FINAL SUBMISSION

AN ANALYSIS OF A CORRUGATED BOX MANUFACTURING FIRM

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INDUSTRY & PRODUCT BACKGROUND

Corrugated boxes are made by assembling three layers of corrugated cardboard sheets. These sheets help to trap air between them, acting as a cushion to preserve the contents of the box.

Corrugated boxes provide several advantages over other types of packing, including strength, lightweight, flexibility, high durability, and aesthetic appeal, furthermore, these boxes are environmentally friendly because they are made without the use of any toxic chemicals and can be readily recycled.

Corrugated boxes are widely utilized in the packaging of food and beverages, chemicals, glassware and ceramics, paper, electronics, textiles, personal care and household products.

The rise of numerous end use sectors has led to an increase in the demand for corrugated boxes on a global scale. Additionally, the e-commerce industry is growing swiftly as a result of the benefits of online shopping, including free shipping options, easy return policies, and hassle-free delivery.

The worldwide corrugated boxes market is now being driven by the burgeoning trend of customized packaging as well as the advent of product-specific corrugated boxes that protect objects from mechanical stress.

ORGANIZATION BACKGROUND

Megha Packaging, a small manufacturing company based in Kolkata, is mainly engaged in the production of **corrugated boxes, cores, rolls** and **corrugated board**. In addition to making the above items, the firm is also involved in the **spindle** and **reel** business. Corrugated boxes will belong to the segment of packaging solutions.

The company buys raw materials from the market only after accepting orders from the respective firms which then undergoes through various processing stages to get transformed into the desirable products. The stages of manufacturing Corrugated Rolls & Sheet, Corrugated Carton Boxes and Cores are shown in the diagram below.
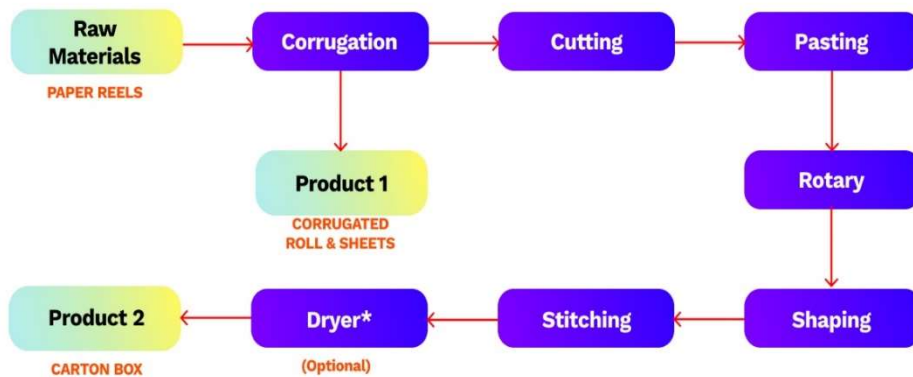
Steps for manufacturing of i)Corrugated Rolls & Sheets and ii)Carton Boxes
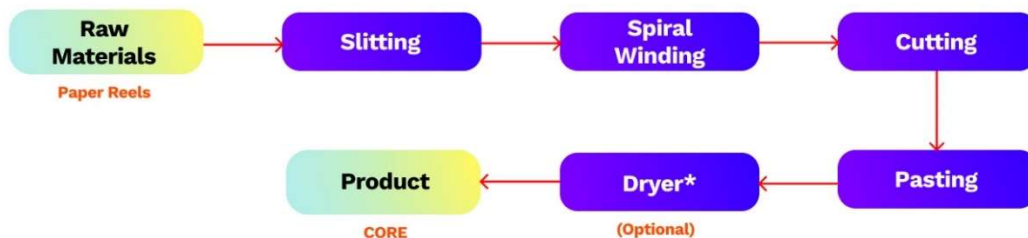
Steps for manufacturing of Core

SOME PICTURES OF THE FIRM

PRIMARY DATA CLEANSING

- Data was maintained in Tally software in a typical invoice like format which was exported to excel.

