# Hidden Costs of Reverse Logistics: An Activity-Based Cost Analysis

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**ABSTRACT**

Reverse logistics plays a vital role in the construction and mining equipment industry, where managing product returns efficiently is critical for both cost optimization and sustaining dealer satisfaction. This project conducts a financial analysis of the current reverse logistics process for a leading industry player, focusing on the adequacy of their restocking fee strategy implemented in 2015. Using Activity-Based Costing (ABC), the study dissects return workflows across various return types to identify true cost drivers and proposes a new data-driven restocking fee. Findings reveal that the existing flat percentage restocking fee significantly overstates actual processing costs and does not account for variation in return effort. The research also highlights hidden costs from dealer non-compliance, such as incorrect documentation or shipment errors, and recommends a strike-based non-compliance fee model to improve adherence and reduce operational inefficiencies. Ultimately, this project equips the partner company with a transparent and equitable cost model to better align pricing strategies with actual logistics costs while reinforcing process discipline across its dealership network.

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# 1. INTRODUCTION

## 1.1 Motivation

Reverse logistics is a form of supply chain management that focuses on the movement of products from the end customer back to the supplier or manufacturer. The process starts with the end customer, moving backwards to the distributor and back from the distributor to the manufacturer. Where forward logistics deals with sales to customers, reverse logistics encompasses product returns (Jenkins, 2021). “Take-make-dispose” strategies (Singh, 2020) or purely forward supply chain processes in production and consumption within the supply chain are bound to have a detrimental impact on the environment in the long run as they tend to generate substantial waste. Reverse logistics is crucial to ensure sustainable growth and development (Arroyo et al., 2023). Further, implementing reverse logistics helps to maximize product lifespan, improves the efficiency of the supply chain, and provides better customer experience.

Many companies have gradually begun to venture into reverse logistics (Cassidy, 2023) defining their own criteria, policies, and strategies to enhance customer satisfaction while seeking competitive advantages. Reverse logistics has become one of the core supply chain processes to achieve a balance between maintaining a strong relationship with the customer and making returns financially viable for the company in the long term. While the idea of generating revenue from returned goods is appealing, the pivotal question of whether the costs associated with the entire reverse supply chain justify the investment is crucial to a company’s strategy.

Our partner company, a leader in the construction and mining equipment industry, has a fairly established reverse logistics process for its customers (dealers), and to offset the costs of parts returned in poor condition, the company has implemented a charge on the total value of the parts in its returns program. This charge is applicable to its dealers and certain types of returns, aimed at covering refurbishing services. However, the company is interested in revisiting the existing strategy to evaluate what is the rationale behind the previously imposed restocking fee and whether the restocking fee-initially imposed in 2015-charged is still relevant after nine years.

Today, the company supports customers from five continents, which they divide into three regions: Americas (North, Latin, South America and the Caribbean), EAME (Europe, Africa, Middle East) and APD (Asia Pacific). Currently, the Americas region handles the highest volume of dealerships as well as dealer returns. Therefore, our project will focus on the Americas region.

At present the partner company has 78 dealerships in the Americas region. Over the past nine years, there has been a significant increase in the parts returned by the dealers, with an average of 14%

increase on the dollar amount credited each year (using data from 2020-2023), meaning that the reverse logistics of the company is behaving as intended, considering the yearly increase in the demand. It is, however, interesting to note that despite the changing market prices and increase in dealer returns, the restocking fees have remained the same every year since 2015. Hence, it is necessary to analyze whether the current fixed percentage cost charged on the parts returned is still cost-effective after nine years and to justify the rationale behind the percentage of restocking fee charged.

## 1.2 Problem Statement

The returns strategy of our partner company was established in 2015, and it has not been revised since then. There is also no data or documentation on how the initial restocking fee was derived. Today, the company offers six types of returns and, depending on the cause of the return, restocking fees are charged or waived. If the return is originated due to a request from the partner company or a problem that they are responsible for, they absorb all the costs. However, if the dealers return the products because they no longer need the material, then the partner company will charge the dealer the established restocking fee.

The company currently uses a credit model, meaning that they credit back to the dealer the cost of the material returned considering the price at the moment of authorization. Return authorization is granted after the analysis of the parts the dealer intends to return. If the parts meet the return criteria, a return order number is created, and the total dollar amount of the parts returned minus the restocking fees is credited only after the materials are inspected and processed. For the core return type (surplus) the company credits the dealer in advance 85% of the value of the materials returned when the first truck is offloaded. Once the material is inspected and processed, the company debits the 85% already given and proceeds to issue the 100% credit minus any charge incurred, including the restocking fees.

Our partner company's main objective is to assess whether the financial outcomes of their reverse logistics process are beneficial for both the dealer and the company, by evaluating whether the fixed restocking fee established in 2015 is sufficient to offset the associated costs and support decision-making on strategic adjustments to ensure profitability and dealer compliance.

Since this policy was established nine years ago, it is necessary to revisit the end-to-end process of the different return types offered by the partner company to come up with a robust documentation of the actual cost of doing returns today, not only evaluating the original services covered by that fee but also assessing the financial feasibility of imposing charges on customers for non-compliance events

unrelated to the condition of the material, such as incorrect data entries that must be corrected before sending the material back to stock.

In that context, the questions to be answered include:

1. What is the actual cost of processing dealer returns for the partner company, and, given the existing strategy for restocking fees, is it adequate?
2. Is it necessary to consider implementing a differentiated fee structure based on return types or adding new parameters to more effectively offset these costs?

## 1.3 Scope: Project Goals and Expected Outcomes

The project's goal was to conduct, and provide the partner company with, a comprehensive financial analysis of the different types of return processes (surplus, rapids, specials) that they offer in the Americas region, defining the actual costs affecting the company and identifying the specific categories under which these costs occur to evaluate the current strategy around restocking fees. This analysis will support decision-making on strategic adjustments to improve operational efficiency and profitability.

