

## REDUCTION OF EXCESSIVE CLAIM COSTS ASSOCIATED WITH DAMAGED CARDBOARD CARTONS IN DISTRIBUTION

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### ABSTRACT

Courier services suffer a severe problem of experiencing parcel damages that lead to customer complaints and carton claims. Cardboard cartons are easily prone to being damaged during transition and courier companies are not always accountable for parcel damages but still endure consequences as claim costs continue to rise every financial year. The Plan-Do-Check-Action system was used to collect and analyze data intending to prioritize problems, and a parcel inspection was conducted for 22 suppliers to measure variables. Correlation analysis was conducted, and results showed a strong correlation between weight, size, internal carton utilization, and flute corrugated size used on a cardboard. A fish-bone diagram was used to represent the potential root-causes, as a result the relationship between these variables has proven to have the most impact on parcels being damaged. The correlation between the flute corrugated size and internal carton utilization along with mishandling of stock impacted damages the most. During the movement, the durability of the carton is highly depended on these variables. An implementation of training and awareness on how to handle stock with care was conducted to reduce damages during distribution while optimising operations.

**Keywords:** PDCA cycle, Distribution, Root-cause analysis

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## 1 INTRODUCTION

Logistics distribution is a highly integrated supply chain network that is generally focusing on the optimal operation of movement from consignor to consignee. The supply chain can be described by pointing to such features as: process object of flow, structure, goals - functional scope and areas of cooperation of the participating entities [1]. The expected business threat in logistics is known to be high fuel cost, fuel cost has emerged as one of the top ten challenges in the truck transport industry [2] however that is not always the case. The business process operations design is currently the most vital and impactful function in the supply-chain of goods by courier services.

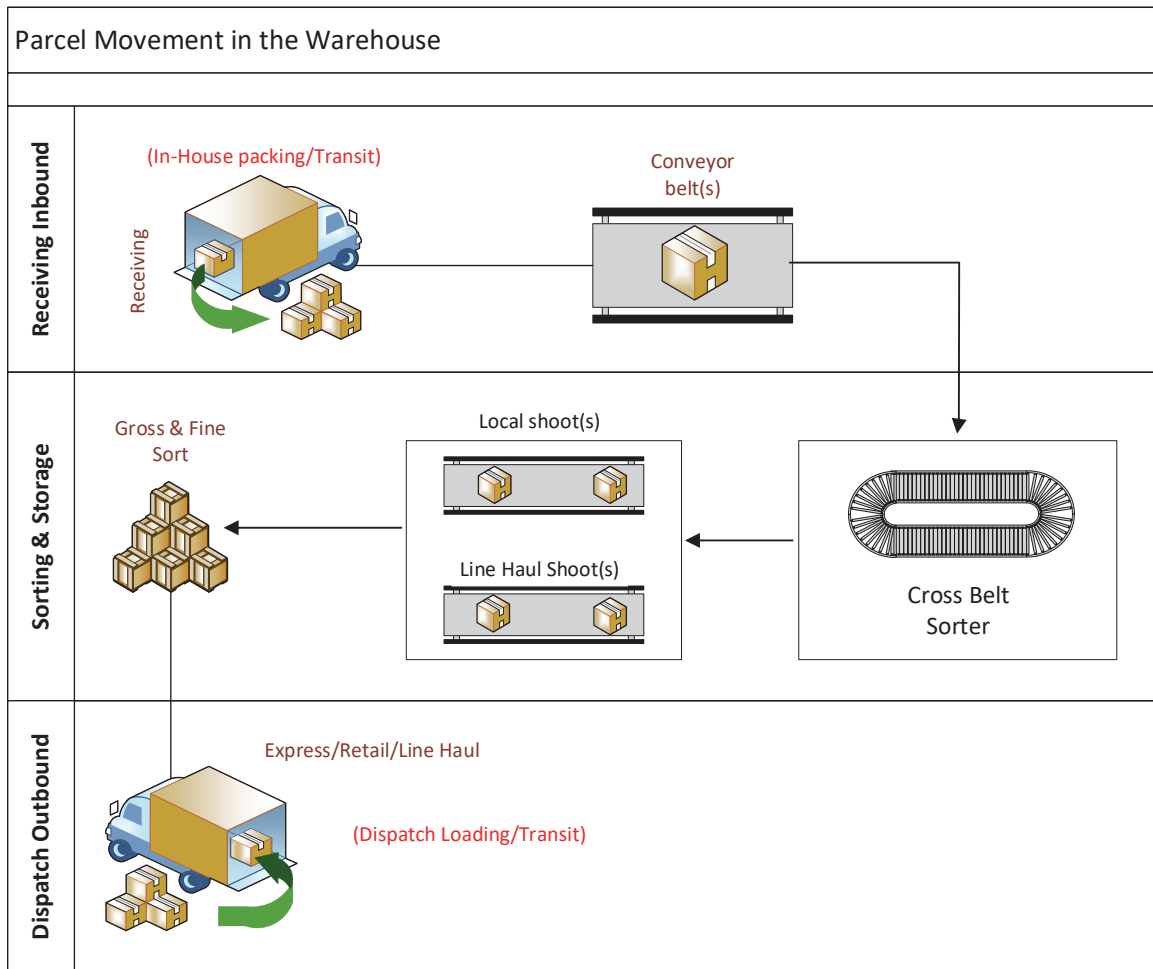
Consumers are no longer willing to accept poor service offerings [3]. Service failures arise when perceptions of performance are lower than expectations, resulting in dissatisfaction [4, 5]. Therefore, the number of complaints across the globe is steadily rising. With the current state of increase in number of customer complaints and cardboard packaging claims due to parcels being damaged within the network, distribution services lose 34% of revenues due to product damages every financial year. This paper adopts a focused improvement approach to optimize logistics operations by developing a framework for reduction of excessive claim costs associated with damaged cardboard packaging in distribution. The deployment of plan-do-check-action, root cause analysis, correlation analysis and development of training solutions was used to address packaging damages. Lean manufacturing does enhance logistics by getting the right product, in the right quantity, in the right condition, at the right place, at the right time, to the right customer, at the right price [6].