- Excel sheets were then converted to csv format using **python** & additional packages/dependencies (Pandas, xlrd, openpyxl)
- Further pre-processing done using **bash**, **sed** and **awk** to extract the required fields from the unclean data and transform it into a format suitable for analysis
- Scripts used to achieve the same is shown below:

```
12:02:39 PM ⚡ sayan in BDM Capstone Project Final_18-03-22/Sayan_Project/data
)cat xlsx_to_csv.py

       File: xlsx_to_csv.py

  1    import glob
  2    import pandas as pd
  3    import re
  4
  5    source_path = './Raw_data/ALL BILLS 21-22_Megha Sales'
  6    destination_path = "./21-22csv"
  7
  8
  9    for name in glob.glob(source_path+'/*.*'):
 10        # print(name)
 11        file_name = name.split("/")[3]
 12        # print(file_name)
 13
 14        read_file = pd.read_excel(source_path+"/"+file_name, sheet_name=None)
 15
 16        file_name = re.sub(r'\s+', '', file_name)
 17
 18        for sheet_name, data in read_file.items():
 19            if "xlsx" in file_name:
 20                data.to_csv(destination_path+"/"+file_name.replace(".xlsx", ".csv"), index=False)
 21            else:
 22                data.to_csv(destination_path+"/"+file_name.replace(".xls", ".csv"), index=False)
 23        print("Converted "+file_name+" to csv")
```

```
12:04:39 PM ⚡ sayan in BDM Capstone Project Final_18-03-22/Sayan_Project/data
)cat csv_generate.sh

     File: csv_generate.sh

  1  for i in `ls $1`; do ./script.awk ./$1/$i | sed -E -e 's/invoice\s+?no\s+?\:\s+?//Ig ; s/name\s+?\:\s+?//Ig ; s/invoice\s+?date\s?\:\s+?//Ig';done;
```

```
12:04:42 PM ⚡ sayan in BDM Capstone Project Final_18-03-22/Sayan_Project/data
)cat script.awk

       File: script.awk

  1    #!/usr/bin/gawk -f
  2    BEGIN{FS=","}
  3    /^Name/{name=$1}
  4    /^,Name/{name=$2}
  5    /^Invoice Date/{date=$1}
  6    /^,Invoice Date/{date=$2}
  7    /^Invoice No/{invoice=$1}
  8    /^,Invoice No/{invoice=$2}
  9    /^[[:digit:]]/{arr[$1]=$0}
 10    /^,[[:digit:]]/{arr[$2]=$0}
 11    END{for (i in arr){print invoice","name","date","arr[i]}}
```

METADATA & DESCRIPTIVE STATISTICS

- **3511** individual csv files are generated from the python scripts indicating that **3511** invoices were made from April 2019 to December 2021
    - **1530** Invoices were made in year 19-20
    - **836** Invoices were made in year 20-21
    - **1139** Invoices were made in year 21-22
- Finished goods were sold to **222** unique companies in a span of 3 years
- Frequency of transactions and revenue per month is shown below

