

BUSINESS DATA MANAGEMENT (BDM) CAPSTONE PROJECT

MID TERM 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.

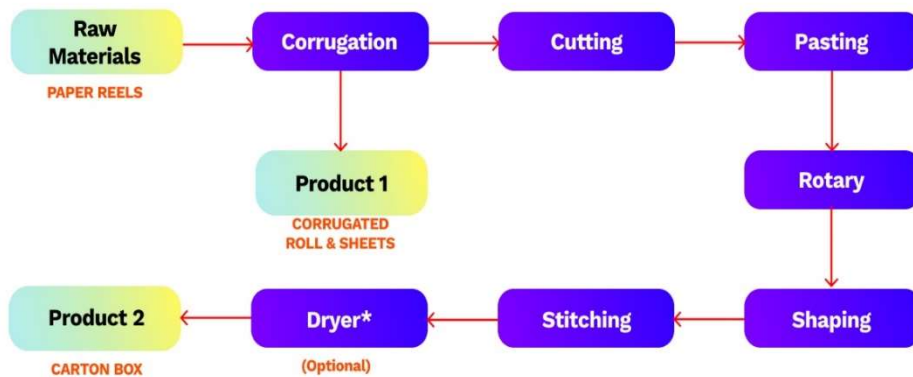
The rise of numerous end use sectors has led to an increase in the demand for corrugated boxes on a global scale. Additionally, the e-commerce industry is growing swiftly as a result of the benefits of online shopping, including free shipping options, easy return policies, and hassle-free delivery.

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.

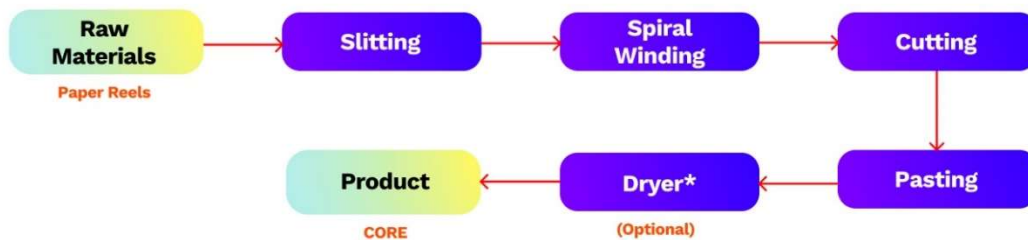
ORGANIZATION BACKGROUND

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.



TAX INVOICE		[] Original For Receipt [] Duplicate For Supplier/Transporter [] Triplicate For Supplier				
MEGHA PACKAGING		Address of Office : 30A, Canal East Road, Kolkata - 700 011. Address of Factory : Phone : 98302 95258				
GSTIN : 19ASGPS2804LZC		PAN : ASGPS2804L				
Invoice No : 884/19-20		Transportation Mode : By Road.				
Invoice Date : 01/11/2019		Vehicle Number :				
P.O No :		Date of Supply : 01/11/2019				
State : West Bengal		Place of Supply : Kolkata				
Details of Buyer :		Details of Consignee [Shipped to] :				
Name : MYSHA ENTERPRISE		Name : MYSHA ENTERPRISE				
Address : 717, Moulana Abul Kalam Azad Sarani, Kolkata- 700011.		Address : 717, Moulana Abul Kalam Azad Sarani, Kolkata- 700011.				