To achieve this goal, we used an Activity-Based Costing methodology to assign a cost to all the activities involved in the reverse logistics process of the company. This methodology identified the overall costs of the process, considering the resources utilized from initiation to completion. However, to get to this point, we also needed to understand the different steps involved in the end-to-end returns process to accurately capture all the activities in the current returns workflow.

The deliverables to the sponsor company include,

1. A comprehensive analysis of the different activities involved in the different return types
2. Financial analysis report of the actual costs incurred in the returns process in the Americas region
3. Proof of concept of a proposed new restocking fee based on the financial analysis conducted

The project scope is limited to analyzing and proposing a new restocking fee to the partner company. Whether the company implements the proposed fee is entirely up to the management's discretion.

# 2. STATE OF PRACTICE

The crux of our capstone project is to analyze whether the current reprocessing fee charged by the sponsor company for dealer returns is justified and gauge whether a new restocking fee is necessary. Our sponsor company, like many other companies, is trying to find the answer to one important question

– what is the true cost of reverse logistics? The true cost of reverse logistics remains unknown for some companies and can be attributed to the limited attention given by upper management, who consider it 'the cost of doing business' and not necessary for an exhaustive analysis of the process (Goldsby & Closs, 2000).

To address this issue, we reviewed literature pertaining to reverse logistics, the processes involved and its current existing challenges. We also reviewed literature on restocking fee structures to identify what could be an optimal structure to implement. Finally, we also assessed our proposed method of cost determination of the reverse logistics process: Activity-Based Costing.

## 2.1 Reverse Logistics and Existing Costing Challenges

In a closed loop supply chain process, products are returned backwards in the supply chain instead of being discarded, and hence methods to bring the products back into inventory must be deployed. Within the supply chain closed loop, three aspects need to be considered in the returns process: the processes involved in refurbishing, the personnel/labor, and the driving force behind the return process. Product refurbishing is generally required for more complex machinery and is considered to typically be a labor-intensive process (de Brito et al., 2003). This is the case for our sponsor company, which deals in construction and mining equipment. Presently, while reverse logistics is gaining traction, there are challenges involved in this process:

a. Reverse logistics is costly and involves complex return flows. It is hence necessary to map out the entire process in order to track the returns process step by step (Newcastle Systems, 2022).
b. Customers are demanding and will invariably push for a low-cost product return policy. It is necessary for the company to understand the expectations of their customers while also ensuring they are profitable (Altug, 2012).
c. Most effort is spent by companies on the initial sales of the products and hence return management becomes a topic that is often given less importance in terms of strategy development and implementation (Goldsby & Closs, 2000).
d. Reverse logistics is often seen as an unavoidable cost in the manufacturing business and hence not studied as extensively as initial sales. Therefore, there is a lack of comprehensive understanding of the reverse logistics process and its associated costs.

## 2.2 Restocking Fees

Research suggests that employing the extreme policies of either providing a full purchase refund to the customer for their returns or completely disabling product returns may not be the optimal solution to the company (Che, 1996; Davis et al., 1995). Allowing full refunds may induce reckless behavior among the customers and they may also start to get less cautious about their purchases. On the other hand, disallowing returns all together may cause the manufacturer to lose out on sales from customers for not providing them with the flexibility (Wagner & Martínez-de-Albéniz, 2020). Therefore, some refunds may be allowed and the manufacturer can use their resotcking fees to influence the customers product return behavior as well (Shulman et al., 2009). Matthews and Persico (2007) suggest that the ideal refund amount returned to the customer should be equal to the salvage value of the customers' product returns. The salvage value in this case is calculated as the final value that is derived from the returned products minus the cost of remanufactuing, refurbishing and moving the products back to inventory (Shulman et al., 2009). Some research suggests that it may be a good option to charge higher restocking fees for less popular products being returned while charging a lower or marginal restocking free for the more popular products (Wagner & Martínez-de-Albéniz, 2020). However, in the case of our sponsor, dealing with an extremely huge pool of product assortments (>1300 just in terms of generalised product families), the value of this approach might be almost impossible to analyse. Instead, it may be of value to see whether restocking fee can be segmented by the level of compliance/conformance to the returns process/ or by the type of returns instead for the case of our sponsor.

## 2.3 Activity-Based Costing

Although the sponsoring company has a well-established returns process, the restocking fee charged to dealers, which aims to cover expenses related to reprocessing and refurbishing, has not been revisited in the past nine years. It is important for the company to evaluate whether the existing strategy for restocking fees is adequate and if new charges should be imposed due to non-compliant customer behavior during the process. To do this, it is necessary to analyze the total cost of the returns process.

Every time there is a request for a return, there is a cost incurred. This cost can vary depending on the reverse logistics strategy and policy applied, ranging from as simple as repackaging or relabeling to as complex as refurbishing (Altug, 2012). This cost can be calculated through traditional cost analysis; however, it usually oversimplifies the cost allocation by assigning overhead costs to a single cost driver.

While traditional cost analysis can be a useful method for simpler processes, it may lead to inaccurate outputs in more complex environments.

