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Abstract

The setting of the project was a technology company which, for confidentiality issues, will be called Puerto Rico Repair Industry (PRRI). The UniBox project was formed to reduce high packaging costs by replacing thirty different box designs for Power over Ethernet (PoE) switches with one universal solution. A literature review was conducted to substantiate the advantages of multi-depth corrugated boxes in terms of cost-effectiveness, sustainability, and compliance with ASTM standards. Data collection included stakeholder interviews and supplier evaluations. Drop tests were conducted to validate durability. Cost analysis compared the costs of the packaging options to those of the current packaging. The results showed that Uline was the best supplier, providing adequate boxes with an 88% cost reduction, at \$6.88 per unit. The implementation of multi-depth boxes was expected to improve warehouse operations. The overall findings of the project indicated that standardized multi-depth packaging is practical and cost-effective.

Background

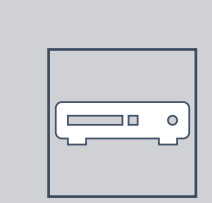
Puerto Rico Repair Industry (PRRI) operates in the Power over Ethernet (PoE) switch repair sector, specifically in the packaging and supply chain division. (The company name is fictitious to preserve confidentiality.) The company operates a repair area that works with a high mix of PoE switch products and low demand. To remain competitive, the personnel sought to standardize their packaging. This request helped in their target to increase cost efficiency, which is critical for profitability and customer satisfaction.



Problem

PRRI currently uses thirty unique packages to accommodate 54 PoE switch part numbers (PNs) of varying sizes. PRRI purchases a box with foam from a local company that charges from \$50.00 to \$60.00 per box (unit price) without shipping cost to deliver the packaging. Due to the high mix and low volume demand, the local company passes the labor cost to create a small batch of boxes. The lack of standardized packaging in PRRI increases material expenses, storage requirements, and shipping costs.

Objectives



1. Fit all 54 PoE switch PNs in one box design.



2. Reduce packaging costs compared to the current multi-box approach.



3. Maintain compliance with industry durability and safety standards.

Methodology

Data collection & Analysis

Public information, academic studies (Google scholar, PUPR digital repository), simulated data, and expert interviews were obtained. Interviews were conducted with PRRI subject matter experts in the packaging engineering area. During the interview, the team collected data on part descriptions, product families, and demand.

The red box in Figure 1 indicated the top 10 PNs that represent 20% of the highest demand per quarter. For this Pareto, the team used 30 PNs that had the most demand. This information advised the team which PNs had the highest demand. The team identified the top offender part family, which was the JL06, with a demand of 409 boxes per quarter. This information advised which part family was the most important to PRRI and needed a constant supply.

Based on the data gathered, the team identified the total demand of 2,280.75 boxes needed quarterly. Based on a year of 260 working days, the daily demand for shipping was 35.09 units. The team recommended keeping a 10% safety stock, which equals 3.6 boxes per day or 234 boxes quarterly, for a total quarterly demand of 2,514.85 boxes. The recommendation made to PRRI was to conduct a re-order point per quarter at 1,527 boxes or every 57 days.