State : West Bengal		State : West Bengal				
State Code : 19		State Code : 19				
PAN : AJUPA0044P		PAN : AJUPA0044P				
GSTIN : 19AJUPA0044P1ZU		GSTIN : 19AJUPA0044P1ZU				
S. N.	Description of Goods/Service	HSN C Code	Qty	Unit	Rate	Total
1)	20 " - 80 Gsm (14 BF-5 nos)MB	48191010	1280	Kg	22.00	28,160.00
Total :			1280			
E Way Bill No. :		Packing & Forwarding /Any Other		0.00		
Electronic Reference Number :		Total Taxable Value		28160.00		
Add CGST @ 6%		Add SGST @ 6%		1690.00		
Add IGST @		Total Value including Tax		31540.00		
Total :		Total :		31,540.00		
Total Invoice Value [In Words] : Thirty One Thousand Five Hundred Forty Only. Tax Payable On Reverse Charges: No. E. & O.E., Subject to Kolkata Jurisdiction only , P ayments to be made through Banking Chane ls only , O verdue payment will attract interest @ 24% , I f Any complain intimation to be given with in seven days from receipt of material. The Buyer is responsible to collect TRANSPORTER'S COPY OF				For MEGHA PACKAGING Authorized Signatory		

TAX INVOICE		[] Original For Receipt [] Duplicate For Supplier/Transporter [] Triplicate For Supplier				
MEGHA PACKAGING		Address of Office : 30A, Canal East Road, Kolkata - 700 011. Address of Factory : Phone : 98302 95258				
GSTIN : 19ASGPS2804LZC		PAN : ASGPS2804L				
