Analysing Raw Material Usage and Production Efficiency in C Son Paper Mills

A Final Report for the BDM capstone Project

Submitted by

Name: Thomas Samuel

Email: 23f1001534@ds.study.iitm.ac.in

Roll number: 23f1001534

IITM Online BS Degree Program,

Indian Institute of Technology, Madras, Chennai

Tamil Nadu, India, 600036

Contents

Executive Summary

C Son Paper Mill, a packaging paper manufacturer based in Kerala, faces 2 major challenges: declining profitability due to market saturation from higher-quality imports, and inefficiencies arising from inconsistent, manual data recording in procurement and production. These challenges impact cost control, operational efficiency, and pricing strategy.

To address these issues, internal financial data form April 2024 to January 2025 were collected, cleaned, and analysed using Excel and Python. Descriptive statistics and analytical techniques such as trend analysis, supplier performance evaluation, margin analysis, and pricing sensitivity simulations were applied. The focus was on understanding cost structures, identifying reliable suppliers, optimizing pricing for better margins, and improving production efficiency.

The analysis revealed that a few suppliers, such as Nambiyattukudy Food & Spices for Boiler Fuel, and AXCHEM for Retention Aid consistently offered lower costs and had higher reliability. Shifting procurement to these suppliers, along with increased bulk purchasing, led to a measurable improvement in profitability. Additionally, price sensitivity simulations showed that a small increase in the price of low-margin, high-volume Uncoated Duplex Boards could significantly enhance profits provided that the buyers are not extremely price sensitive.

The analysis show that the profitability trend increased as procurement behaviour changed to make more bulk purchases, even in the absence of increased sales volume. Recommendations include continuing bulk procurement, marginal price increases for Uncoated Duplex Board and digitizing operational data capture to ensure better decision making. If implemented effectively, these strategies could substantially improve the mill's profitability and operational control.

Methods

Understanding the Business Context, Problems and Objectives

There were 2 primary challenges observed in C Son Paper Mill, particularly in the procurement and production environment. Firstly, Chinese manufacturers entered the packaging paper industry in India offering a board of superior quality, which led to a saturated market and a state of oversupply with no growth in demand. Which further leads to low profitability. In this situation, it is important to understand cost structures and operational efficiencies to identify improvement opportunities. The objectives aligned with this are as follows:

- Evaluating supplier performance by comparing material cost data.
- To find the average cost of production of each type of board
- Understand the margins to price the products better
- Assessing the production efficiency of the mill in terms of quantity

The second issue pertains to the manual recording of critical operation data, including inventory levels and procurement activities. Further the lack of other data like daily machinery downtime and material wastage and usage. As a result, the data could be incomplete and inconsistent which may obstruct accurate reporting and cause inefficiencies.

Data Collection

The data collected were some internal Excel spreadsheets of financial data which were maintained for taxation purposes. Data was collected from the time April 1st 2024 to January 31st 2025. This way recent and highly relevant data was collected for analysis. Specifically, the data collected, were the Profit and Loss records with particulars by month, records of purchases of raw materials daily including quantities and total amount, a sales register with the quantity of good sold and total amount by day, and a record of the sales and produced goods quantities by different kinds of board groups and across different GSM grades (e.g.: “LWC ECO Bundles 280-319 GSM”).

Data Cleaning and Preprocessing

Data cleaning is a crucial step to ensure the quality and reliability of the results of any analysis. Eliminating redundant or irrelevant information and creating derived variables that enhance the interpretability of the data, reduces the risk of errors and bias during the analysis. A clean and

well-structured dataset lays a solid foundation for accurate insights and meaningful conclusions.

To prepare the dataset for analysis, data cleaning and preprocessing were done using Microsoft Excel's Power Query tool. This involved loading the raw data, and removing the irrelevant rows and column to reduce the noise and clutter of the dataset. Additionally, some new columns were added across multiple sheets to compute the average cost of each raw material and a month column was added to allow aggregation by month. These values served as a standardized metric to be used for comparison and further analysis.

Some other blank rows were removed from the dataset. Further, the names of suppliers with minor differences were standardized and changed to allow for quick and easy analysis of data. These steps are pivotal to get reliable results from the analysis.

Overview of Analytical Techniques

A range of analytical techniques were employed to address the identified business problems and objectives. Each method is outlined below, along with the application and justification in the business context.

