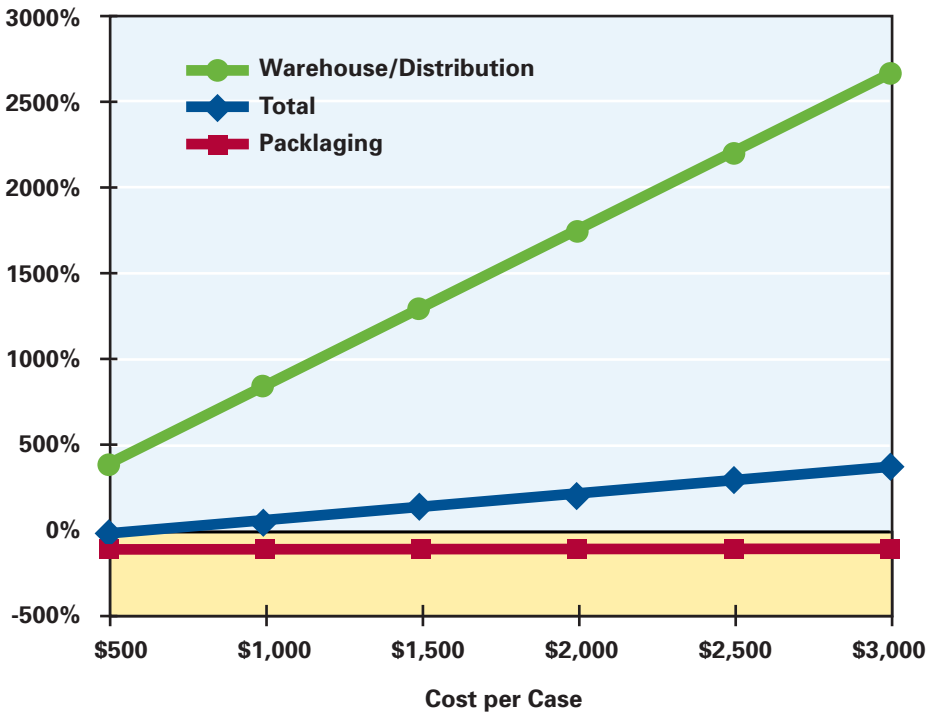

Figure 12: First Year ROI for 2D Barcode

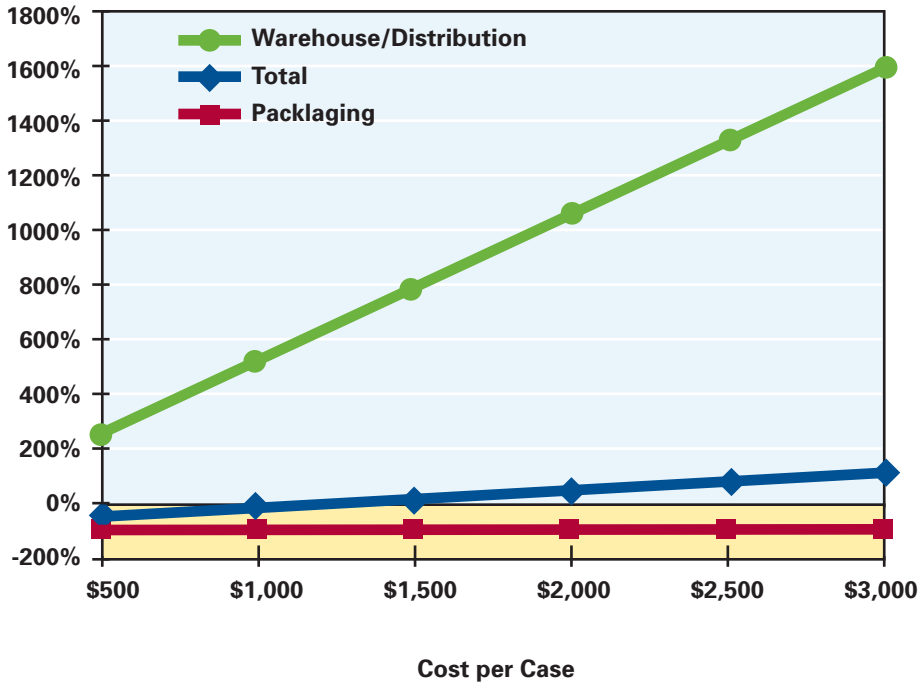

Figure 13: First Year ROI for RFID

6.0 Additional AIT Benefits

The following sub-sections include benefits of AIT that were not included in the model. For those activities that were quantifiable, positive results were identified, as summarized in the following chart, which highlights the annual percentage improvement by each technology.

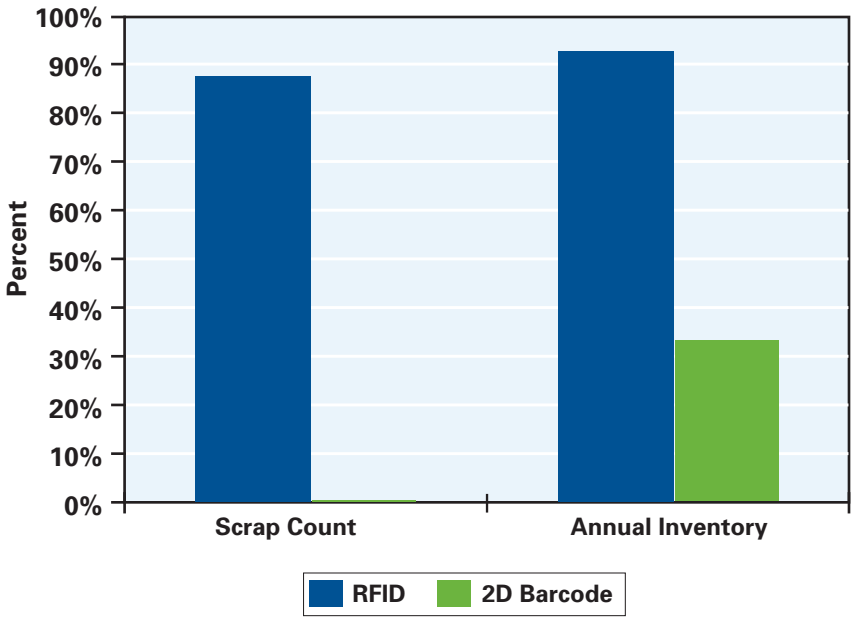

Figure 14: Other AIT Benefits

6.1 Scrap Count

One of the activities associated with the packaging line is to collect and count the scrap packaging material (cartons and cases). The annual scrap count was estimated at approximately 3% for Actonel 35mg. The time to count the scrap was estimated for 2 people spending 2 hours each for each production run.

No time savings were associated with barcodes. Because line of sight is required for a reader to capture the identification, each scrap item would need to be handled. It is quite possible that scanning could take longer than the normal physical count and therefore no savings are associated. RFID provides a good opportunity to improve the scrap count process. Scrap items would not need to be separated and individually handled, so that the scrap count activity would simply entail collection of the materials and movement through a portal reader to establish the physical count.

6.2 Annual Inventory

While the model incorporates the daily or monthly cycle count processes, and associated benefits with 2D barcode and RFID, the annual inventory is analyzed separately.

	Packaging	Warehouse/Distribution
Estimated Reduction - 2D Barcode	10%	50%
Estimated Reduction – 2DRFID	95%	95%

The results of the analysis indicate that for the packaging facility, RFID provides a significantly better time savings than 2D barcode. Because the packaging facility currently uses barcodes, there is less opportunity for improvement, although with the greater level of data and association of case to pallet, we believe there would be a nominal improvement. RFID provides a much greater savings with the ability to scan the inventory by walking through one time and capturing the information.