## 2 LITERATURE REVIEW

Courier services are an intermediary that distribute finished products from business to consumer (B2C) and consumer to consumer (C2C). At one place of shipment couriers pick up shipments for many recipients, and thus B2C service is implemented [7]. The distribution leg can be short, like in the same city, or long like exporting overseas. However, during the supply-chain reliable packaging is vital and plays a huge role in the distribution process. According to Pongrácz [8], the only way between production and consumption is by making use of packaging. Moreover, Pongrácz [8] stated that during urbanisation, the transportation of products will be crucial and therefore packaging will play an enormous role. In addition to this, another source stated that packaging plays an immense role in the business world, as a result of globalization where all companies are in constant competition with each other [9]. Moreover, Gunasekaran [9] explains that packaging does not receive as much attention as it deserves. However, when the package reaches the consumer and it is destroyed or wasted, this is when packaging is brought into attention [8]. This study will focus on improving controllable factors that influence reduction of packaging claims.

Yu et al. [10] used a decision tree combined with clustering method to develop real time logistics monitoring system of packages during transportation, that has inertial measurement units (IMUs) which can be easily installed and can detect states of packages correctly, the system can distinguish different states of packages with different weights.

Optimisation is an action of making the best out of the situation or a resource, and in logistics, the aim of optimisation is focused on a more effective utilisation of transport means, technologies, and human resource. A typical parcel movement line for inducted stock in the distribution network as shown in Figure 1 is characterised by the movement of load vehicles from the warehouse, conveyor belt system, cross belt sorter, palletisation and loading vehicle for dispatch. Since this is a cross dock operation, stock is not stored for a long period in the warehouse.



**Figure 1: Flow diagram for distribution operations**

Dominic [11] mentioned that excellent and reliable packaging is mandatory to protect goods during transportation. Moreover, courier service internal staff are responsible for handling stock with care until the last mile delivery. There are many aspects and guidelines to consider with handling and packing goods to enable safe transport [12]. This study focused on the problem of cardboard packaging damages that lead to poor service delivery, excessive claims and increase in operational expenses.

Reverse logistics can also be recognised as optimisation because it refers to the reverse logistics system, the layout of the various logistics facilities and transport facilities between the arrangements. The distribution of transport nodes using transport logistics makes it possible to reduce transport difficulty. In relation to freight transport the reduction of transport as well as shipping happens [13]. Operations research can be understood as a resource to find an optimal solution while evaluating various factors [14], for example the routes can be chosen for several vehicles from the same location or from several independent locations [15].