Invoice No : 863/19-20		Transportation Mode : By Road.				
Invoice Date : 24/10/2019		Vehicle Number :				
P.O No :		Date of Supply : 24/10/2019				
State : West Bengal		Place of Supply : Kolkata				
Details of Buyer :		Details of Consignee [Shipped to] :				
Name : ANNAPURNA ASSOCIATES		Name : ANNAPURNA ASSOCIATES				
Address : 30A, Canal East Road, Kolkata - 700 011.		Address : 30A, Canal East Road, Kolkata - 700 011.				
State : West Bengal		State : West Bengal				
State Code : 19		State Code : 19				
PAN : AEYPM0154P		PAN : AEYPM0154P				
GSTIN : 19AEYPM0154P1ZM		GSTIN : 19AEYPM0154P1ZM				
S. N.	Description of Goods/Service	HSN C Code	Qty	Unit	Rate	Total
1)	38 " x 120 Gsm -14 BF-2 Reels	48191010	1067	Kg	21.00	22,407.00
2)	38 " x 100 Gsm -14 BF-2 Reels	48191010	1064	Kg	21.00	22,344.00
3)	42 " x 100 Gsm -14 BF-2 Reels	48191010	1243	Kg	21.00	26,103.00
Total :			3374			
E Way Bill No. :		Packing & Forwarding /Any Other		0.00		
Electronic Reference Number :		Total Taxable Value		70854.00		
Add CGST @ 6%		Add SGST @ 6%		4251.00		
Add IGST @		Total Value including Tax		79356.00		
Total :			Total :		79,356.00	