For warehouse/distribution, the same significant savings opportunity exists for RFID. However, 2D barcode does also provide a greater opportunity at warehouse/distribution than at the packaging facility, because AIT equipment is not in use at warehouse/distribution. In this instance, savings are still not as great as with RFID, due to the necessary line-of-sight required to capture the data. But electronic data capture will improve the speed and accuracy of the inventory process.

As long as the annual inventory is conducted, there will be some time required to move through the facility, collect the data, and resolve discrepancies. However, in many instances the use of RFID and cycle counting has eliminated the need for annual wall-to-wall inventory, and may be an opportunity at both locations.

6.3 Storage Location Tagging

While the model examined the opportunity to conduct inventories more quickly with RFID, further improvement is possible in the use of inventory and storage location tagging and forklift readers. This would enable more streamlined retrieval and loading at the packaging facility, and greater product visibility at warehouse/distribution.

6.4 Shrinkage

Shrinkage was not discussed as an issue at either location. The use of RFID can function as a theft deterrent throughout the supply chain. The low OSD numbers for the packaging facility and warehouse/distribution facility indicate this is not an issue at those facilities, but for other locations, supply chain nodes, and products it could be. The use of AIT at the item level also provides quicker notification of issues that may arise.

6.5 Supply Chain Visibility

Identification and visibility are two of the primary drivers for effective supply chain management. If the location of specific products is known, more informed decisions can be made, such as rerouting to meet unexpected demand, greater accuracy in responding to customer inquiries regarding their shipments, and overall process improvements across the supply chain functions including transportation, inventory, order picking among others. This section highlights three opportunities that are not included in the model, but that benefit from improved visibility across the supply chain.

6.5.1 Returns

The model incorporates the specific opportunity associated with chargebacks for returned product. However, there is also the overall improvement in visibility associated with AIT that enables greater decision making capability. By knowing what product is returned, from which customer, through which distribution channel, management has greater ability to adjust operations and demand in real-time. Similar opportunities as those included in the model apply to the return process for shipping, receiving, counting, and reconciliation driven by the automatic capture of data at the item, case, and pallet level. Overall, RFID can provide greater improvements than 2D barcode given the ability to make multiple reads simultaneously and without the line-of-site requirement.

6.5.2 Recalls

The model incorporates the specific opportunity associated with chargebacks for returned product (discussed in section 6.5.3). However, there is also the overall improvement in visibility associated with AIT that enables greater decision making capability. By knowing what product is returned, from which customer, through which distribution channel, management has greater ability to adjust operations and respond to changes in demand in real-time. Similar opportunities as those included in the model apply to the return process for shipping, receiving,

counting, and reconciliation driven by the automatic capture of data at the item, case, and pallet level. Overall, RFID can provide greater improvements than 2D barcode given the ability to make multiple reads simultaneously and without the line-of-site requirement.

6.5.3 Contracts and Chargebacks

Within the P&G supply chain, pharmacies are offered incentive payments for selling the P&G brands. In some instances not all of the products are sold and the products are returned. When products are returned to P&G the standard process is for the customer to charge back the incentive payment. However, the lack of historic visibility for the specific returned product has created the reliance on the pharmacy to report the returned product and refund the incentive payment. Anecdotal evidence indicates that at least some portion of the incentive payments do not get charged back to P&G. The item-level visibility provided by either 2D barcode or RFID will enable P&G to accurately identify returned products and associate with any incentive payments that should be reimbursed to P&G.

6.5.4 Inventory Holding Costs

The current practice at the packaging facility is to hold product for up to 5 days while the QA testing is completed and documented. As with all inventory, there is a holding cost associated with product lying idle. The packaging facility SME could not recall a lot not being released because of QA failure. With the improved visibility and controls provided by AIT, the need to hold the product at the packaging facility while waiting for QA release is diminished, and safety stock and associated inventory holding costs could be reduced proportionally if product were loaded and shipped immediately following the packaging process. In the case of the packaging facility, QA hold time could be reduced,. Figure 15 shows the improvements in inventory levels that could be achieved if the hold time was reduced.