### 3 RESEARCH APPROACH

The Plan-Do-Check-Action (PDCA) system was used to collect, analyse data, improve, and control operational processes continuously. This methodology is the most effective technique to look for better effects or improvement [16]. During the Plan phase, a parcel inspection document was developed and used to collect information and data of the variables influencing claims for each damaged cardboard in terms of parcel specifications. In the Do phase, the



correlation analysis was performed on measured variables and the results of the study was used to design required operational processes by identifying process parameters which are resulting to cardboard packaging damages. To accurately describe the problem, a fishbone diagram was developed to identify the root-cause to improve controllable factors that influence reduction of packaging claims.

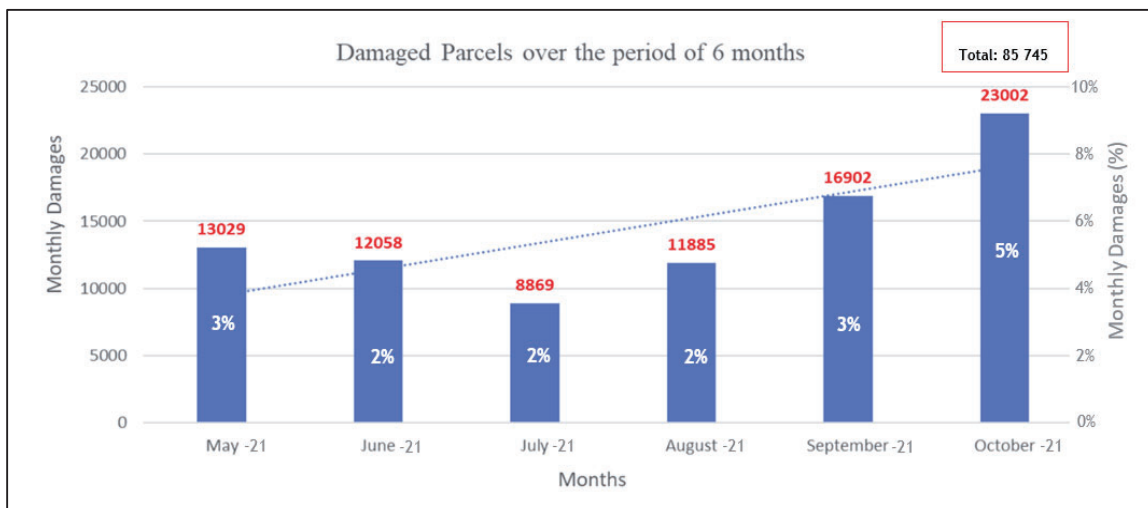
*Mishandling = Stacking misalignment of corrugated cardboard due to lack of awareness*

In the Check phase, a database was created for capturing structured information related to damages received within the distribution network with an aim of understanding a detailed description of the damaged cardboard. In the Action phase, the results were validated through statistical analysis and used to develop training solutions to empower employees for sustained optimisation of logistics and distribution of parcels. Lastly, cardboard packaging damages were tracked to verify if there were improvements in reduction of packaging claims after the implementation of the PDCA cycle and training solutions.

#### 4 DEFINITION OF PROBLEM AND IMPLEMENTATION OF SOLUTIONS

##### 4.1 Problem definition

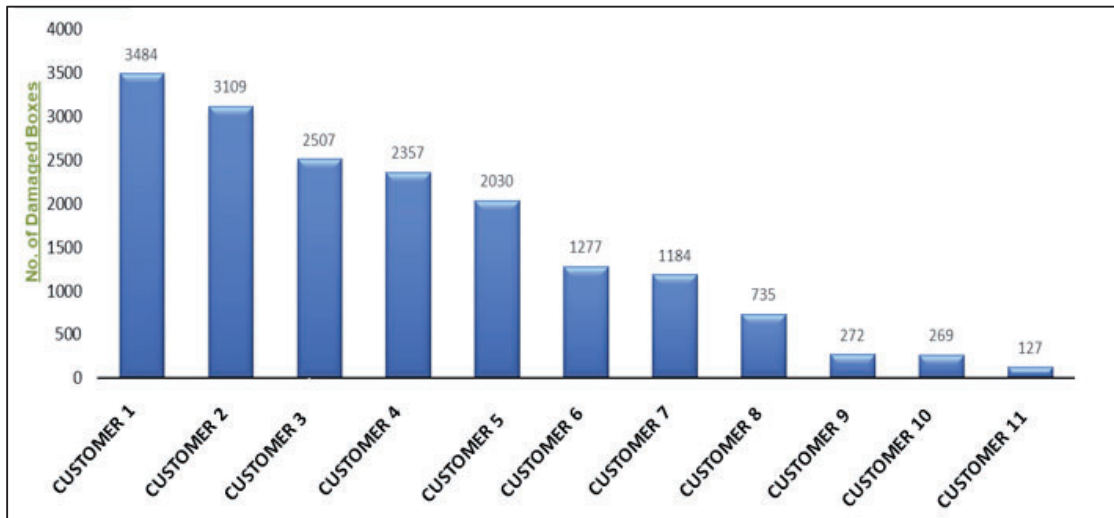
Historical data of the breakages enquired within the distribution network was retrieved from packaging damages records. Data was drawn from the Logidata ERP system for the freight and Figure 2 shows a summary of cardboard packaging damages resulting to excessive claims. Over a period of 6 months, the distribution service experienced a total of 85 745 parcel breakages during the consignment of goods from B2C or C2C within the regions of South Africa. In this study, attention was paid for every damaged parcel since it results to excessive claims and loss in business revenue.