1. Trend Analysis:

   Trend analysis involves identifying patterns or trajectories in data over time. Mathematically, it can be evaluated using moving averages.

   $$Y_t = \alpha + \beta_t$$

   Application-

   Sales quantity, input quantities, input average costs and profit and loss data were plotted over monthly intervals to observe the fluctuations and observe any patterns or trends. This was accomplished in excel by first using pivot tables to summarize the monthly averages and then plotting a line graph of the data.

   This method was critical in analysing and understanding costing and other trends in the data, which is relevant to understand how the profitability of the paper mill is being affected over the given period.

2. Contribution Analysis:

Contribution analysis helps us assess how individual components contribute to a total value. If total cost is $C = \sum_{i=1}^{n} C_i$, then contribution of component i is $\frac{C_i}{C}$.

Application-

Sales values by different groups were considered to find out how much each group, (i.e. Coated Duplex board, Uncoated Duplex boards and Grey boards) contribute to the total sales value. To do this, the Sales data was considered, and a pivot table was made to separate sales value by group, after which a pie chart was made in Excel to show the contribution of each individual group.

In the context of understanding what boards are selling best and hence which boards contribute to revenue is critical once again to address the objective of profitability of the paper mill.

3. Aggregation Techniques:

Average cost of a raw material is pivotal information to understand how the costing structure of production and further to understand how it varies according to order size and supplier is crucial.

Average cost was found using the classic arithmetic mean formula $\bar{x} = \frac{1}{n}\Sigma x_i$.

Application-

This was calculated and added in a new column for every purchase of each raw material on Excel using the "=AVERAGE()" formula.

Understanding average costs while not directly beneficial to objectives, facilitate further analysis and presents a very strong and rigorous base to conduct further analysis on average cost of production of each board, find the margins and so on. Hence, it acts as an indispensable tool for our analysis.

4. Input Supplier Analysis:

Supplier analysis is important to evaluate the performance and cost-effectiveness of different vendors based on key indicators. These indicators help determine which suppliers offer the best value and consistency. Key metrics considered were:

- No of purchases
- Total quantity supplied
- Average cost per kg
- Cost variability (Standard deviation)

Application-

Pivot tables were used extensively to get the desired tables in this case. The data for each raw material was grouped by supplier, then the count of purchases, Sum of quantity, average of average cost, and standard deviation of average cost were added as values to the pivot table. Finally, some line charts were plotted by supplier and some relevant tables were made from the obtained data. This way the required information was obtained using Excel.

This analysis directly addresses the objective of evaluating the supplier performance by analysing raw material costs. High variability, low order frequency, or high costs shows the undesirable suppliers and helps with cost reduction during procurement. Additionally, frequency of purchases serves as a proxy for reliability of supplier while total quantity serves as a proxy for supplier capacity and scale.

5. Average Cost of Production by Board and Margin analysis:

To accurately evaluate production efficiency and profitability across different board types (Coated Duplex, Uncoated Duplex, and Grey Board), the average cost of production was estimated for each board. This was done by an approach based on proportional allocation of raw material costs using production quantities as weights. The raw materials Boiler Fuel, Sizing Agent, Oxidised Starch, Retention Aid, PAC, Coating Chemicals and Waste paper were considered for the same.

- Each raw material total cost was allocated to the 3 boards according to their proportional production quantities. For example, if Q_{coated}, $Q_{uncoated}$, and Q_{grey} denote the total quantities of each board produced, then the proportions were calculated as: $$\text{Proportion}_i = \frac{Q_i}{Q_{\text{coated}} + Q_{\text{uncoated}} + Q_{\text{grey}}}$$

  Let C_{raw} be the total cost of a particular raw material, then the cost allocated to board i is: $C_i = C_{\text{raw}} \times \text{Proportion}_i$
- Now waste paper is used in a certain way in the production of each board hence some new formulas were devised to account for this. The different boards, Grey board uses 100% kraft paper, while both the coated and uncoated duplex boards use 60% kraft paper along with 20% each of No.1 white cuttings and No.2 white cuttings. The formulae are given as:

$$C_{\text{kraft, grey}} = \left(\frac{Q_{\text{grey}}}{Q_{\text{kraft base}}}\right) \times C_{\text{kraft}} + \left(\frac{Q_{\text{grey}}}{Q_{\text{kraft base}}}\right) \times C_{\text{kraft imp}}$$

$$C_{\text{kraft, unc}} = \left(\frac{Q_{\text{unc}}}{Q_{\text{kraft base}}}\right) \times C_{\text{kraft}} + \left(\frac{Q_{\text{unc}}}{Q_{\text{kraft base}}}\right) \times C_{\text{kraft imp}}$$