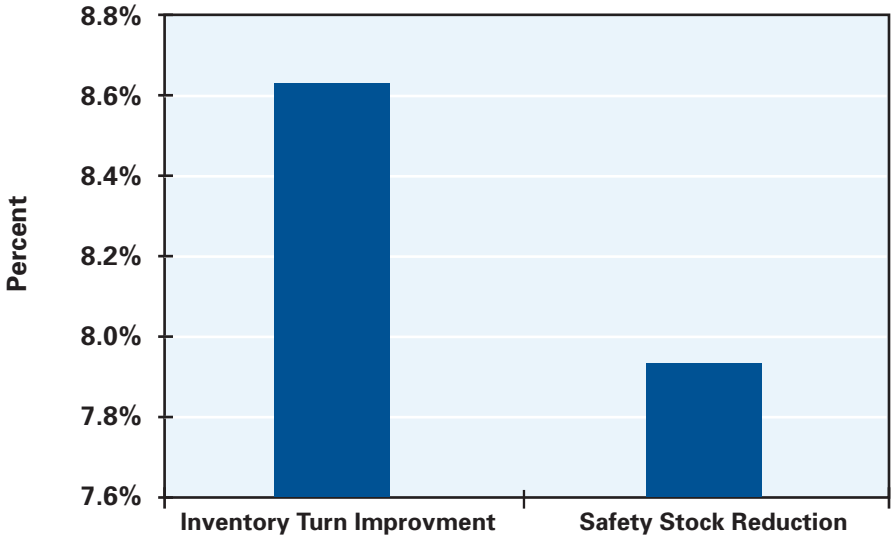

Figure 15: Estimated Inventory Benefits of RFID

Ancillary benefits associated with this would include minimized loss or damage to product sitting in the packaging facility and any recount or reconciliation associated with the time delay in loading the product for shipment. While the involved processes are not directly impacted by RFID and 2D barcode, this benefit is enabled equally under either technology through the improved visibility and capability to react to any potential QA issues with confidence, accuracy, and speed.

7.0 Conclusions

Through modeling, simulation, and analysis of the effects of 2D Barcode and RFID technologies on a subset of the Actonel 35mg supply chain, it is clear that both technologies provide opportunities to reduce labor costs and reduce OSD-related expenses. In the case of 2D Barcode, process time was reduced by 21% compared to a reduction of 37% using RFID. In terms of annual OSD, both RFID and 2D Barcode provided a 67% reduction (improvement). As the models demonstrate, there are many activities within the supply chain that derive benefit from both of the technologies, including order checking, cycle counts, shipping, and receiving. The benefits, and implementation costs, will differ depending on the type of technology, but both demonstrate the opportunities enabled through capturing data electronically at the item level. From a time savings perspective, RFID yields benefits greater than that of 2D Barcode, primarily driven by the line-of-sight requirement for 2D Barcode. From a cost-to-implement perspective, RFID also costs more than 2D barcode, primarily because of the consumables cost.

In addition to the modeled processes, the analysis effort identified a number of other areas that can derive benefit from the insertion of AIT, including scrap count and annual inventory, while enhanced asset visibility enabled by the technology can improve the recalls, returns, and QA release processes. For example, with greater internal controls provided by AIT, product can be shipped directly upon completion of the packaging process, rather than being held at the packaging facility for QA release. This reduces the safety stock requirement at the warehouse/distribution center through shorter delivery cycle times.

This modeling and simulation effort not only allowed for a quantitative analysis of AIT technologies, it also led to a greater understanding of the Actonel supply chain. The resulting model captures the specific processes and attributes, and provides a valuable tool for further analysis. Additional To-Be models can be created, including a hybrid implementation of both 2D barcode and RFID. Increased volume can also be modeled to simulate a surge in demand. The model can be expanded as necessary to represent other, more complex supply chains. Ultimately, the ability to effectively model different technologies across different scenarios enhances the strategic decision making required to comply with mandates, efficiently improve processes, and generate competitive advantage.

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