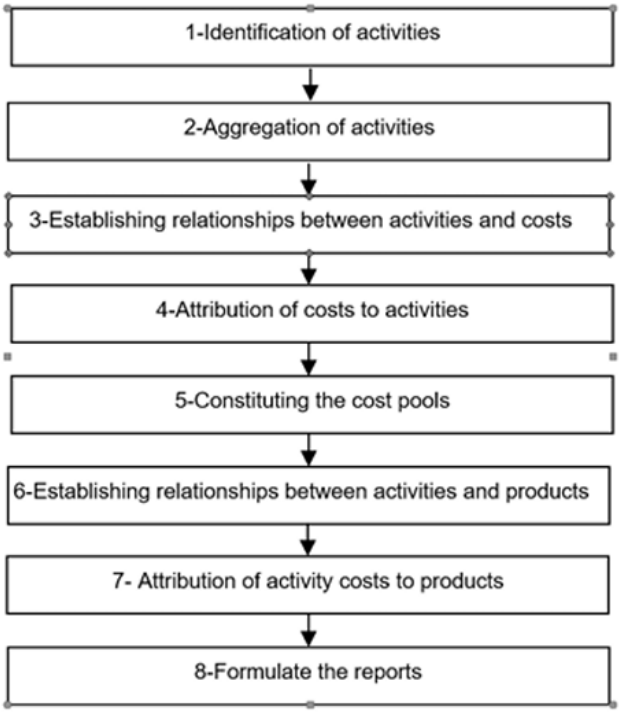
According to Kumar and Mahto (2013) “Activity-based costing (ABC) is a method for determining true costs. Though ABC is a relatively recent innovation in cost accounting, it is rapidly being adopted by companies across many industries….”. Activity-based costing focuses on activities and identifies their cost drivers, assigning costs based on the consumption of these activities, thus producing a more accurate total cost compared to the traditional cost analysis. Key concepts when implementing this methodology are:

a. Activity: Task or action needed to complete a specific work (Schmidt, n.d.).
b. Activity driver: Quantitative metric that triggers or measures the demand of the activity (Kumar & Mahto, 2013).
c. Cost driver: Activity that triggers a cost and helps assign overhead costs. Common categories include transaction drivers (measuring the frequency of the activity) and duration drivers (measuring the time taken to complete it) (Hooijer, 2024).
d. Cost pools: Simplified grouping of costs associated with a particular set of activities (Hooijer, 2024).
e. Resource: Economic element required to complete the activity (e.g., salaries, supplies) (Kumar & Mahto, 2013).

Various studies describe different steps to execute this methodology depending on the process analyzed. Goldsby and Closs (2000) suggest that to initiate the ABC methodology and identify the activities, it is necessary to build a comprehensive map of the process, including not only the operative activities but also the administrative ones that support the physical operations. As a second step, they also emphasize the importance of identifying the cost drivers of the mapped activities, which they describe as the greatest challenge in applying ABC.

From another perspective, Demirel & Aksoylu, 2018, in their study on the ABC application in the case of End-of-life Vehicle Recovery, elaborate more on the approach taken to apply the methodology, which is shown in Figure 1.

Figure 1 Steps of ABC Approach (Demirel & Aksoylu, 2018)




As mentioned earlier, Traditional Cost Analysis can lead to inaccurate outputs due to the use of basic accounting techniques. In order to perform a detailed and accurate analysis, Activity-Based Costing proves to be a methodology that provides accuracy in analyzing cost structures and is more suitable for complex processes with high diversity of products.

The benefits of applying this tool to analyze the true cost of doing returns are (Demirel & Aksoylu, 2018; Hooijer, 2024; Schmidt, n.d.; Shulman et al., 2009)

- Identification of redundant activities
- Evaluation of alternative cost strategies
- Reduction of resources assigned to certain activities
- Increased productivity and profitability
- Improved accuracy in the allocation of costs
- Clearer understanding of the relationship between costs and the activities that trigger them
- Enhanced informed decision-making

Calculating reverse logistics cost using ABC will allow firms to not only minimize their costs but also to understand how employees and teams are performing and thus make necessary changes to increase the productivity of their firm (Demirel & Aksoylu, 2018).

## 2.4 Non-Compliance Events

A major issue that our sponsor company faces is also the non-compliance of the dealers in the product returns. When the dealer is non-compliant, additional man hours are spent trying to rectify the errors and update the database accordingly – this is also a hidden cost incurred by the company. Any man hours spent in rectifying non-compliance events by dealers is time lost on the actual processing of returns to send back to inventory. A monetary deterrent to prevent non-compliance would encourage the dealers to be more cautious and proactive in checking the returns product before they are sent back to the sponsor company. Certain companies charge a non-compliance fee to deter their customers from being complacent while making the returns; one such example is Amazon. Table 1. shows the fee structure that Amazon uses for chargeback/non-compliance in North America (Heubel, 2025) .

Table 1 Amazon Returns Fee Structure (Heubel 2025)

| Chargeback Type | Chargeback Cost |
|---|---|
| ASN Accuracy | 2-6% of COGS |
| Carton Content Accuracy | $2.6 per unit |
| Carton Information Compliance | $10 per box |
| Import Documents Late Delivery | $150 per document, +$50 per each additional day |
| Import PO On-Time Non-Compliance | 3% of COGS |
| Import Shipment Late Booking | 3% of COGS |
| No Show | $50-$250 |
| PO On-Time Accuracy | 3-10% of COGS |
| Oversized Carton | $25 per box |
| Overage PO Units | 10% of COGS |
| Overweight Carton | $25 per box |
| Paper Invoice | n/a |
| Prep Issues | $0.63-$1.26 per unit |
| Rejected Delivery | 3% of COGS |
| Ships In Own Container | $1.8-$4.4 per unit |

Certain non-compliance events are charged based on percentage while others are charged per unit of non-compliance.

# 3 METHODOLOGY

Data was gathered from the company for 2022-2024. First, the traditional costing method was applied to calculate the existing restocking fees as a percentage of the average returns value. Then interviews were conducted with in-house as well as personnel involved in the returns process from the subsidiary company, in order to map out the full returns process and calculate the cost drivers. Activity-Based Costing was applied to propose a new fee to charge the dealers a new percentage to truly cover restocking fees, and finally costs were allocated for non-compliance events.