2019	Total Transactions Made	Sum of Revenue	2020	Total Transactions Made	Sum of Revenue	2021	Total Transactions Made	Sum of Revenue
Apr	197	40,54,197.40	Jan	218	42,42,012.10	Jan	140	38,76,308.80
May	276	67,58,171.60	Feb	239	48,69,214.00	Feb	96	23,83,189.95
Jun	219	46,72,027.60	Mar	169	27,80,936.95	Mar	163	57,80,332.79
Jul	299	63,33,318.80	May	25	4,54,462.25	Apr	139	43,72,293.15
Aug	247	52,16,903.50	Jun	91	16,98,168.38	May	142	40,81,064.49
Sep	254	53,01,859.35	Jul	137	27,90,119.00	Jun	127	38,87,760.30
Oct	198	39,21,873.95	Aug	73	15,58,691.00	Jul	126	30,22,377.59
Nov	214	50,60,664.85	Sep	113	22,45,175.80	Aug	150	46,52,943.73
Dec	221	40,88,403.78	Oct	148	29,25,142.66	Sep	181	62,48,321.33
			Nov	135	33,11,696.49	Oct	133	55,30,461.53
			Dec	153	47,32,856.10	Nov	140	51,79,180.95
						Dec	217	75,12,942.78
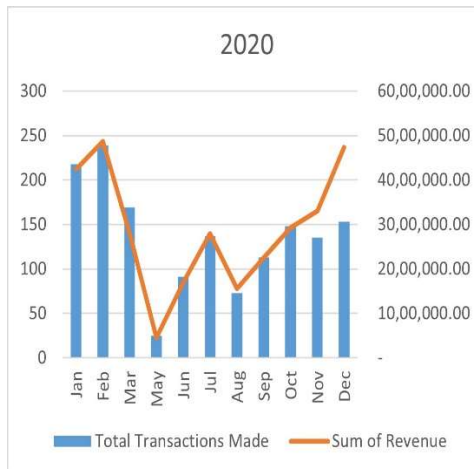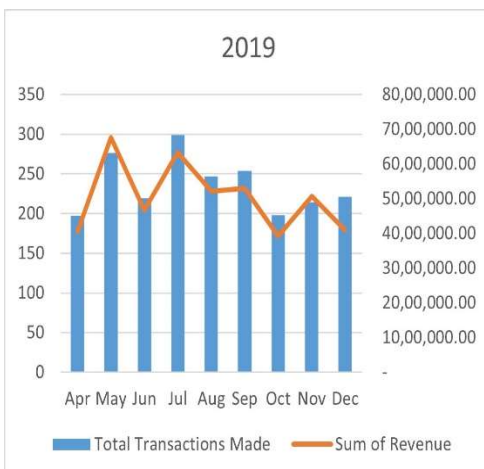
- Percentage of total revenue contribution per product is shown below
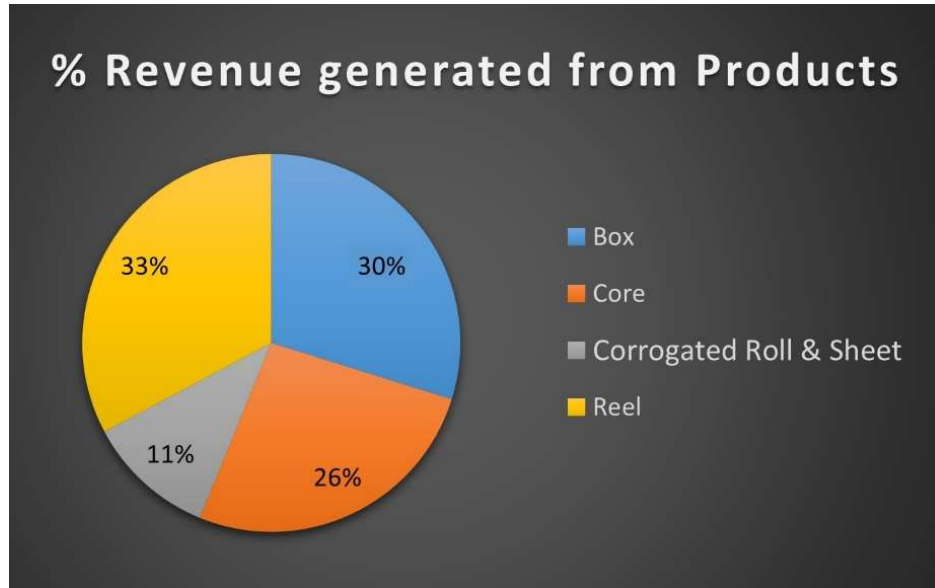
- **Box** and **Core** comprises of majority of the revenue (63% approx.)
- The trend line of the revenue generated by the firm is shown below
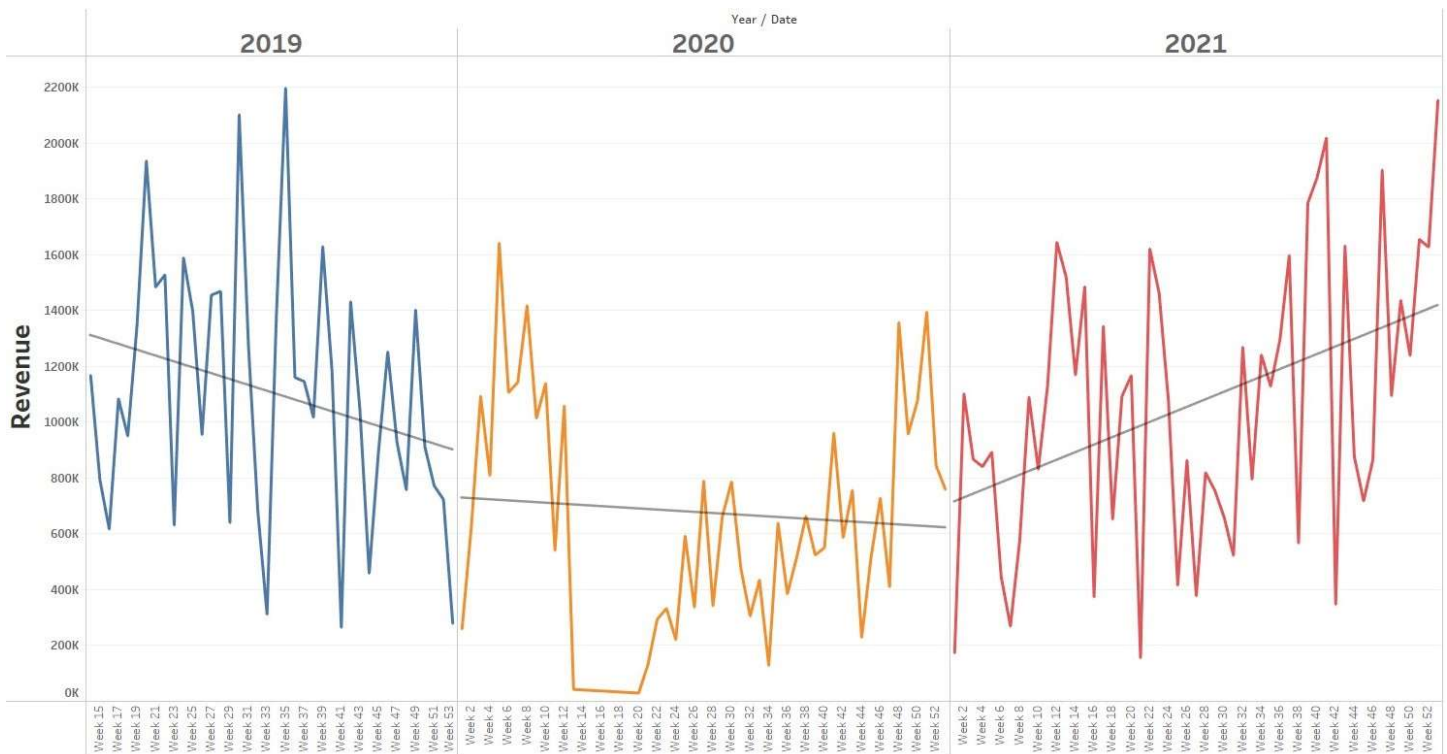
Constraints: **Extra Financial Data (Balance Sheet, etc.) and Inventory Data is not available to me due to some privacy concerns.**