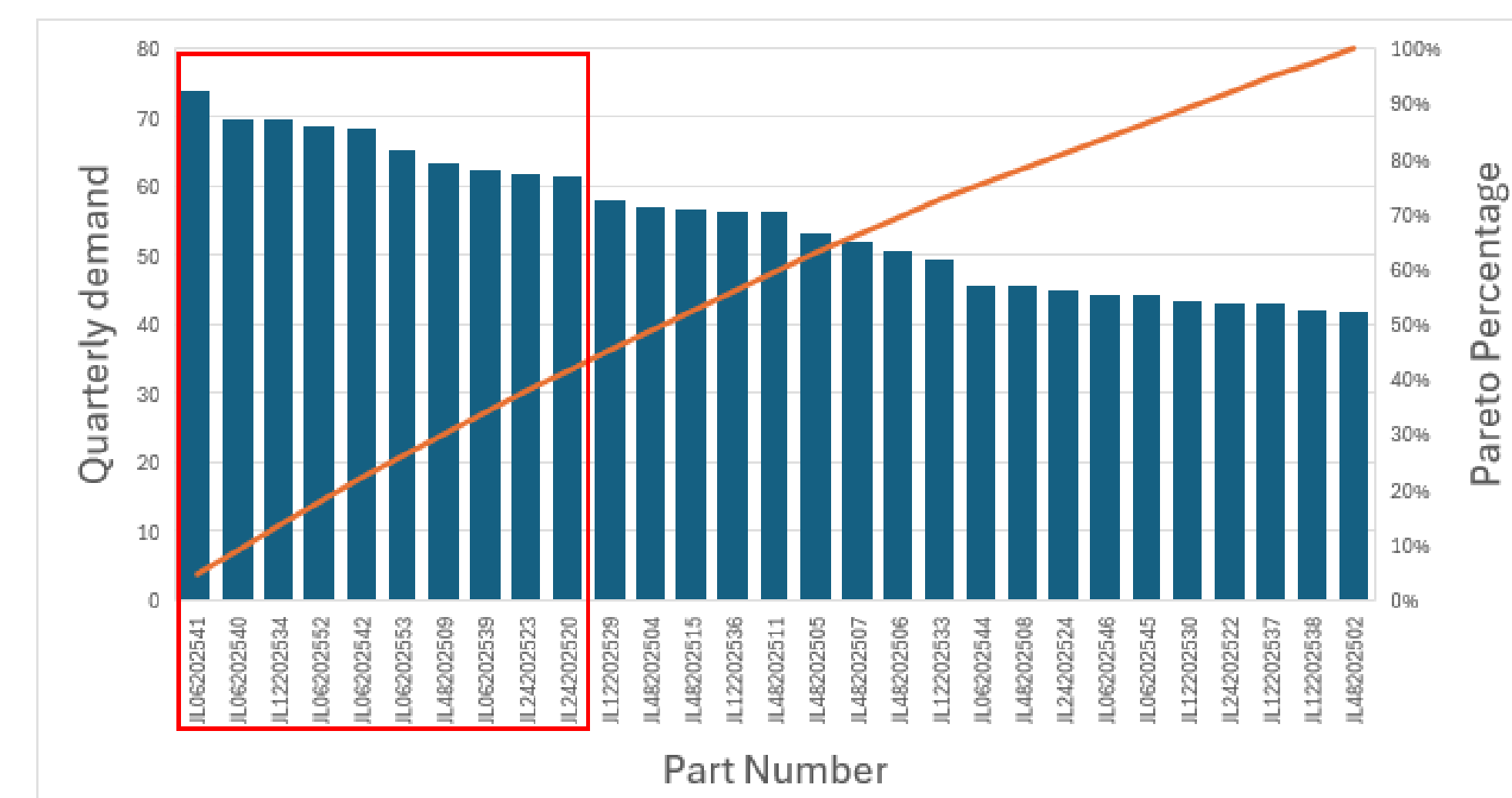


Figure 1
Quarterly chart per Part number

Box Selection / Design

The team identified a box that meets the objectives. During the review of acceptable packages with the suppliers, Uline sales team suggested a multi-depth package and foam. This solution, presented in Figure 2 and suggested by Uline, addressed the objective of the project [1].



Figure 2
Multi-Depth Corrugated Box

Supplier Sourcing

During the review of potential suppliers, the team created a list of three potential suppliers that could produce a multi-depth box. The suppliers were: Uline, Amazon, and Foam Pack, a local company in Puerto Rico.

Multi-Depth Corrugated Box

A multi-depth corrugated box is designed with multiple pre-made creases or scores along its sides, allowing the packager to adjust the box height as needed. To select the desired height, the packager needs to fold down the crease at the desired height and tear down the corners [2]. This instruction allows the packager to select the desired height for the product. In Figure 3 you can observe in detail the instruction of how to build the Multi-Depth Corrugated Box.