$$C_{\text{kraft, coat}} = \left(\frac{Q_{\text{coat}}}{Q_{\text{kraft base}}}\right) \times C_{\text{kraft}} + \left(\frac{Q_{\text{coat}}}{Q_{\text{kraft base}}}\right) \times C_{\text{kraft imp}}$$

$$C_{\text{cuttings, unc}} = \left(\frac{Q_{\text{unc}}}{Q_{\text{coated}} + Q_{\text{unc}}}\right) \times (C_{\text{No1}} + C_{\text{No2}} + C_{\text{No2 imp}})$$

$$C_{\text{cuttings, coat}} = \left(\frac{Q_{\text{coat}}}{Q_{\text{coated}} + Q_{\text{unc}}}\right) \times (C_{\text{No1}} + C_{\text{No2}} + C_{\text{No2 imp}})$$

Where,

- $Q_{\text{kraft base}} = Q_{\text{grey}} + 0.6 \times (Q_{\text{coated}} + Q_{\text{uncoated}})$
- C_{kraft} = Total cost of Kraft Paper
- $C_{\text{kraft imp}}$ = Total cost of Imported Kraft
- C_{No1} = Total cost of White Cuttings
- C_{No2} = Total cost of No. 2 Cuttings (Domestic)
- $C_{\text{No2 imp}}$ = Total cost of No. 2 Cuttings (Imported)

- Next, the total cost per board was calculated as:

$$C_{\text{board}}^{\text{total}} = \sum_{k=1}^{n} C_{\text{board}}^{(k)}$$

- Finally, the margin was calculated as:

$$M_i = P_i - \bar{C}_i$$

Where,

- P_i is the average selling price of board i
- $\bar{C}_i$ is the average cost of production of board i

- The average selling price was determined as a weighted average of the sales rate with the quantity sold as weights for each board. The cost of coating chemicals was added only to Coated Duplex Boards while all other materials were distributed proportionally.
- The above calculations were all carried out with the help of custom functions in Python, to facilitate quick and easy analysis. The function took in the production quantities data, along with raw material costs and split them as necessary.

This method ensures that the calculation for raw material costs by board are as close to reality as possible. It is accurate since the costs are not arbitrarily assigned and instead are proportional to the quantities produced. Further, it allows us to compare the boards based on unit economics, and understand the margins of production and price the products better. This is directly aligned with the objective since it helps to understand

raw material costs, average production costs and hence compare the profitability of each board to determine better pricing strategies.

6. Price Sensitivity and Elasticity-Based Profit Optimization:

To evaluate the profitability impact of pricing changes for a board, we employed a simulation-based approach combining linear demand elasticity assumptions with profit maximization analysis. This helps determine the optimal pricing for a board.

- Simulation Framework:

  A hypothetical price increase range was created, spanning Rs. 2-4. For each price point demand was estimated using a constant elasticity model with an assumed elasticity of -0.1. Now in the case of packaging paper, price sensitivity of buyers for a high volume good will be low, hence this assumption. This means that for every ₹1 increase in price, demand drops by 10% of the price change. The total profit at each price point was then computed as the product of per-unit margin and the adjusted demand. Some formula used for this are:

$$\text{New Demand} = D_0 \times (1 + E \times (\text{P} - \text{P}_0))$$

$$\text{Profit} = (\text{P} - \text{Cost}) \times \text{New Demand}$$

  Where,

  - D_0 is base demand
  - E is price elasticity of demand (–0.1)
  - P_0 is the base price
  - P is the simulated price
  - Cost is the average cost per unit

- Scenario Analysis:

  To complement the simulation, a hypothetical grid was made in Excel. Each row varied the price increase (%) and calculated corresponding drop in demand.

$$\text{New Profit} = ((\text{Base Price} + \text{Price Increase}) - \text{Unit Cost}) \times \text{Base Demand} \times (1 - \text{Demand Drop}\%)$$

$$\text{Difference } \% = \frac{\text{New Profit} - \text{Base Profit}}{\text{Base Profit}} \times 100$$

  This analysis was conducted using Excel linear programming solver to find values of demand drop with minimum loss for every situation of price increase.

This allowed us to understand the threshold of demand drops for certain price increase ranges.

This method is crucial to understand how increase in prices and demand drop affect profitability. Thereafter, gain insights to optimize pricing of different boards to increase profitability.