ANALYSIS AND FINDINGS

PARETO ANALYSIS

The pareto analysis follows for the sales data, that is**, 80% of the revenue is being generated by 20% of the consumers.** This helps the company prioritize those consumers and focus on the production of those goods consumed by the respective consumers.
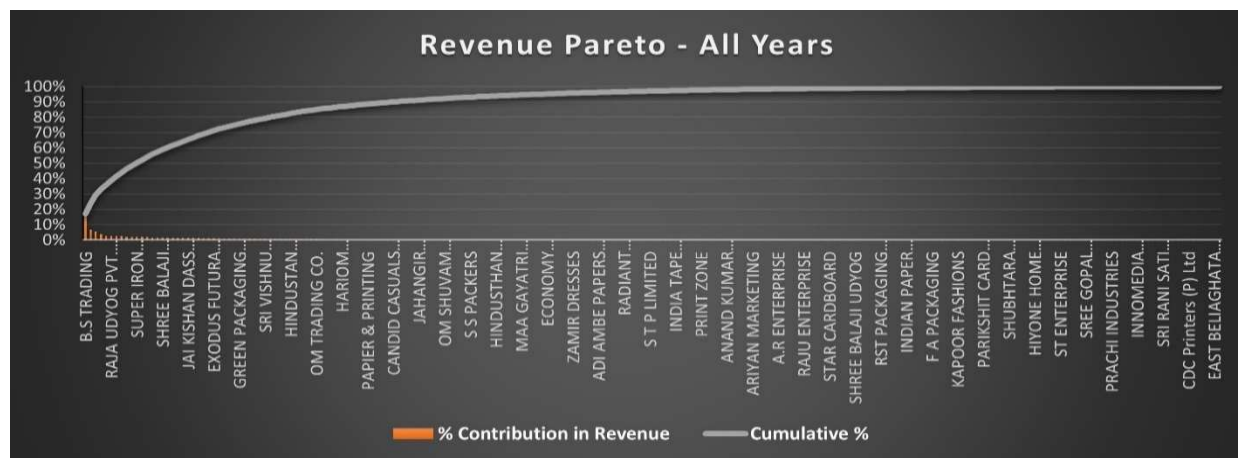
SEGMENT ANALYSIS

The 80% revenue generating companies are further broken down into four segments

- Category A – Consumers in this category appears consistently for all three years and is significantly contributing towards the total revenue, hence they are called "**consistent**"
- Category B – Consumers in this category are contributing significantly towards the total revenue since the last two consecutive years, hence they are called **"emerging"**
- Category C – Consumers in this category has either reduced their orders, or abruptly discontinued ordering since the last year, hence they are called **"declining"**
- Category D – Consumers in this category are inconsistently appearing in the 20% revenue generating companies list for the past three years, hence they are called **"inconsistent"**