Total Invoice Value (In Words) : Seventy Nine Thousand Three Hundred Fifty Six Only. Tax Payable On Reverse Charges: No. E. & O.E., Subject to Kolkata Jurisdiction only, P payments to be made through Banking Channels only, Overdue payment will attract interest @24% . If Any complain intimation to be given with in seven days from receipt of material. The Buyer is responsible to collect TRANSPORTER'S COPY OF				For MEGHA PACKAGING Authorized Signatory		

- 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

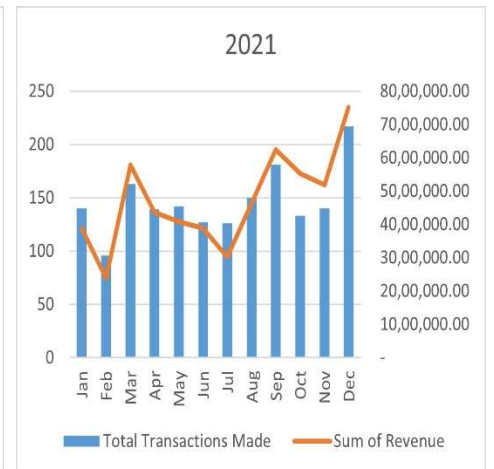
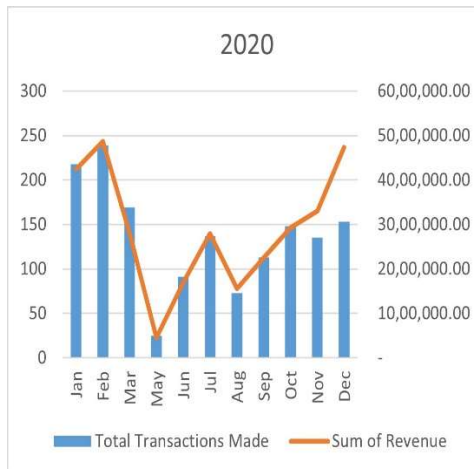
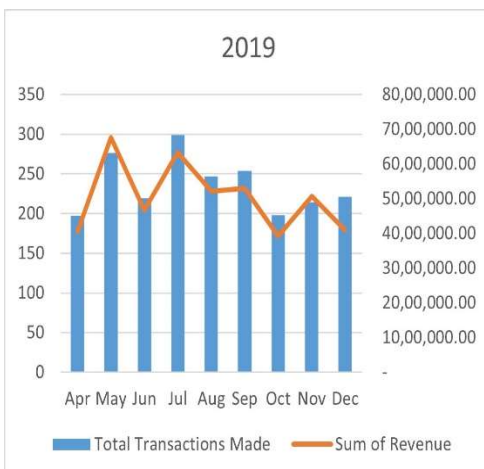
File: script.awk

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]}}
```

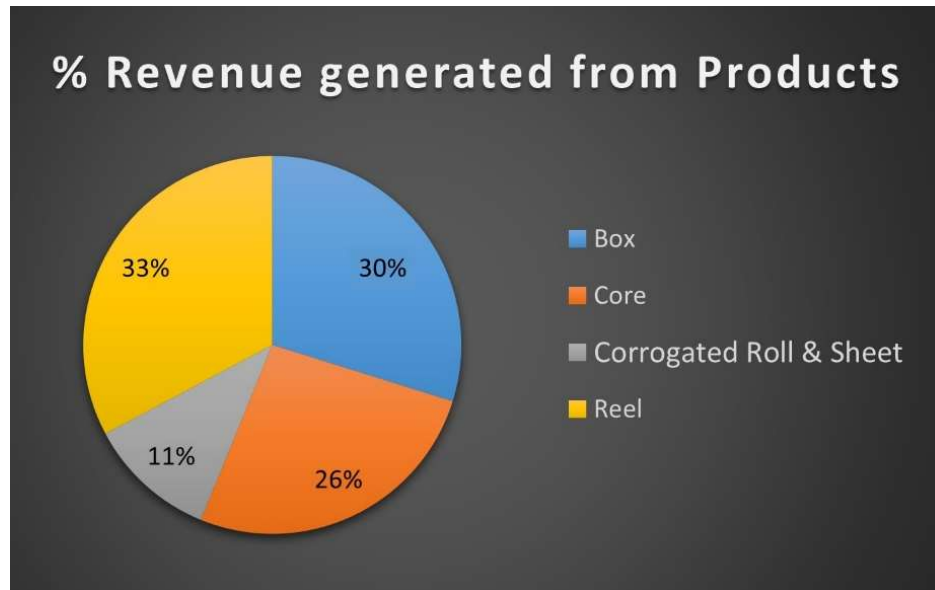
METADATA & DESCRIPTIVE STATISTICS

- 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

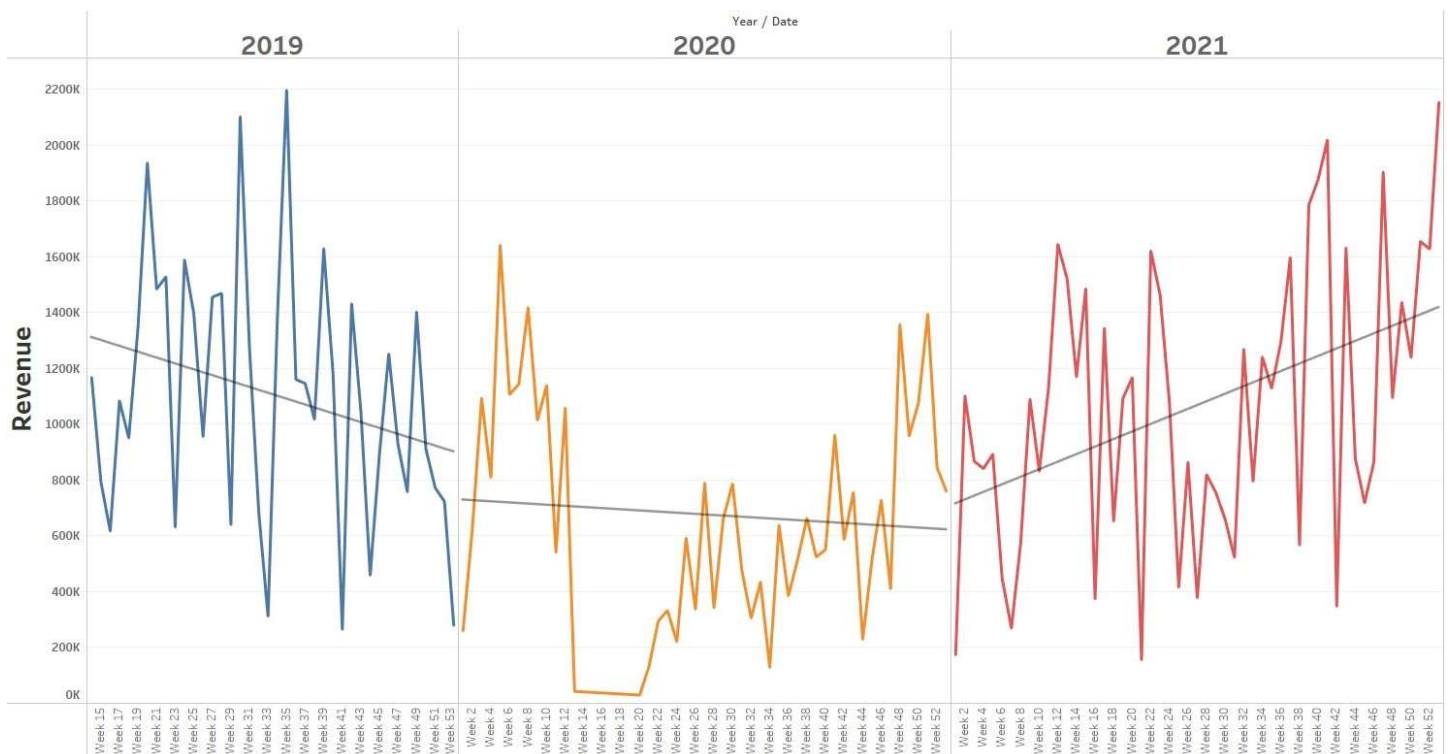
2019	Total Transactions Made	Sum of Revenue	2020	Total Transactions Made	Sum of Revenue	2021	Total Transactions Made	Sum of Revenue
Apr	197	40,54,197.40	Jan	218	42,42,012.10	Jan	140	38,76,308.80
May	276	67,58,171.60	Feb	239	48,69,214.00	Feb	96	23,83,189.95
Jun	219	46,72,027.60	Mar	169	27,80,936.95	Mar	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

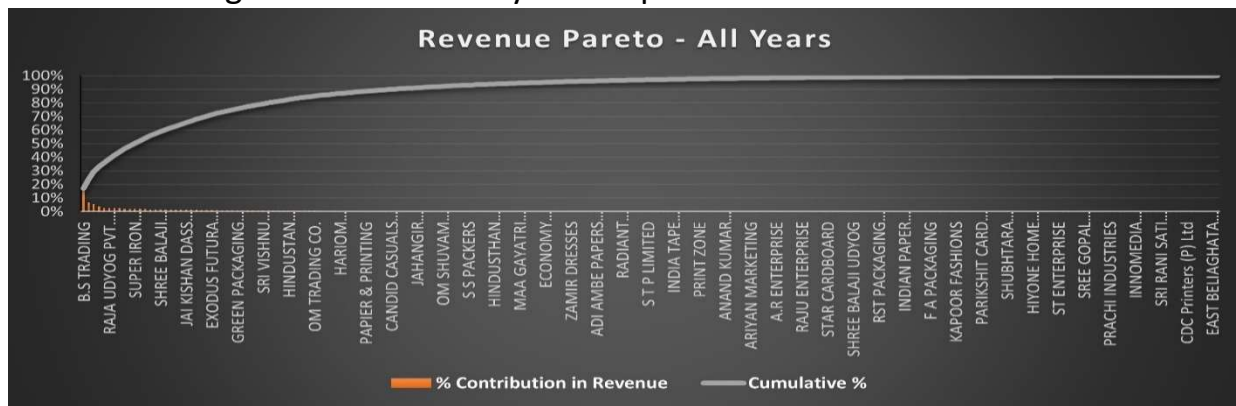


Constraints: Extra Financial Data (Balance Sheet, etc.) and Inventory Data is not available to me due to some privacy concerns.