## 3.1 Methodology Selection

We calculated the yearly costs incurred based on the traditional costing methods. However, we eventually proposed to change the fee in the future to move to the Activity-Based Costing method based on the extensive literature review conducted. As mentioned in Chapter 2, although traditional cost analysis remains widely practiced, it often oversimplifies cost allocation by attributing overhead costs to a single cost driver. While this approach can be effective for straightforward processes, it may produce inaccurate results in more complex settings. Based on research on other companies like Amazon that are engaging in the returns and reverse logistic process, we also proposed an additional non-compliance fee structure to the company based on the specific non-compliance event encountered. Based on this we proposed an updated percentage fee calculated using Activity-Based Costing and a new fee structure specific for non-compliance events.

## 3.2 Data Gathering

Our methodology is outlined below:

1. **Data cleaning:** The sponsor company provided us with the purchases and returns (dollar amount and volume) per dealer from 2022 to 2024, data that we used to derive the cost of the returned material. The data provided was primarily linked to the stores that returned the material rather than to the parent branch. For practicality and consistency with the data collection shared by the company, we analyzed the data at the parent branch level. To do this, we added the main dealer code to the records and classified the stores into the 78 parent branch dealer codes. The data tables also included records where no return type was identified; and contained dealer codes of other regions or empty records for some codes that we had to look for in different tables. However, this step was key to maintain

consistency and accuracy in our results. Data cleaning was done in order to obtain the total and average value of the returns by all the dealers between 2022-2024.

2. **Process Mapping:** We interviewed the Receiving Facilities team in EAME to understand the returns process and to determine whether the same returns process is being applied in the North Americas region. This step was done because the EAME returns process is more established and mature in comparison to the North America receiving facility. We then interviewed the team at the returns facility in North America to validate and confirm the overarching processes involved in the returns so that costs can be allocated to each reprocessing activity identified, to determine the restocking fee through activity-based costing.
3. **Refurbishing Costs:** We interviewed the Quality team at the receiving facility in North America to determine the total cost spent on refurbishing returned parts. We received the details on the refurbishing costs from 2022-2024 from which we used the average over the periods to determine the expected yearly refurbishing costs.
4. **Process Detailing:** We interviewed the Returns team in North America to get further details on each returns process. The data gathered included the labor needed at each step and their level in the hierarchy, the cost of the labor, the average time taken to process an HU at each step per unit of labor, and the consumables used in the returns process and associated costs.
5. **Non-Compliance Event:** We interviewed the personnel handling non-compliances in order to understand the different types of non-compliance events and the time taken to rectify each specified non-compliance event. Considering some events lead to the same efforts to make the return compliant and continue with the process, the events were categorized in the following incident types:

    1. No Part Tags
    2. No HU Labels
    3. Return cancelled but material sent
    4. No ASN transmitted and ASN created by sponsor company
    5. Incorrect HUs declared
    6. ASN created but not transmitted
    7. Incorrect Country of Origin declared

## 3.3 Application of Methodology

This section discusses the methodology applied to arrive at the new restocking fees using Activity-Based Costing as well as the derivation of the non-compliance event fees.

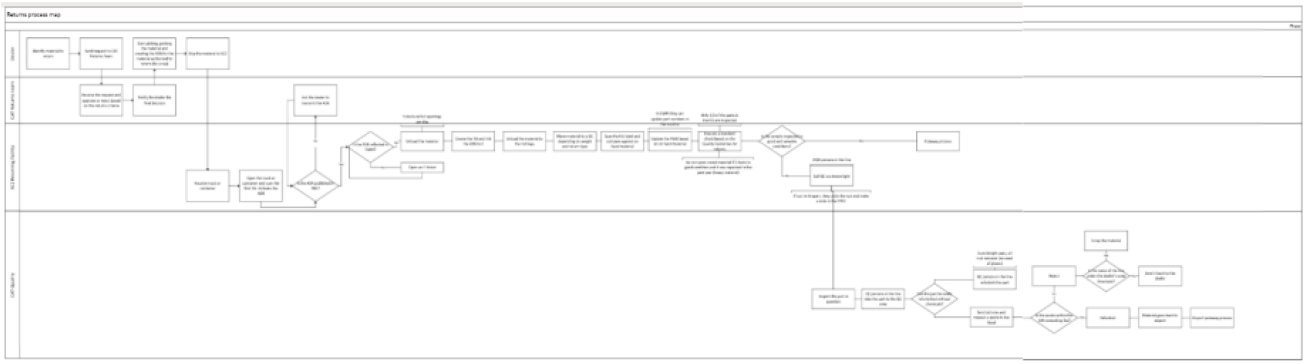
### 3.3.1 Activity-Based Costing – Return Types

The methodology began with process mapping of surplus, rapids, and special returns to identify key operational activities. Related tasks were then aggregated into six activity pools - Return Set Up, Receiving, Table Checking, Heavy Processing, Repack, and Quality Check - for simplicity and focus on major cost drivers. For each activity, we defined cost drivers, and identified labor resources and hourly costs. We estimated the processing time per unit and used historical data to define daily volumes and flow percentages through each activity. Subsequently, we calculated the available and required processing capacity, cost per minute of each activity, and the daily and annual costs per return type. Finally, using these figures, we derived the cost per return.

1. **Identification of activities: Process mapping**

   The first step involved mapping the entire returns process from the receipt of material authorization to final disposition. This visual mapping as shown in Figure 2 allowed us to identify all the key activities performed during the processing of surplus, rapids, and special returns.