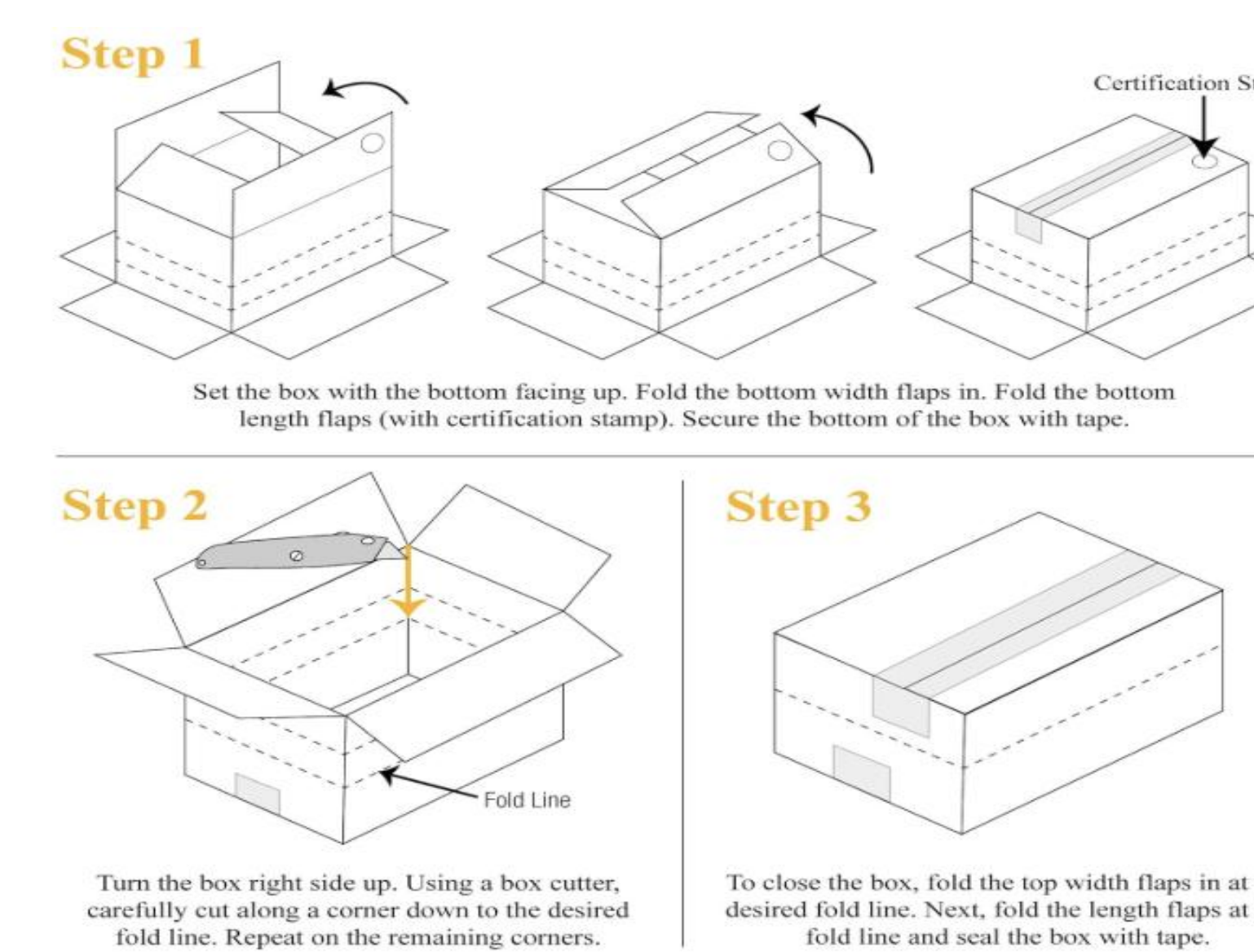


Figure 3
Multi-Depth Corrugated Box build Instructions

Results

The seller proposed by the Unibox team was Uline. The box met the industry standard ASTM D5118, 200# Double Wall 60 lbs. / linear inch of stacking weight before crushing [1]. Additionally, in Figure 4 it was compared that Uline had the lowest unit cost of \$6.88, lower than Status Quo average of \$55.00. This marked an 88% cost reduction. The selected box met the maximum length, width, height, and weight to fit all parts.