7. Production Efficiency Analysis (Quantity-Based):

   To analyse the operational efficiency of the paper mill in terms of quantity produced we used the formula: $\text{Efficiency} = \frac{\text{Sales Quantity}}{\text{Raw Materials Used}}$

   This metric was calculated by first aggregating data on sales quantity and raw material purchases by month using Excel and hence a line chart was made to visualize the same. The raw materials considered here are Waste Paper, Boiler Fuel, Oxidised Starch, Retention Aid, PAC, Coating Chemicals and Sizing Agent.

   This metric captures how much finished product was obtained per unit of input, helping identify months of higher operational efficiency or material waste.

To conclude, these methods provided a structured framework to analyse the data, enabling a data-driven foundation for interpreting the results.

Results and Findings:

This section summarizes the key findings from the analysis of raw material costs, supplier trends, pricing strategies and production efficiency. Charts, tables, and simulations are used to highlight insights across seven core focus areas.

1. Raw Material Cost Trends:

   This section examines monthly fluctuations in raw material costs and quantities.

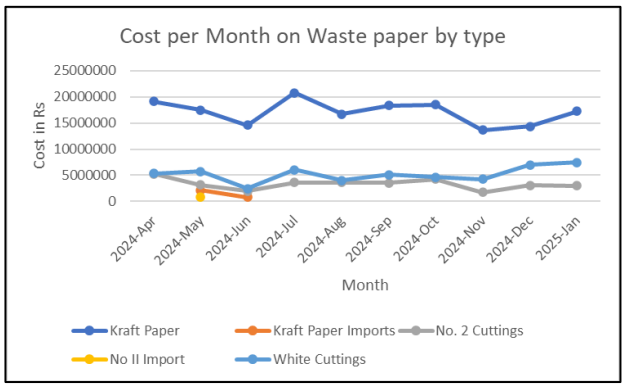

Fig 3.1.1: Cost of each type of Waste Paper by month

From fig 3.1.1, we see that a major part of the cost of waste paper is accounted for by Kraft Paper, which is as expected since it is the biggest component of production. Similarly Waste paper also makes the

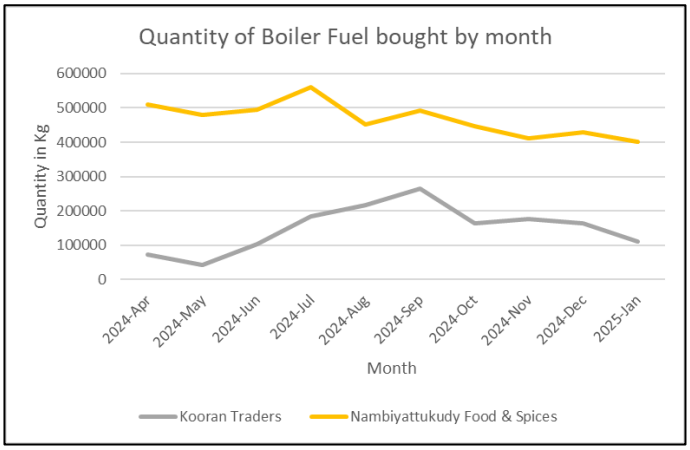

Fig 3.1.2: Quantity of Boiler Fuel bought by month

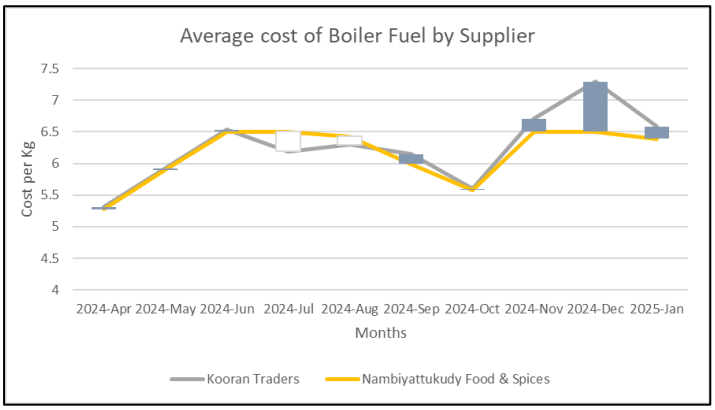

Fig 3.1.3: Difference in Average Cost of Boiler Fuel

most significant contribution to costs of production, followed by Boiler fuel.

As fig 3.1.2 shows, Boiler fuel has 2 significant suppliers, and we see that Nambiyattukudy Food & Spices are the major supplier of the two. Given this it is important to understand how the unit costs are for the two suppliers.