**Figure 2: Summary of cardboard packaging damages resulting to excessive claims**

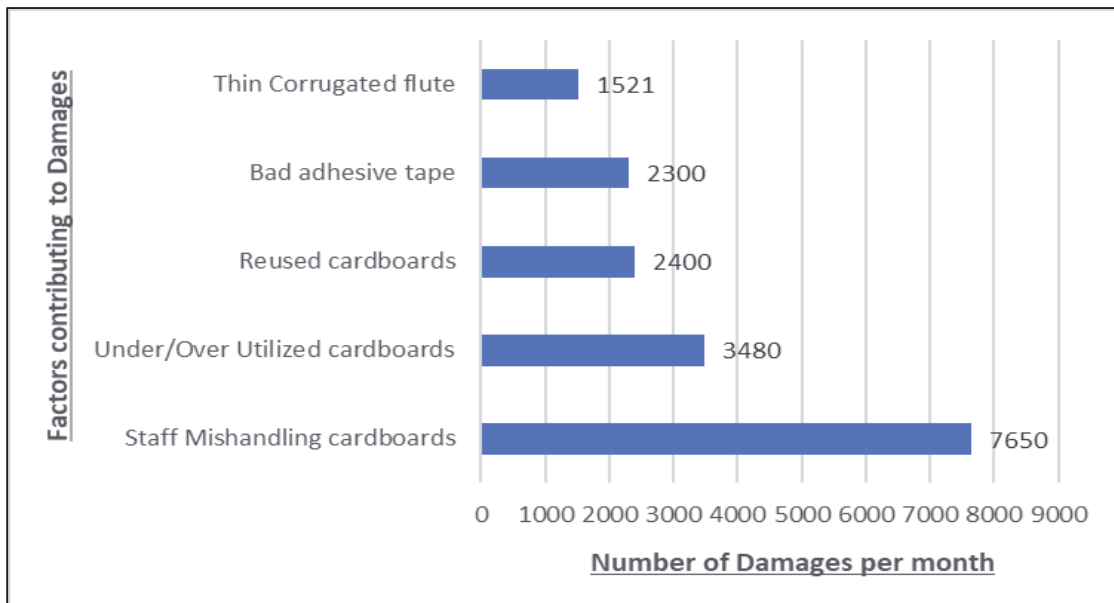
Figure 3 shows a summary of packaging damages per customer that were assessed in one month, that had >100 damages. Out of the 22 suppliers measured, only 11 suppliers had damages >100. The highest number of damages assessed was 3484 by customer 1 followed by 3109 by customer 2. As a result, the assessment checks performed included packaging size, weight of parcel, internal packaging utilization, flute corrugated size used and type of adhesives used for the package. The database was created for capturing structured information related to damages received within the distribution network, it is capable of capturing and storing up to 1000 cardboards per day.





**Figure 3: Summary for packaging damages per customer**

Figure 4 shows a summary of factors that contribute to cardboard packaging damages in the distribution network. The highest number of damages were experienced due to staff mishandling cardboards followed by receiving cardboards from suppliers that are internally over or under utilized.