Also shown in Figure 4 is the cost of \$0.00 that was observed from the Foam Pack column. The team sent a quote request to Foam Pack (local packaging company) and they sent no response. The team provided a second option, Amazon. This option had a higher cost but had the fastest lead time of 1 week. In case the shipments from Uline got delayed or there were any difficulties with Uline, the team offered a second option with a higher unit cost of \$36.53 but was lower than the status quo average of \$55.

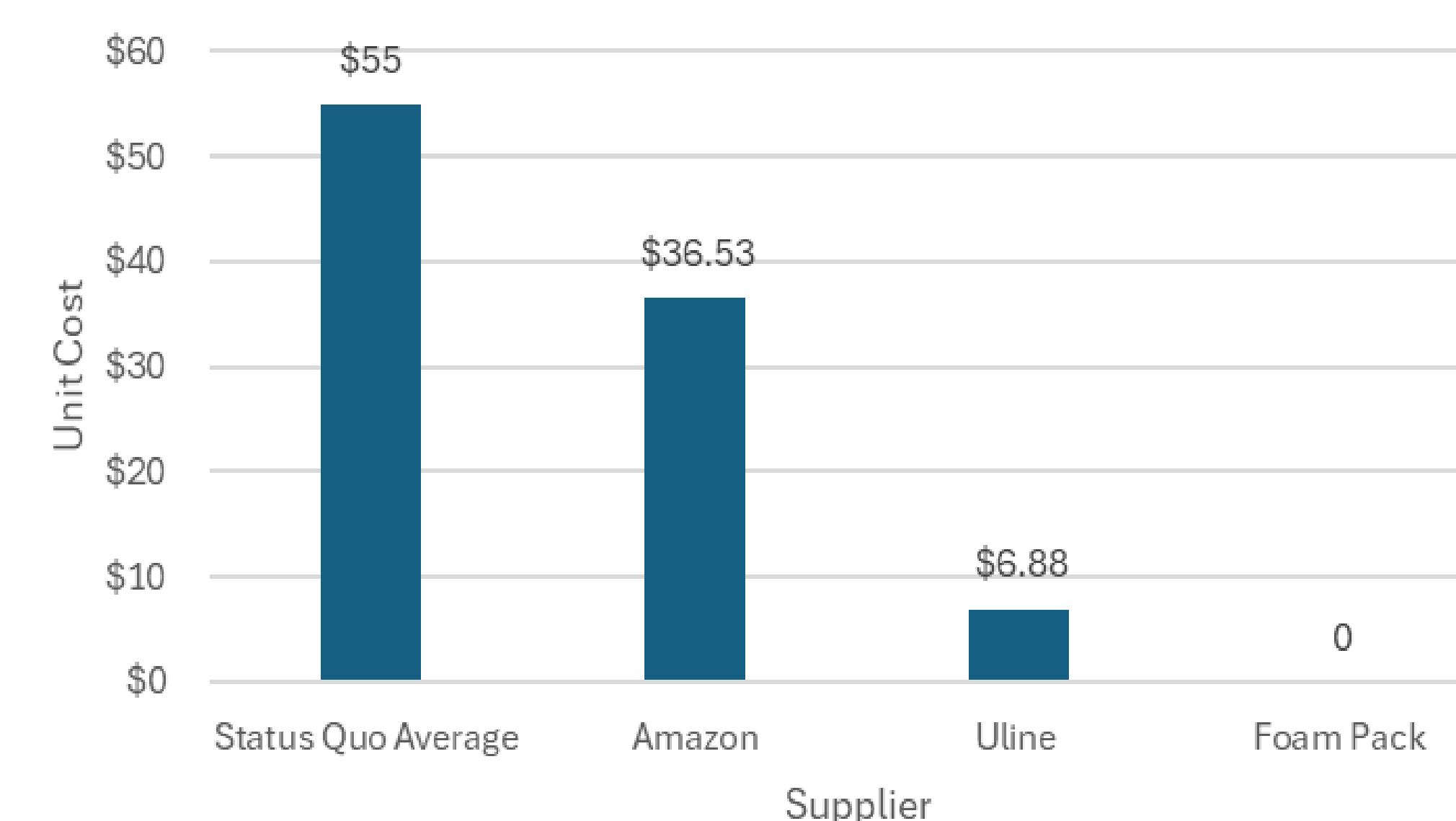


Figure 4
Total Unit Cost per Seller

Drop Test

The team conducted the drop test using the part family with the highest weight, which was the JL48 that had a weight of 10 lbs., using the approved Uline corrugated box. The team obtained the baseline measures to conduct the drop test using the ASTM D5276-19 standard [3].

A multi-depth corrugated box was used, and a sample product was packaged. Afterwards, the team proceeded to drop the box ten times. In Figure 5, are the areas that were observed and reviewed from a free fall of a 30-inch height. The drop test was analyzed, and the observations were that there was no structural