From fig 3.1.3, we see that once again Nambiyattukudy Food & Spices offer more stable prices, while Kooran Traders have significant variability in the prices. From the quantity of Boiler fuel supplied, it is evident that this has been noticed and the required optimization has been done.

From fig 3.2 and 3.3, we see that Nambiyattukudy Food & Spices are reliable and stable, hence it should continue to be the major supplier.

2. Supplier Performance and Cost Variability:

To best understand supplier performance some tables were made with relevant information. For this No of purchases is considered a proxy for reliability, Total Quantity supplied acts as a proxy for scale of supplier and average cost and cost variability acts as important metrics to understand performance.

Boiler Fuel	No of Purchases	Total Qty (Kgs)	Average Cost/kg	Cost Variability
Excellent Traders	2	17175.00	4.20	0.74
Kizhakkebhagath Agro Mills	4	15660.00	6.38	0.25
Kooran Traders	234	1499000.00	6.30	0.54
Nambiyattukudy Food & Spices	495	3176275.00	6.11	0.48
PA TRADING	2	19030.00	3.15	0.00
Average	**147.4**	**945428**	**5.23**	**0.40**

Table 3.2.1: Boiler Fuel Supplier Performance

From table 3.2.1, it is obvious that through measures of reliability, cost variability and scale, that Nambiyattukudy Good & Spices is the best supplier for Boiler Fuel

Sizing Agent	No of Purchases	Total Qty (Kgs)	Average Cost/kg	Cost Variability
CubaneSpeciality Chemicals Pvt.Ltd	2	2400	147.5	0
Elixa Technologies Private Limited	3	31550	47.2	0
Ivax Paper Chemicals Ltd.	1	9780	49.56	0
Rishabh Metals & Chemicals Pvt. Ltd	4	22000	129.8	0
Triveni Rasayan Limited	3	10105	138.06	0
Average	**2.6**	**15167**	**283.91**	**0**

Table 3.2.2: Sizing Agent Supplier Performance

From table 3.2.2, it can be observed that there seem to be about 2 prevailing price ranges, possibly due to two grades or types of products available. Additionally, we see that the cost variability is 0, which implies constant prices are prevalent. In such a situation, based on scale, reliability and least average costs, the best suppliers are Elixa Technologies Private Limited and Rishabh Metals & Chemicals Pvt. Ltd.

Retention Aid	No of Purchases	Total Qty (Kgs)	Average Cost/kg	Cost Variability
Axchem Solutions India Pvt Ltd	7	10475	240.37	59.16
Tanisha Resins Private Limited	2	6250	173.85	6.29
Triveni Rasayan Limited, Coimbatore	3	1500	407.10	0.00
Average	**4**	**6075**	**273.78**	**21.82**

Table 3.2.3: Retention Aid Supplier Performance

From table 3.2.3, We notice that Axchem Solutions India Private Limited, have extremely high-cost variability, however it also seems to be the most reliable supplier of Retention Aid. The high variability can be explained because of bulk purchases. Axchem Solutions India Private Limited provide lesser average costs for bulk purchases compared to other suppliers, hence in this case if purchases can be made in bulk it is best to choose Axchem Solutions India Private Limited. Further analysis of this is done in the next section.

PAC	**No of Purchases**	**Total Qty (Kgs)**	**Average Cost/kg**	**Cost Variability**
Al-Fah Associates	6	26700	39.94	3.61
Flowmax Water	3	12000	41.46	0.56
Grasim Industries Limited- Madhya Pradesh	5	148850	17.35	0.00
Poluchem Chemicals	3	6000	40.43	0.45
Average	**4.25**	**48387.5**	**34.79**	**1.15**

Table 3.2.4: PAC Supplier Performance

From table 3.2.4, we see that once again there are 2 prevalent price range. In this situation, we see that Grasim Industries Limited- Madhya Pradesh has extremely high scale however being an out of state supplier is used only for bulk orders while, Al-Fah Associates provide raw materials for immediate orders and have discounted rates for bulk purchases. Hence it would be highly advised to buy more PAC in bulk from Grasim Industries Limited- Madhya Pradesh, whenever possible and limit smaller purchases.

3. Procurement Strategy and Cost Optimization Trends:

Analysis was done to understand procurement strategies and how it affected overall costs. To set context and understand the situation better let us first look at the Profit and Loss trend and the sales quantity trends by month.