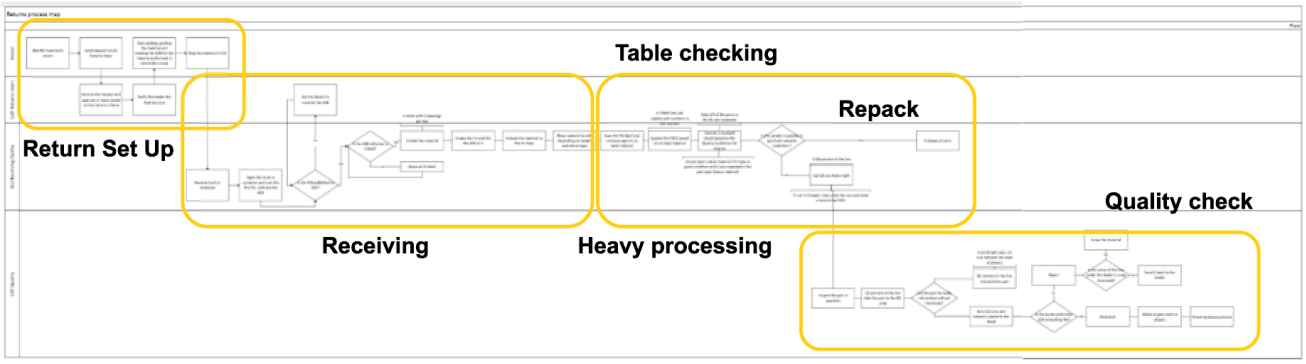
Figure 2 Returns Process Map



2. **Aggregation of activities (Activity pooling)**

   To simplify the model and focus on major cost drivers, closely related tasks were grouped into broader activity pools. This aggregation as shown in Figure 3 ensures a balance between model accuracy and practical usability for ongoing operational tracking.

Figure 3 Returns Process Map with aggregated activities




Final activities defined:

- Return Set Up
- Receiving
- Table checking
- Heavy processing
- Repack
- Quality check

### 3. Establishing costs and cost drivers for each activity and per return type

For each activity, the associated labor resources and their corresponding hourly costs were identified in Table 2. Additionally, cost drivers (such as RONs, HUs, or parts) were defined to reflect the operational workload linked to each activity in Table 3.

Table 2 Labor Costs

| Activity | Headcount | Hourly rate | Daily labor cost |
|---|---|---|---|
| Partner company returns analyst | 4 | [redacted] | [redacted] |
| Receiving (3PL staff) | 15 | [redacted] | [redacted] |
| Table checkers for surplus (3PL staff) | 16 | [redacted] | [redacted] |
| Heavy processers (3PL staff) | 5 | [redacted] | [redacted] |
| Rapids/Claims/Targeted/Specials checkers (3PL staff) | 25 | [redacted] | [redacted] |
| Repack (3PL staff) | 7 | [redacted] | [redacted] |
| Quality Inspectors (3PL staff) | 7 | [redacted] | [redacted] |

Table 3 Cost Drivers

| Activity | Cost driver |
|---|---|
| Return Set Up | Number of Return Order Numbers (RONs) set up |
| Receiving | Number of Handling Units (HUs) |
| Table checking | Number of Handling Units (HUs) |
| Heavy processing | Number of Handling Units (HUs) |
| Repack | Number of parts |
| Quality | Number of parts |

**4. Attribution of time to activities**

We assigned the expected processing time per unit for each activity in Table 4. This time estimation reflects how long on average, each unit (RON, HU, or part) requires at each stage.

Table 4 Time spent at each activity

| Activity | Unit of Measure | Surplus | Rapids | Specials |
|---|---|---|---|---|
| Return Set Up | Minutes per RON | 120 | 10 | 45 |
| Receiving | Minutes per HU | 10 | 10 | 10 |
| Table Checking | Minutes per HU | 10 | 10 | 10 |
| Heavy Processing | Minutes per HU | 15 | 15 | 15 |
| Repack | Minutes per Part | 3 | 3 | 3 |
| Quality Check | Minutes per Part | 10 | 10 | 10 |

**5. Definition of cost driver volumes and percentages flowing to the activities**

Annual and daily return volumes were defined based on historical data in Table 5. For each return type (surplus, rapids, specials), we estimated the expected number of units and assigned the corresponding share (percentage) to each activity, according to process flows, in Table 6.

Table 5 Annual and Daily returns

| Return Type | Annual Parts | Parts per HU | Annual HUs | Daily RONs | Daily HUs | Daily Parts |
|---|---|---|---|---|---|---|
| Surplus | [redacted] | 16 | [redacted] | 3 | [redacted] | [redacted] |
| Rapids | [redacted] | 5 | [redacted] | 33 | [redacted] | [redacted] |
| Specials | [redacted] | 10 | [redacted] | 4 | [redacted] | [redacted] |

Table 6 Percentage of returns to each step

| Parameter | Value |
|---|---|
| Percentage to Table Checking | 91% |
| Percentage to Heavy Processing | 9% |
| Percentage to Repack | 5% |
| Percentage to Quality Check | 10% |

**6. Calculation of available and required capacity per activity and return type**

**Available Capacity** was determined by calculating the total minutes of work available per day, based on headcount and working hours.

**Required Capacity** was calculated as the total time needed to process the expected volume of returns. The capacity analysis is shown in Table 7.

$$Available\ Capacity = Headcount\ \times Work\ shift\ hours\ \times 60$$

$$Required\ Capacity = Daily\ Cost\ Driver\ Volume\ \times Time\ spent\ processing\ the\ cost\ driver\ (minutes)$$

Table 7 Capacity analysis for each return activity

| Activity | Available Capacity (min) | Surplus Required Capacity (min) | Rapids Required Capacity (min) | Specials Required Capacity (min) |
|---|---|---|---|---|
| Return Set Up | 1920 | 360 | 330 | 180 |
| Receiving | 7200 | 1850 | 1120 | 520 |
| Table Checking -Surplus | 7680 | 1683 | NA | NA |
| Table Checking - Rapids & Specials | 2400 | NA | 1019 | 473 |
| Heavy Processing | 12000 | 249 | 151 | 70 |
| Repack | 3360 | 444 | 84 | 78 |
| Quality Check | 3360 | 2960 | 560 | 520 |

**7. Calculation of cost per minute per activity**

The cost per minute of each activity was determined in Table 8 by dividing the daily labor cost by the available daily capacity in minutes.

$$Cost\ per\ minute\ = \frac{Daily\ Cost}{Available\ Capacity}$$

Table 8 Cost per minute per activity

| Activity | Cost per Minute |
|---|---|
| Return Set Up | [redacted] |
| Receiving | [redacted] |
| Table Checking - Surplus | [redacted] |
| Table Checking - Rapids & Specials | [redacted] |
| Heavy Processing | [redacted] |
| Repack | [redacted] |
| Quality Check | [redacted] |

## 8. Calculation of daily and annual cost per return type

The **Daily Cost** for each return type and activity was determined in Table 9 by multiplying the cost per minute by the required capacity per day.