The companies falling in the above categories are shown below

Year 2019	Year 2020	Year 2021
B.S TRADING	B.S TRADING	B.S TRADING
MYSHA ENTERPRISE	MYSHA ENTERPRISE	MOHAN BOARDS PVT LTD
ANNAPURNA ASSOCIATES	SUMAN INTERNATIONAL	N.F TRADING
ANNAPURNA CORRUGATED BOX INDUSTRIES	RAJA UDYOG PVT. LTD.	SUMAN INTERNATIONAL
SUPER IRON FOUNDRY PVT. LTD. (BURDWAN)	EXODUS FUTURA PVT. LTD.	ANNAPURNA ASSOCIATES
SM PACKAGING	VERVE OVERSEAS	TAPARIA IMPEX (P) LTD.
SRILAB POLYMER (P) LTD.	TAPARIA IMPEX (P) LTD.	JKE TAPES PRIVATE LIMITED
SUJOY ENTERPRISE	ANNAPURNA ASSOCIATES	HARIOM POLYPACKS LIMITED
RAJA UDYOG PVT. LTD.	SM PACKAGING	JAI KISHAN DASS MALL JUTE PRODUCTS (P) LTD.
M.G PACKAGING	OM SAI POLYMER	RAJA UDYOG PVT. LTD.
TAPARIA IMPEX (P) LTD.	SRILAB POLYMER (P) LTD.	GANPATI PACKAGING
GREEN PACKAGING INDUSTRIES PVT.LTD.	CENTURY EXTRUSIONS LIMITED	SHREE BALAJI ENTERPRISE
UNIWORTH PAPER & ALLIED PRODUCTS	FUJI INDUSTRIES	SRILAB POLYMER (P) LTD.
FLEX-O-CUT	BOTHRA POLY FILMS PVT. LTD.	SUNNY ENTERPRISE
COGNATE SYSTOPACK SOLUTION	FLEX-O-CUT	RAHUL ENTERPRISES
	ABABEEL ENTERPRISE	NATIONAL PAPER TUBE INDUSTRIES.
	LOKENATH PRINT & PACKERS	OM SAI POLYMER
	SHREE BALAJI ENTERPRISE	RS ENTERPRISE
	TENTY MARKETING COMPANY (P) LTD	DAS SUPPLIERS
	ESSTEE KLEIN CHEMICAL CO.	VERVE OVERSEAS
	RAHUL ENTERPRISES	FUJI INDUSTRIES
	GREEN PACKAGING INDUSTRIES PVT.LTD.	LOKENATH PRINT & PACKERS
	NATIONAL PAPER TUBE INDUSTRIES.	STARWAY PAPER PACK
	SUJOY ENTERPRISE	CENTURY EXTRUSIONS LIMITED
		SRI VISHNU INDUSTRIES
		OM TRADING CO.
		BHARAT PLASTIC INDUSTRIES
		MYSHA ENTERPRISE
		HINDUSTAN ADHESIVES LIMITED.
		MARUTI POLY FILMS

- Firms belonging to categories **A and B** must be taken care with utmost importance since they are highly likely to be the **loyal customers of the company**

- The firm needs to **take feedback from Category C and D** companies to provide better service as per their requirements and have an increased likelihood on retaining customers

- Further business opportunities can be explored to **retain category C and D** companies & **convert them into category A/B** to increase revenue generated

The companies in the above categories and the products they consume are given below

CATEGORY A

Company Name	Product
B.S TRADING	Reel
MYSHA ENTERPRISE	Reel
ANNAPURNA ASSOCIATES	Reel
SRILAB POLYMER (P) LTD.	Box
RAJA UDYOG PVT. LTD.	Core
TAPARIA IMPEX (P) LTD.	Box

CATEGORY B

Company Name	Product
SUMAN INTERNATIONAL	Core
VERVE OVERSEAS	Box
OM SAI POLYMER	Box
CENTURY EXTRUSIONS LIMITED	Reel
FUJI INDUSTRIES	Box
LOKENATH PRINT & PACKERS	Core
SHREE BALAJI ENTERPRISE	Core
RAHUL ENTERPRISES	Corrogated Roll & Sheet
NATIONAL PAPER TUBE INDUSTRIES.	Reel

CATEGORY C

Company Name	Product
SM PACKAGING	Reel
SUJOY ENTERPRISE	Corrogated
GREEN PACKAGING INDUSTRIES PVT.LTD.	Box
FLEX-O-CUT	Corrogated

CATEGORY D

Company Name	Product
ANNAPURNA CORRUGATED BOX INDUSTRIES	Reel
SUPER IRON FOUNDRY PVT. LTD. (BURDWAN)	Corrogated Roll & Sheet
M.G PACKAGING	Reel
UNIWORTH PAPER & ALLIED PRODUCTS	Reel
COGNATE SYSTOPACK SOLUTION	Box
EXODUS FUTURA PVT. LTD.	Corrogated Roll & Sheet
BOTHRA POLY FILMS PVT. LTD.	Box
ABABEEL ENTERPRISE	Reel
TENTY MARKETING COMPANY (P) LTD	Box
ESSTEE KLEIN CHEMICAL CO.	Box
MOHAN BOARDS PVT LTD	Box
N.F TRADING	Reel
JKE TAPES PRIVATE LIMITED	Box
HARIOM POLYPACKS LIMITED	Core
JAI KISHAN DASS MALL JUTE PRODUCTS (P) LTD.	Core
GANPATI PACKAGING	Box
SUNNY ENTERPRISE	Box
RS ENTERPRISE	Reel
DAS SUPPLIERS	Reel
STARWAY PAPER PACK	Reel
SRI VISHNU INDUSTRIES	Reel
OM TRADING CO.	Core
BHARAT PLASTIC INDUSTRIES	Box