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
UNI WORTH 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

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.



Product

Box
Core
Corrogated Roll & Sheet
Reel



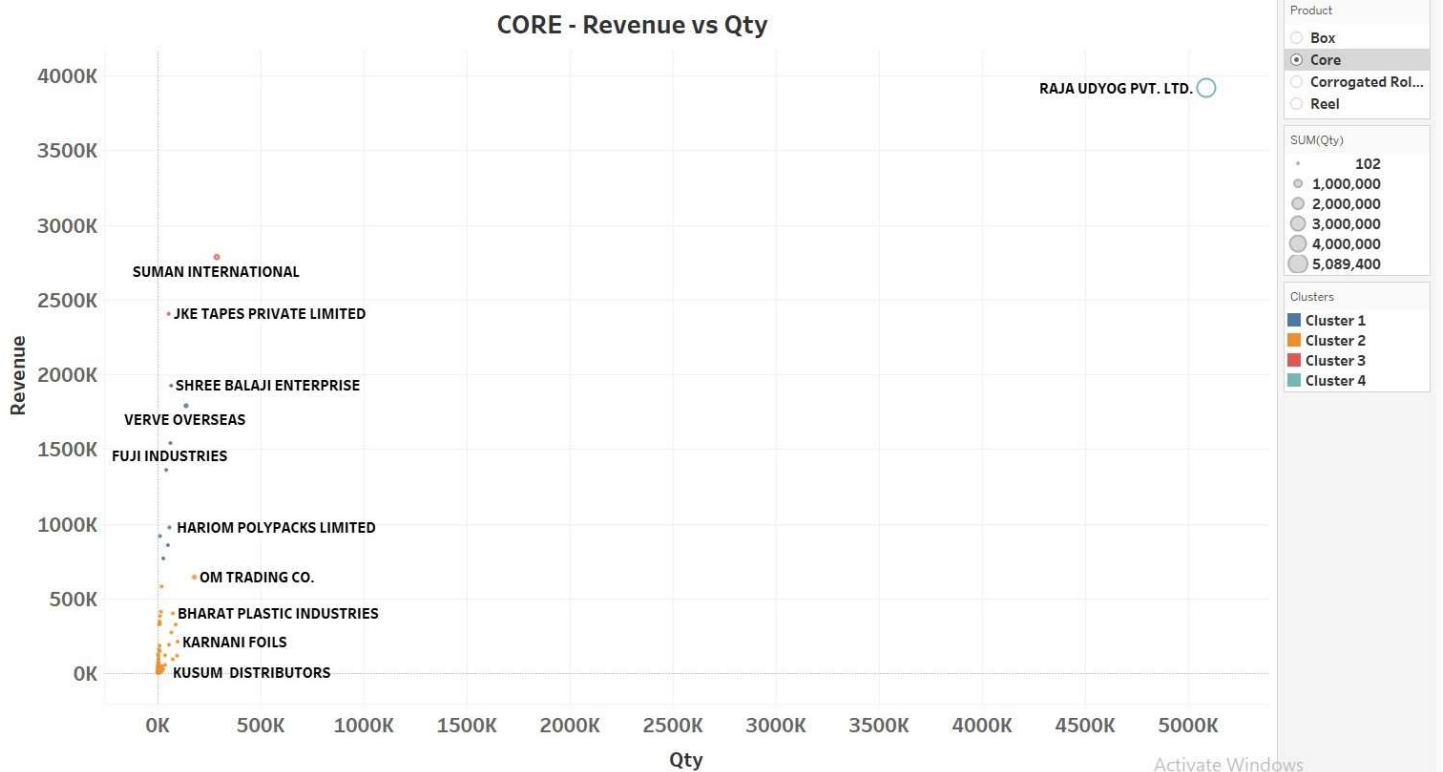
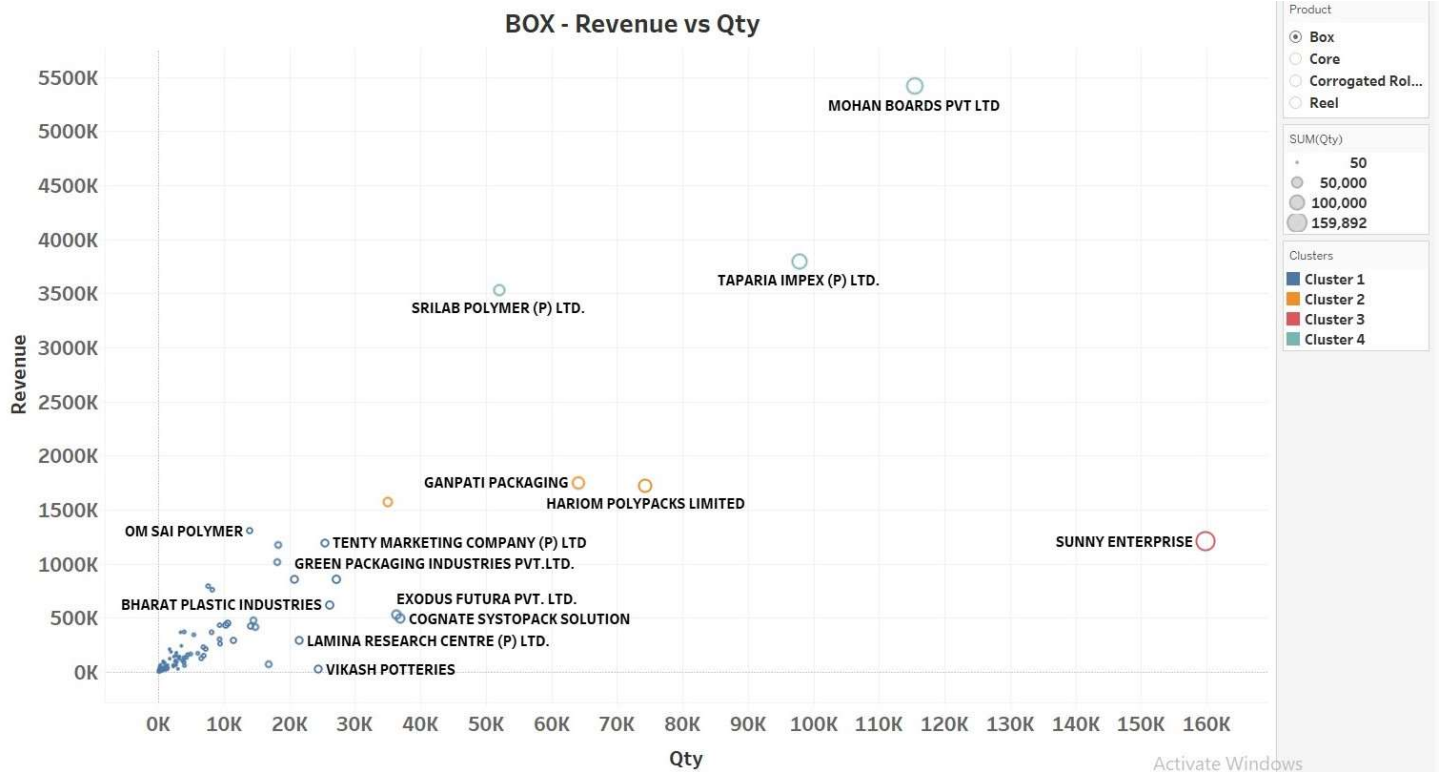
Product