The **Annual Cost** was then extrapolated in Table 10 based on the number of working days per year.

$$Daily\ Cost = Cost\ per\ minute\ \times Required\ Capacity$$

$$Annual\ Cost = Daily\ Cost\ \times\ Working\ days\ per\ year$$

Table 9 Daily Cost calculations

| Activity | Surplus | Rapids | Specials |
|---|---|---|---|
| Return Set Up | [redacted] | [redacted] | [redacted] |
| Receiving | [redacted] | [redacted] | [redacted] |
| Table Checking - Surplus | [redacted] | [redacted] | [redacted] |
| Table Checking - Rapids & Specials | [redacted] | [redacted] | [redacted] |
| Heavy Processing | [redacted] | [redacted] | [redacted] |
| Repack | [redacted] | [redacted] | [redacted] |
| Quality Check | [redacted] | [redacted] | [redacted] |

Table 10 Annual Cost calculations

| Activity | Surplus | Rapids | Specials |
|---|---|---|---|
| Return Set Up | [redacted] | [redacted] | [redacted] |
| Receiving | [redacted] | [redacted] | [redacted] |
| Table Checking - Surplus | [redacted] | [redacted] | [redacted] |

| | | | |
|---|---|---|---|
| Table Checking - Rapids & Specials | [redacted] | [redacted] | [redacted] |
| Heavy Processing | [redacted] | [redacted] | [redacted] |
| Repack | [redacted] | [redacted] | [redacted] |
| Quality Check | [redacted] | [redacted] | [redacted] |

**9. Calculation of cost per return and cost drivers: Activity-Based Costing**

Finally, the cost per part in Table 11 and cost per HU in Table 12 were calculated by dividing the annual total cost by the annual processed volume of parts or HUs, respectively:

$$Cost\ per\ part = \frac{Annual\ Cost}{Annual\ volume\ of\ parts}$$

$$Cost\ per\ HU = \frac{Annual\ Cost}{Annual\ volume\ of\ HUs}$$

Table 11 Cost per part

| Activity | Surplus | Rapids | Specials |
|---|---|---|---|
| Return Set Up | [redacted] | [redacted] | [redacted] |
| Receiving | [redacted] | [redacted] | [redacted] |
| Table Checking - Surplus | [redacted] | [redacted] | [redacted] |
| Table Checking - Rapids & Specials | [redacted] | [redacted] | [redacted] |
| Heavy Processing | [redacted] | [redacted] | [redacted] |
| Repack | [redacted] | [redacted] | [redacted] |
| Quality Check | [redacted] | [redacted] | [redacted] |
| **Total** | [redacted] | [redacted] | [redacted] |

Table 12 Cost per HU

| Activity | Surplus | Rapids | Specials |
|---|---|---|---|
| Return Set Up | [redacted] | [redacted] | [redacted] |
| Receiving | [redacted] | [redacted] | [redacted] |
| Table Checking - Surplus | [redacted] | [redacted] | [redacted] |
| Table Checking - Rapids & Specials | [redacted] | [redacted] | [redacted] |
| Heavy Processing | [redacted] | [redacted] | [redacted] |
| Repack | [redacted] | [redacted] | [redacted] |
| Quality Check | [redacted] | [redacted] | [redacted] |
| **Total** | [redacted] | [redacted] | [redacted] |

### 3.3.2 Cost for Non-Compliance Events

In parallel to the Activity-Based Costing analysis, another costing method was developed to estimate the costs associated with non-compliance events. This approach includes both labor and material components.

Labor Cost was calculated by multiplying the time spent handling non-compliant units by the hourly labor rate, adjusting for minutes:

$$Labor\ cost = \frac{Time\ Spent\ per\ HU\ (mins) \times Hourly\ Labor\ Cost}{60}$$

Total Cost was calculated in Table 13 by adding the labor cost to any direct material cost associated with rework:

$$Total\ Cost = Labor\ Cost + Material\ Cost$$

Table 13 Non-Compliance events cost

| Non-Compliance Event | Time Spent per HU (mins) | Labor Cost | Material Cost | Total cost |
|---|---|---|---|---|
| No Part Tags | 10 | [redacted] | [redacted] | [redacted] |
| No HU Labels | 20 | [redacted] | [redacted] | [redacted] |
| Return Cancelled but Material Sent | 25 | [redacted] | [redacted] | [redacted] |
| No ASN Transmitted and ASN created by sponsor company | 15 | [redacted] | [redacted] | [redacted] |
| Incorrect HUs Declared | 60 | [redacted] | [redacted] | [redacted] |
| ASN Created but Not Transmitted | 40 | [redacted] | [redacted] | [redacted] |
| Incorrect Country of Origin Declared | 20 | [redacted] | [redacted] | [redacted] |

The above cost calculation provides a straightforward view of the financial impact of non-compliance events, complementing the more detailed Activity-Based Costing perspective.