TREND ANALYSIS

Upon plotting the Monthly Revenue graph, it is observed that the quantities of **boxes** and **reels** sold during the period of April to September is low every year for the past three years.

Upon communicating this insight with the company, it is interpreted that the demand is typically **low during summer seasons** and **high in winter seasons** as majority of the orders come from a fan manufacturing firm and they typically manufacture their products during winter, when the demand is low to meet high demand during the summer seasons.
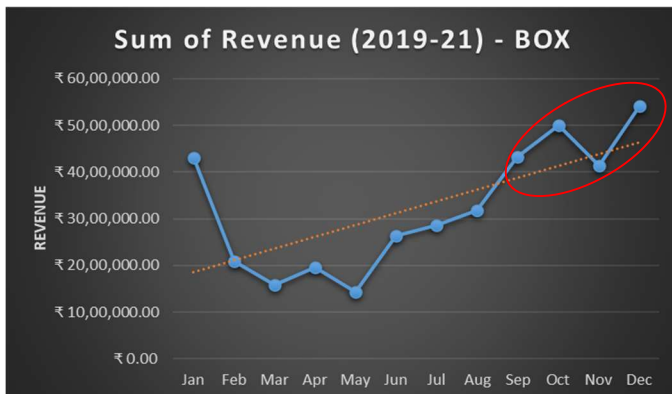
Trend of BOX

- Sales spikes during September to December
- There is a dip during October due to Durga Puja holidays
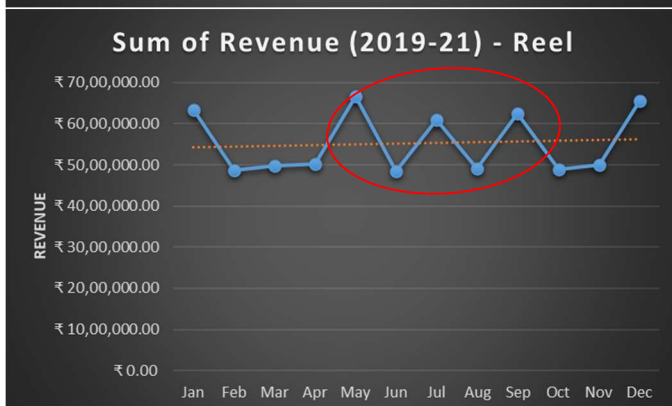
Trend of REEL

- The demand remains almost the same throughout the year
- These zig-zag patterns are to avoid losses (the firm dispatches products only after they receive full payment)
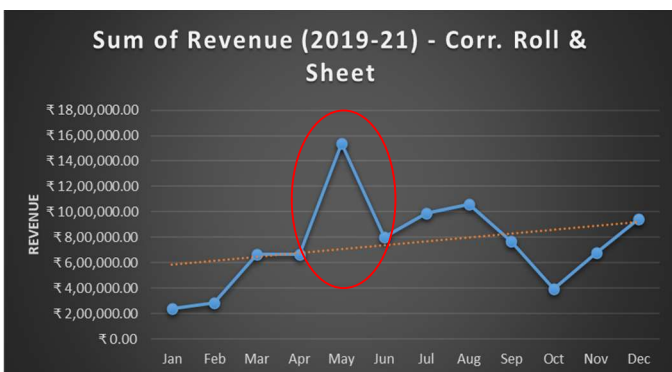
Trend of Corr. Roll & Sheet

- The demand goes up during May
- The demand is quite low during the puja holidays
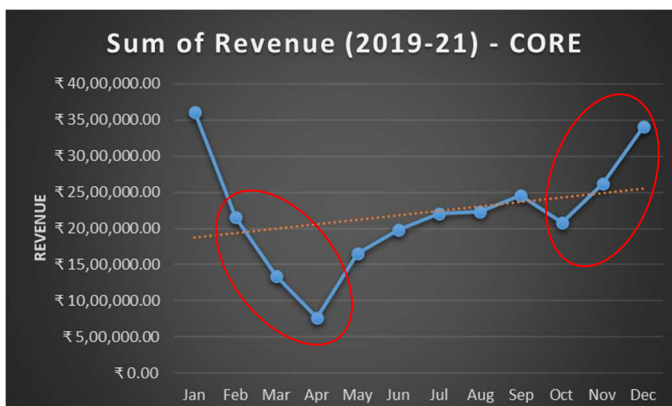
Trend of CORE