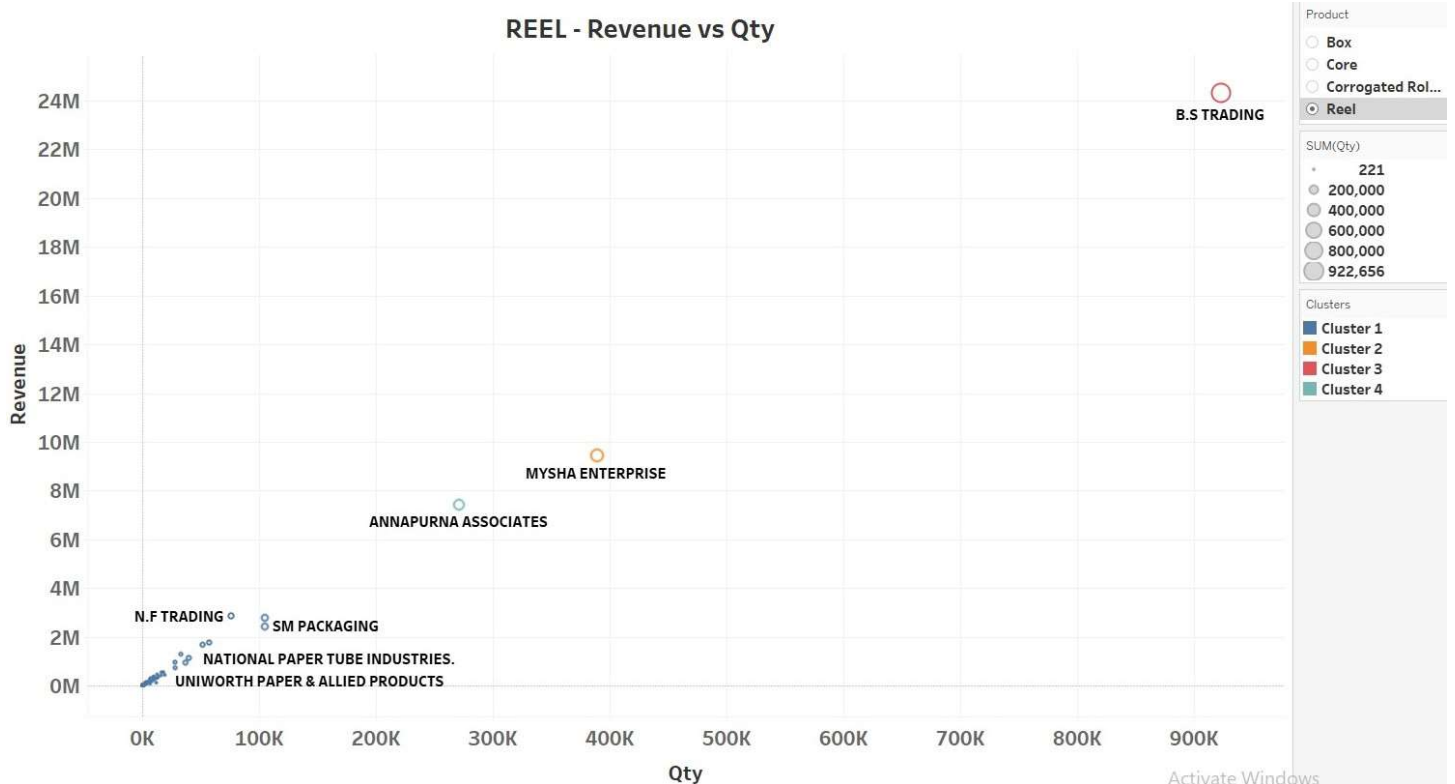
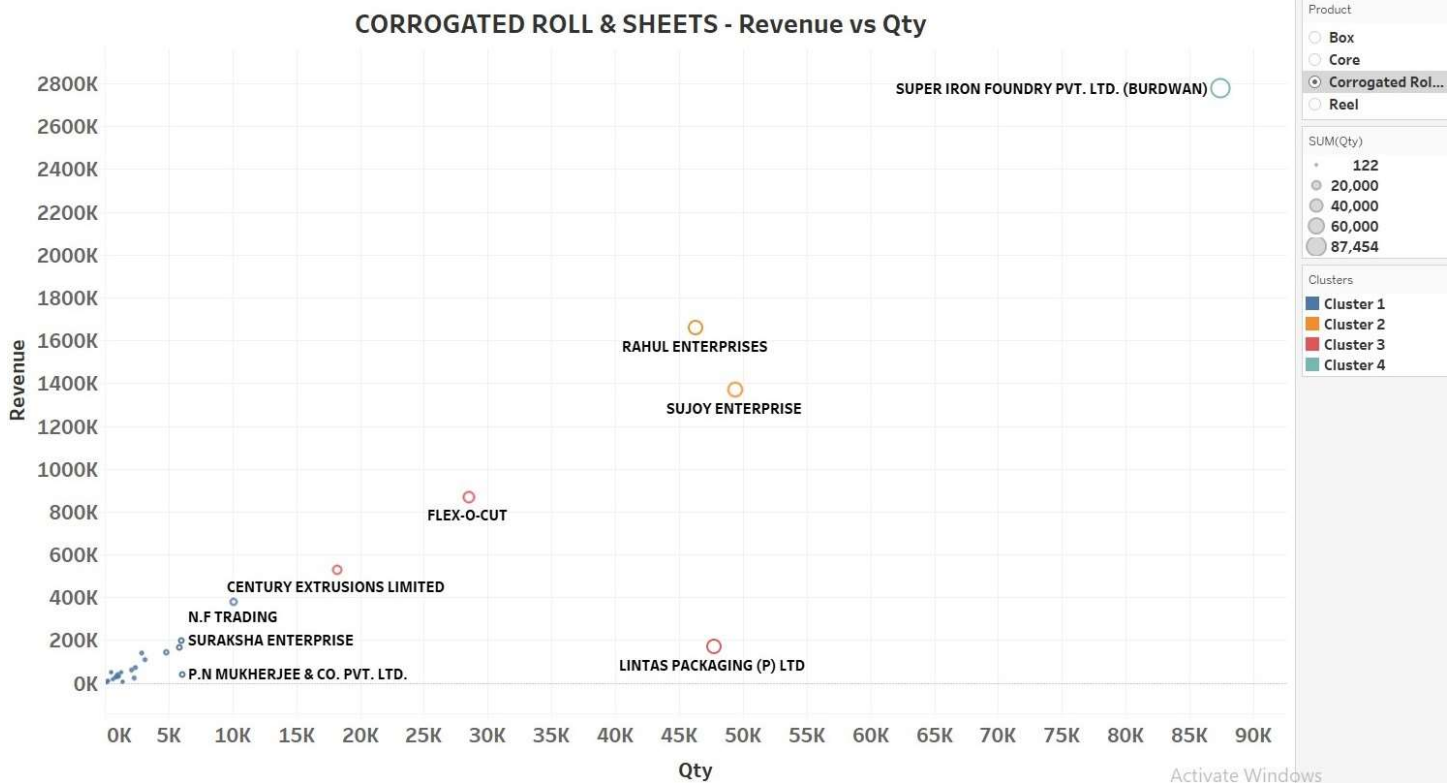
Box
Core
Corrogated Roll & Sheet
Reel

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.

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.





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 labor 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.