# 4 RESULTS AND DISCUSSION

## 4.1 Results

The current returns process consists of six key steps managed by both in-house and subsidiary returns logistics teams. Our analysis revealed that the existing restocking fees charged to dealers is higher than the actual operational costs. To address this, we recommend transitioning to an Activity-Based Costing (ABC) model to ensure fairer and more accurate cost allocation. Although a differentiated fee by return type was initially considered, high variability in return volumes led us to propose a single average fee of 1.5% of part value. Additionally, we propose fixed charges for repeated non-compliance events to encourage dealer accountability and streamline returns management.

### 4.1.1 Current Process

Based on the interviews conducted with the Returns Process team, the returns process can be classified into six different steps.:

1. Returns Set-Up – In this step in-house labor works on setting up the return in the system to prepare the electronic transactions for the return to be started.
2. Receiving – In this step, the products are received by the third-party logistics team at the receiving facility via trucks or containers. The team receives boxes/ Handling Units (HU) and splits them based on weights to either table checking or heavy processing. HUs that are above a specific weight threshold are classified as Heavy boxes and sent to Heavy Processing; HUs below the threshold are moved to the Table Checking step.
3. Table Checking – In this step, the stationed personnel unbox the HU and inspect the returned parts to check on the quality and decide if any refurbishment is necessary.
4. Heavy Processing – In this step, the stationed personnel unbox the HU and inspect the returned parts to check on the quality and decide if any refurbishment is necessary.
5. Repack – Once the materials are checked and inspected, they need to be sent back into inventory. If the packaging of the parts is not in saleable condition, they need to be repacked and sent to the repacking table where they are packed into new boxes as per spec, after which they are shipped out of the receiving facility back into inventory.
6. Quality – In this step, the third-party logistics executes a standard check based on the quality guidelines for returns and if the sample inspected is not in saleable condition, they will call via

a visual signaling system the sponsor company's in-house quality team to inspect the part. The quality team decides which parts need refurbishment and sends those materials for refurbishment accordingly. If any part seems to require refurbishment, the whole HU is re-checked to ensure that there are no other parts that are defective and might also potentially need refurbishment.

### 4.1.2 Current Restocking Fees

Based on the data gathered, we classified the yearly reprocessing costs into 4 categories: Subsidiary returns receiving company's labor cost, in-house labor costs, refurbishing costs for quality issues and consumable costs. The indexed results can be seen in Table 14.

Table 14 Current Restocking Fees

| Credits issued | Amount (indexed) |
|---|---|
| Return credits yearly average | $ 21,836.86 |
| | |
| Restocking costs | Amount (indexed) |
| In-house labor cost | -$323.72 |
| Subsidiary returns receiving company's labor cost | -$44.00 |
| Refurbishment expenses yearly average | -$1.00 |
| Consumables Cost | -$25.00 |
| **Total Restocking Cost** | **-$393.72** |

The calculated results show that the restocking fee charged by the company is higher than the actual total expenses incurred in the restocking process. These results are the opposite of what was predicted, and the refurbishment costs were lower than expected. This is because the quality expense over the past 3 years was only 0.0046% of the returns value, implying that dealers are either generally returning parts in good condition and these parts do not require any major refurbishment, or materials being returned for refurbishment are mostly being scrapped. Nevertheless, a deterrent fee would still be necessary to prevent reckless purchase and returns behavior on the part of the dealer. We subsequently proposed a new fee to be used going forward, which uses an Activity-Based Costing method.

### 4.1.3 Proposed Restocking Fees

Initially, we considered implementing a differentiated restocking fee based on the return type given the differences in processing complexity and effort for each category. The idea was that this

approach could more accurately reflect the true cost of handling each return type and promote fairness and efficiency in the returns process.

However, following thorough data clean-up and analysis, we observed that the annual volumes by return type were highly volatile. Specifically, the data showed no stable or predictable distribution pattern over time. For example, in one year, the returns might consist primarily of surplus returns, while in another year, the mix could be dominated by rapids or specials. This lack of consistency in return type distribution would introduce significant variability in the fees collected year after year, making it difficult to maintain a stable and fair fee structure for both the company and the dealers. It would also expose the process to potential mismatches between the fees charged and the actual costs incurred, depending on the volume shifts.

Given these findings, we concluded that implementing a differentiated fee per return type was not advisable at this time. Instead, a single, average restocking fee based on the blended activity-based costing across all return types is proposed. This approach offers greater predictability, simplicity, and stability, while still being grounded in a detailed understanding of the actual costs to process returns.

Since we had detailed cost information based on the Activity-Based Costing (ABC) analysis, we took the following approach:

- We calculated the actual cost of processing returns in 2023 by summing the costs per activity per return type (from Tables 11 and 12) and multiplying these costs by the actual volumes received throughout the year.
- We then compared the total amount credited to dealers in 2023 against the actual operational cost of managing returns that year.
- The result of this comparison showed that the amount credited represented approximately 0.05% of the actual cost of return operations.

Recognizing that 0.05% would not be sufficient to drive the desired compliance behaviors, offset operational costs meaningfully, or align with broader industry practices, we proposed setting the new restocking fee at 1.5% of the part value.

The decision to propose a 1.5% fee was based on several factors:

- Cost Recovery: A higher percentage is necessary to cover the labor, handling, and indirect costs consistently, particularly considering the historical lack of cost recovery.
- Behavioral Impact: A 1.5% fee is meaningful enough to incentivize better compliance and discourage unnecessary returns without being punitive.
- Industry Benchmarking: 1.5% remains well below typical retail and logistics restocking fees (which often range from 3% to 20%), ensuring our policy remains reasonable.

### 4.1.4 Charges for Non-compliance events

Based on the application of Activity-Based Costing, we propose charging additional fees for the seven identified non-compliance events in Table 15. However, we also propose implementing a strike-based system for charging non-compliance fee. If the dealer is non-compliant three times consecutively with their returns (this strike encompasses all returns i.e. regardless of the type of return, as long as they are non-compliant three consecutive times, they will be penalized), only then will they be charged for non-compliance events. Doing so will onboard the dealers to the new non-compliance process and reduce the friction and potential for pushbacks.