- The demand goes up during the year ending time
- The demand is quite low during April

TREND OF RATE

- The average rate of **BOX goes down in the months September to October** during which the sales also start to increase

- The **average rate of REELS doesn't change much** and the demand for REELS stays the same throughout the year indicating that it is **a highly desirable product** among the companies (REELS also is the **maximum revenue generating product** (33% approx.) for the firm)

- The **rate of CORE falls down during the summer seasons** when the demand is typically low

- The **rate of CORRUGATED ROLL AND SHEET falls during December to January**

CLUSTER ANALYSIS

Scatter plots between **revenue** and **quantity** is being made for each product and most valuable firm/s consuming that product is identified through clustering. For every product, **four clusters** of companies are being created on the basis of Revenue generated and Quantity ordered. The scatter plots for every product are shown below.
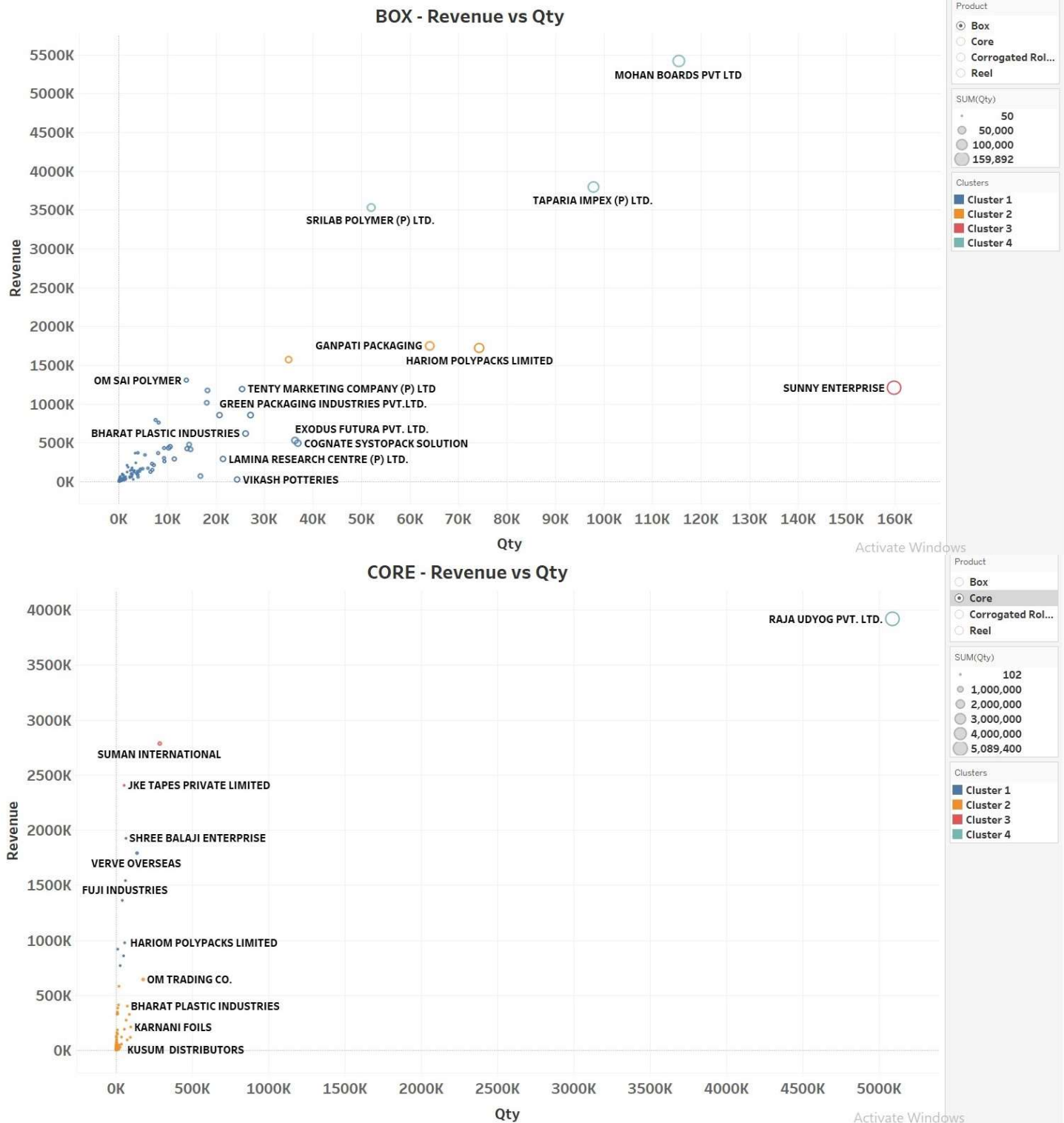
CORROGATED ROLL & SHEETS - Revenue vs Qty