**Figure 4: Summary for factors that contribute to cardboard packaging damages**

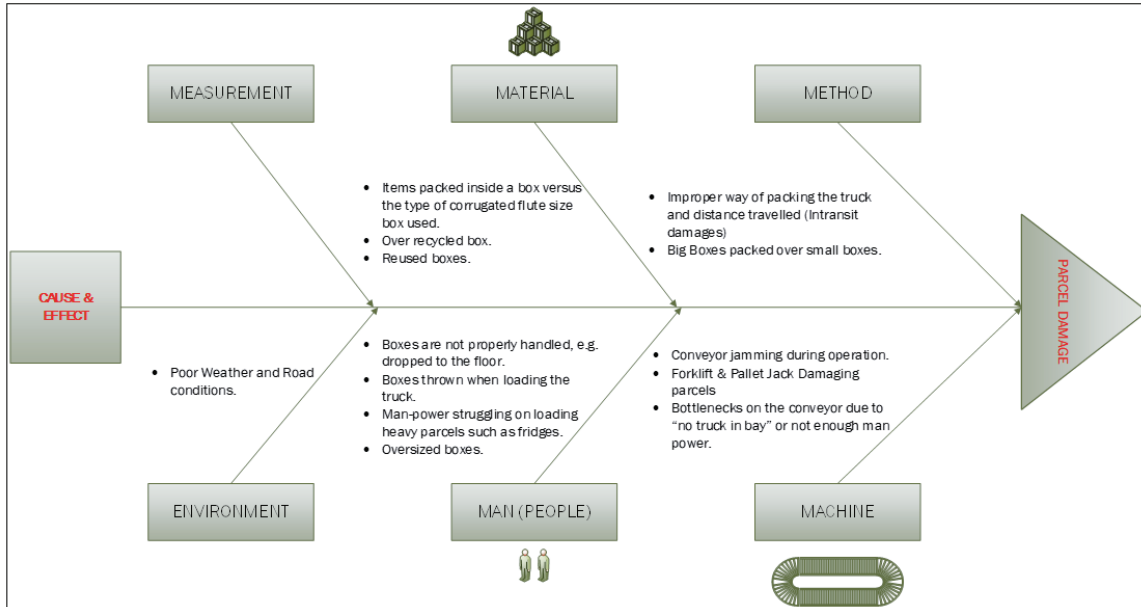
Therefore, in line with proper problem definition, the problem was found to be mishandling of packaging that were resulting to damages.

#### 4.2 Potential causes for packaging damages

A root-cause diagram was used as a tool to identify and display possible causes for packaging breakages. As shown in Figure 5, it represents the deepest underlying cause of positive or negative symptoms within the logistics process that would result in elimination, or substantial reduction, of the symptom [17]. The causal factors were established from brainstorming sessions and information obtained from operations project department. Some of the correlating factors that contribute to packaging damages were revealed to be specifications



such as packaging size, weight of parcel, internal packaging utilization, flute corrugated size used for the package. It was also revealed that man-power is struggling with heavy parcels hence resulting in more breakages. The foundation point for parcel damage prevention is the packaging, keep in mind that each good requires different packaging materials. So, take the necessary time to choose the ideal packaging for your type of product, so that it reaches the customer in perfect conditions.



**Figure 5: Root cause analysis for packaging damages**

The next step was to check if the standards were taken into consideration for each of the causes. Table 1 shows a summary of troubleshooting the potential root causes, the inspection procedures to be followed, and the observations that were made. Concerning poor handling of cardboards, the development of training solutions such as handling parcels in a vertical flute direction (VFD) will enhance the strength of the cardboard, develop a parcel inspection document (PID) and use it to collect information and data of the variables influencing claims and also empower employees for sustained framework while optimising distribution services. The team leader and supervisor use a parcel handling evaluation sheet (PHES) to observe employees as they are executing their duties doing a job. The PHES is a customised job description for each of the jobs that are executed within the cross dock facility.

**Table 1: Troubleshooting potential causes for packaging damages**

Potential root cause	Inspection	Observation
Incorrect method of handling	Perform PHES to check VFD on handled cardboard packaging	Lack of awareness on handling packaging correctly
Incorrect cardboard size used for packaging item	Perform PID to check cardboard size used against packaged item	Some packaging found to be underutilized
Conveyor jamming during operations	Check if there is enough chain lube on the inbound and discharge conveyor	No issues were observed



Incorrect adhesive tape	Perform PID to check adhesive tape used on cardboard packaging	No issues were observed
Incorrect stacking strength	Perform PHES to check VFD on cardboard packaging ensuring stacking strength	Some cardboard stacked incorrectly
Reused cardboards for packaging	Check for worn cardboard packaging	Some cardboards were worn

### 4.3 Implementation of possible solutions

These solutions included developing training solutions for parcel handling methods and stacking strength guides. It was also imperative to check if the packages are still getting damaged after the implementation of training and awareness on handling packaging correctly. Table 2 shows the steps which were followed for the implementation of possible solutions.