damage to the weakest area of the box, Manufacturer's Joint or the corner 2-3-5. There was no visible damage to the product. The PRRI personnel inspected the product after the drop test and functioned normally. It was concluded that it was a successful drop test since the box handled the stress and the product had no damage.

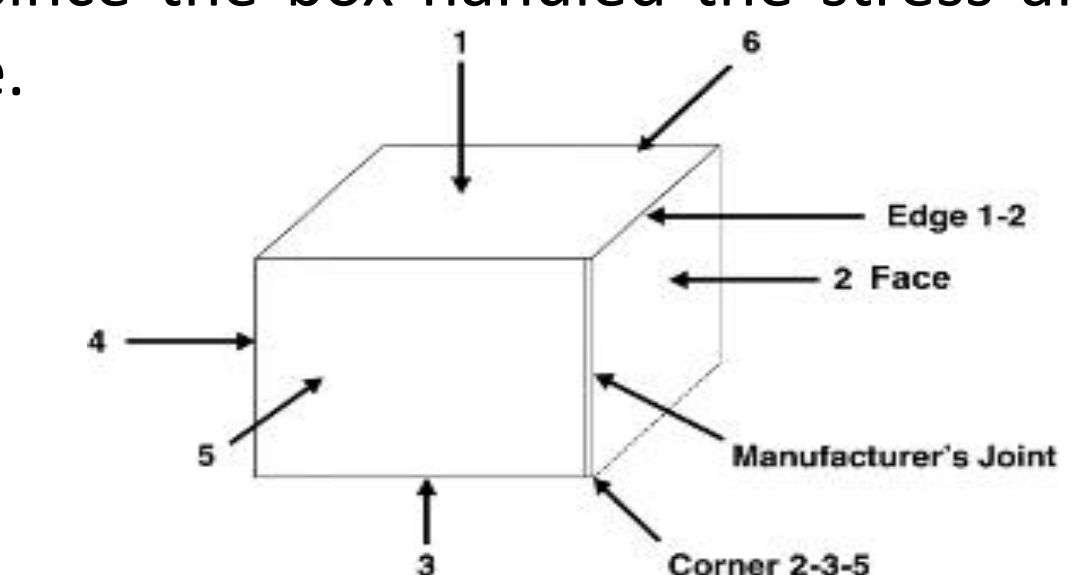


Figure 5
Areas reviewed for impact

Conclusions



Multi-depth packaging, accommodates all 54 PN in one box design.



Uline offers an 88% cost reduction versus the current supplier.



Uline supplier supports profitability, while being compliant with industry standards.



Amazon serves as a reliable backup.



Future effort should focus on monitoring demand; suppliers lot review and benchmarking.

References

- [1]"24 x 24 x 12." <https://www.uline.com/Product/Detail/S-4449/Corrugated-Boxes-200-Test/24-x-24-x-12-Multi-Depth-Corrugated-Boxes>
- [2]"Multi-depth: Adjustable size boxes," Smurfit Kappa, <https://www.smurfitkappa.com/products-and-services/packaging/multi-depth-adjustable-size-boxes>
- [3]"Standard test method for drop test of loaded containers by free fall." <https://store.astm.org/d5276-19.html>