Product
- Box
- Core
- Corrogated Rol...
- Reel

SUM(Qty)
- · 122
- ○ 20,000
- ○ 40,000
- ○ 60,000
- ○ 87,454

Clusters
- ■ Cluster 1
- ■ Cluster 2
- ■ Cluster 3
- ■ Cluster 4

Labels on chart: SUPER IRON FOUNDRY PVT. LTD. (BURDWAN), RAHUL ENTERPRISES, SUJOY ENTERPRISE, FLEX-O-CUT, CENTURY EXTRUSIONS LIMITED, N.F TRADING, SURAKSHA ENTERPRISE, P.N MUKHERJEE & CO. PVT. LTD., LINTAS PACKAGING (P) LTD

Activate Windows

REEL - Revenue vs Qty

Product
- Box
- Core
- Corrogated Rol...
- Reel

SUM(Qty)
- · 221
- ○ 200,000
- ○ 400,000
- ○ 600,000
- ○ 800,000
- ○ 922,656

Clusters
- ■ Cluster 1
- ■ Cluster 2
- ■ Cluster 3
- ■ Cluster 4

Labels on chart: B.S TRADING, MYSHA ENTERPRISE, ANNAPURNA ASSOCIATES, N.F TRADING, SM PACKAGING, NATIONAL PAPER TUBE INDUSTRIES., UNIWORTH PAPER & ALLIED PRODUCTS

Activate Windows

Upon analyzing the above pictorial representations, the company can focus more on the **firms belonging to clusters two, three and four** since they are **ordering in larger quantities** and making a significant impact on the revenue generated by the company.
Further business opportunities can be explored to **convert firms belonging to cluster two and three into a cluster four firm.**

ASSET UTILIZATION ANALYSIS

- The company uses **machines operated by manual labour** which are used to convert raw materials into finished goods.
- An estimate of the **average weight** (in Ton) and the **capacity** of each machine dealing with the respective product is noted down as follows

Year 2019				
Product	Sum of Qty	Avg.Weight (Ton)	Prod Capacity (Ton)	Utilization Factor
Box	255891	0.5	2	25%
Core	1532576	0.29	1	29%
Corrugated Roll & Sheet	175184.5	0.7	1	70%

Year 2020				
Product	Sum of Qty	Avg.Weight (Ton)	Prod Capacity (Ton)	Utilization Factor
Box	138705	0.28	2	14%
Core	2120029.47	0.4	1	40%
Corrugated Roll & Sheet	89487.8	0.36	1	36%

Year 2021				
Product	Sum of Qty	Avg.Weight (Ton)	Prod Capacity (Ton)	Utilization Factor
Box	668323	1.3	2	65%
Core	2773577.044	0.52	1	52%
Corrugated Roll & Sheet	68623.05	0.28	1	28%

- Upon analysing the production capacity with respect to product utilization, we can calculate the **utilization factor** for each machine dealing with each product.

- By seeing the utilization factor, we can clearly see that the **assets are not used to their full capacity**. But before drawing any further conclusion, I think further knowledge on how the company plans its production is essential.

RECOMMENDATIONS

- Companies belonging to category **'A' and 'B' are the consistent revenue generators** for the firm, so the firm should **tend to their needs as earliest as possible**

- The firm should identify potential business opportunities and **increase interaction with firms belonging to categories 'C' and 'D'** to convert them into an 'A' category company

- **Box and Core are performing poorly** (revenue trend is downwards) in the duration Jan-Apr
    - On further communication, it was revealed that majority of the **demand was form a fan manufacturing company** who typically **order during summer season due to high demand in winter season**
    - My recommendation would be to **identify products that has high a demand** during summer season and then **identify business opportunities with companies dealing with those products** and willing to order during winter
    - **Further opportunities may be identified** among the present customers (specially category 'C' and 'D') type companies

- The firm can make a calculated decision of **buying raw materials and stocking the raw materials before the seasons when the demand is high** to maximize profits

Note – Analysis on raw materials was not done due to the unavailability of data (there were some privacy concerns)

- The **utilization factor of the assets is quite low** (40% approx. of the total installed capacity)

    - Utilization factor may be improved by **finding business opportunities among potential clients**
    - **'B', 'C' and 'D' category companies can be targeted** to increase sales and revenue and subsequently increase the utilization factor for assets