**Table 2: Steps for the PDCA cycle**

Description	Responsible	Status
<ul style="list-style-type: none"> <li>Develop a parcel inspection document to collect data of the variables influencing packaging claims.</li> </ul>	Industrial Engineer	Completed
<ul style="list-style-type: none"> <li>Develop a fishbone diagram to identify the underlying root-cause to packaging damages</li> <li>Measure the correlation of variables influencing packaging damages</li> </ul>	Industrial Engineer	Completed
<ul style="list-style-type: none"> <li>Check detailed description of captured structured information related to damages</li> </ul>	Industrial Engineer	Completed
<ul style="list-style-type: none"> <li>Develop training solutions through validated statistical analysis</li> </ul>	Industrial Engineer	Completed

To close the loop, it was vital to do the following tasks:

- Generate an incessant schedule to check packaging variables or review the frequency;
- Generate an incessant schedule to check handling methods or review the frequency.

## 5 RESULTS AND DISCUSSION

The implementation of possible solutions led to the improvement of parcel handling in terms of reduction of packaging damages. These include stacking corrugated cardboard in a vertical flute direction always as this increases the stacking strength of the cardboard and continuously perform feasibility study on packaging. Figure 6 shows a comparison of before and after scenarios for packaging damages. A successful consignment of delivering 100 000 parcels to a consignee is equivalent to generating a R1 million rands sale. In the before scenario, the highest number of cardboards damages in a month was 23 000 which is 5% of the delivered parcels. The results demonstrate that there is a noteworthy improvement after the interventions on issues that were highlighted by the root-cause diagram for cardboard packaging damages and reduced the number of damages drastically to 5000 which is 1% of the delivered parcels in the month of May-22.



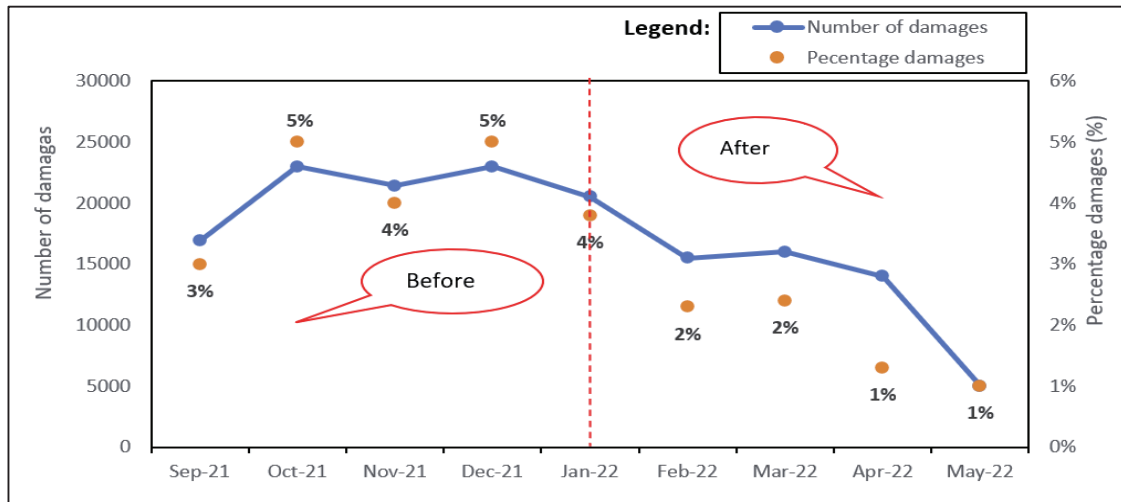


Figure 6: Comparison of before and after scenarios for cardboard packaging damages

## 6 CONCLUSION

The study focused on the improvement of cardboard packaging damages through the deployment of PDCA system and root cause analysis. It was noted that damages during distribution service is a challenge given the escalation of logistics costs associated with supplier claims. Lean manufacturing tools can be used to provide structure to solve problems and measure performance, and thereafter provide solutions to optimise distribution operations while reducing packaging damages. It was also noted that the PDCA is an iterative technique for continuous improvement and can be exploited to improve the distribution operations. The root causes of packaging damages during the distribution operations as a result of mishandling packaging were identified and cost-effective measures were instituted to reduce excessive claims associated with damaged cardboard cartons in distribution. Future research would embrace the impact of Industry 4.0 and other related technology will influence quality and efficiency of packaging solution in distribution.

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