Table 15 Non-Compliance Fees

| Non-Compliance Event | Fixed Fee per HU |
|---|---|
| No Part Tags | [redacted] |
| No HU Labels | [redacted] |
| Return Cancelled but Material Sent | [redacted] |
| No ASN Transmitted and ASN created by CAT | [redacted] |
| Incorrect HUs Declared | [redacted] |
| ASN Created but Not Transmitted | [redacted] |
| Incorrect Country of Origin Declared | [redacted] |

## 4.2 Implications

The findings of this study have significant implications for the sponsor company and the broader reverse logistics landscape. Implementing an Activity-Based Costing (ABC) approach for restocking fees allows for greater cost transparency and fairness, ensuring that the charges reflect the actual expenses incurred in the return process. According to the data, the sponsor company does not perform as many refurbishments as expected and this significantly brings down the restocking fees. In addition, the labor involved in the receiving and restocking process seems to handle most of the refurbishments (mostly minor) instead of quality.

The introduction of non-compliance fees aligns with best practices in supply chain management, ensuring that dealers adhere to procedural requirements and minimizing inefficiencies caused by incorrect data entries. However, this transition must be managed carefully to avoid dealer pushbacks, and the company should consider a phased implementation with adequate communication and support to ease the transition despite the fact that the dealers are given three opportunities to rectify non-compliance before they are charged. Finally, this study provides a framework for other firms in the construction and mining sector looking to optimize their reverse logistics strategies through data-driven pricing models.

## 4.3 Limitations

While this study provides a comprehensive financial analysis of the reverse logistics process, certain limitations must be acknowledged. First, the data used for cost calculations is based only on historical records from 2022-2024. This is because the sponsor company does not have data stored for dealer exchanges prior to 2022 thus limiting the sample size that we used to build the model for future predictions. There was also a lack of data maintenance, time studies and returns tracking by the labor that was receiving and restocking the returns. This lack of robust and comprehensive data maintained, made it difficult to calculate the new fee structure through Activity Based Costing. Additionally, while the proposed Activity-Based Costing approach is much more robust than traditional costing method, it assumes a consistent level of dealer returns; fluctuations in return volume could impact the feasibility of this model. Another limitation is the potential resistance from dealers, who may perceive the introduction of non-compliance fees as an added financial burden rather than an incentive for process improvement. The resistance in non-compliance fees can, however, be offset by highlighting the decrease in the percentage restocking fees paid through Activity-Based Costing. Lastly, the analysis is specific to the Americas region, and applying similar changes to other regions would require further evaluation of regional regulatory policies, dealer behavior, and operational costs.

# 5 CONCLUSION

## 5.1 Management Recommendations

Based on the findings of this study, we recommended that the sponsor company adopt a new restocking fee at 1.5%, grounded in Activity-Based Costing (ABC). The current flat percentage restocking fee significantly overstates the true cost of returns processing. By implementing an ABC-based model, the

company can align charges more closely with actual operational effort and cost, thereby promoting fairness and transparency within its dealer network. In addition to adjusting the restocking fee strategy, the company should implement a strike-based non-compliance fee system. Under this framework, dealers would be penalized only after three consecutive non-compliant return submissions, allowing them a grace period to adjust to the revised policy. This approach minimizes friction and encourages adherence without immediately imposing penalties.

To support these changes, the company should proactively engage its dealers through transparent communication and structured onboarding regarding the new fee structures. Educating dealers on the rationale behind these changes can mitigate resistance and foster greater alignment with company policies. Finally, it is advisable to integrate key performance indicators (KPIs) such as return compliance rates, average processing time per handling unit, and strike occurrences into routine monitoring efforts. These metrics will enable the company to track the effectiveness of the new policy measures and inform future continuous improvement initiatives.

One key recommendation for the sponsor company is to perform due diligence on the subsidiary provider managing the returns process. Currently, there is a lack of sufficient data tracking on critical aspects such as time studies, quality inspections, process flows, and non-compliance event handling. To improve process visibility and future cost analysis, management should enforce a rigorous data maintenance framework and conduct regular audits to ensure compliance and track how much of the materials returned are in good condition, how many are being sent for quality refurbishments and how many are instead being scrapped. Additionally, an audit of labor allocation at the receiving facilities is advised, as preliminary observations suggest potential inefficiencies that may be driving up unnecessary labor costs. Reallocating labor resources more strategically could enhance operational efficiency and reduce expenses.

## 5.2 Future Work

Future work could focus on expanding data collection efforts across a broader timeline once improved tracking systems are in place. With more granular and consistent data, the Activity-Based Costing model can be refined and further validated. Moreover, future studies could explore the impact of resource optimization at receiving facilities to quantify cost savings and improve throughput.

The findings and recommendations presented in this study, while tailored to the sponsor company's reverse logistics operations, offer valuable insights that can be generalized to other companies facing similar challenges in managing returns processes. Many firms across industries continue to rely on simplistic, flat-fee models for restocking and returns handling, which often fail to reflect the true operational costs involved. By adopting an Activity-Based Costing (ABC) approach, companies can improve cost transparency, enhance pricing fairness across their partner networks, and make more informed operational decisions. Likewise, the introduction of a strike-based non-compliance fee system provides a replicable framework for balancing enforcement with partner relationship management. Companies in other sectors - especially those with dealer or franchise-based distribution models - can benefit from structured penalty systems that offer a learning curve, incentivize better behavior, and maintain goodwill.

The recommendations around data collection, labor audit, and KPI integration are equally transferable. Introducing robust data governance and auditing labor allocation practices are scalable strategies that can lead to operational efficiency and cost reduction across varied logistics environments.

Overall, this study not only presents actionable insights for the sponsor company but also establishes a foundational framework that can be adapted by other firms looking to modernize their returns management and cost recovery systems.

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