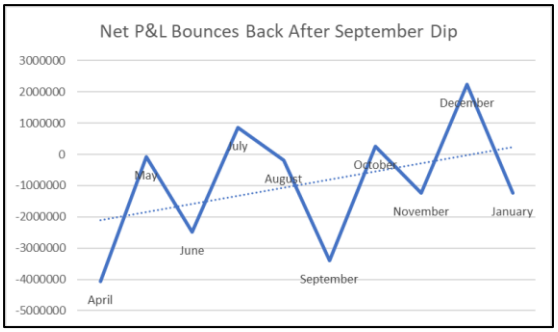

Fig 3.3.1: Profit and Loss Trend

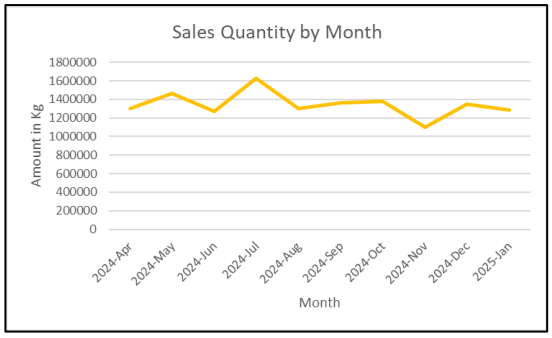

Fig 3.3.2: Sales Quantity by month

From the above figures 3.3.1 and 3.3.2, we see that there has been an upward trend in the Profit and Loss. However, this was not achieved by an increase in sales quantity. This was instead done by reducing costs of procurement by increasing the number of bulk orders placed for certain raw materials.

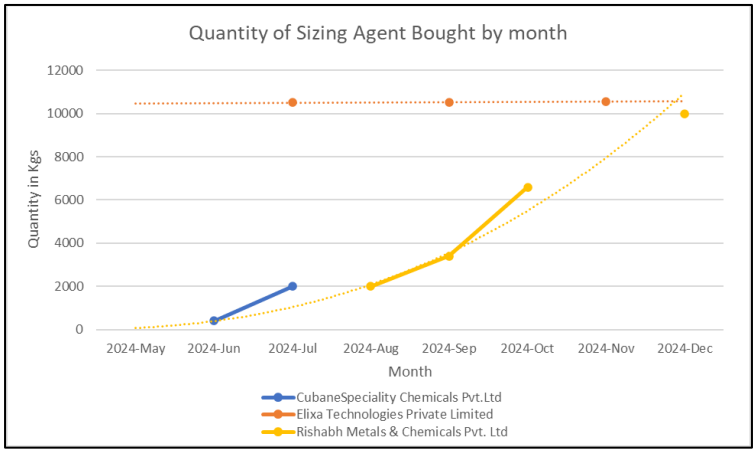

Fig 3.3.3: Quantity of Sizing Agent bought by month

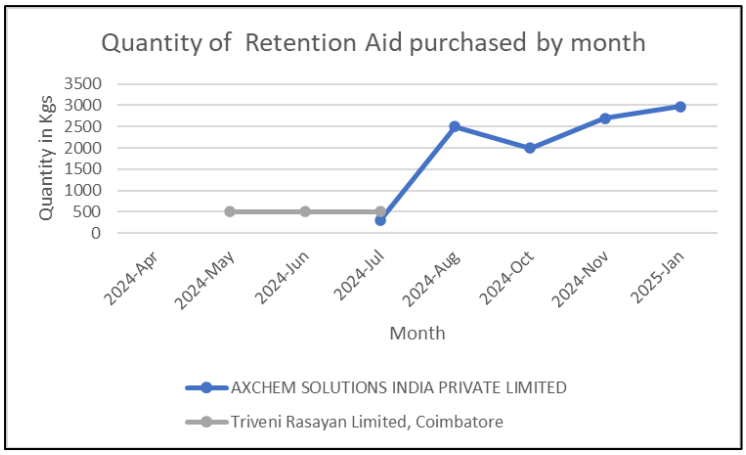

Fig 3.3.4: Quantity of Retention Aid bought by month

Now we can clearly see from fig 3.3.3 and 3.3.4 that the quantity of Sizing agent and Retention Aid bought by month saw an upsurge since September. This shows that bulk orders were placed for these raw materials while not receiving an influx for orders. This helped in reducing the procurement costs of raw materials, which helped the profit to grow over time.

We see that the suppliers mentioned in section 3.2 are the best suppliers further supported by evidence in these 2 charts. Hence, the cost cutting was a result of optimized purchase behaviour. More bulk orders were placed from September, which helped in increasing profits.

4. Board-level Cost Structure Analysis:

The average cost of production of different boards were estimated using the cost of input materials, and hence compared to the average selling price.

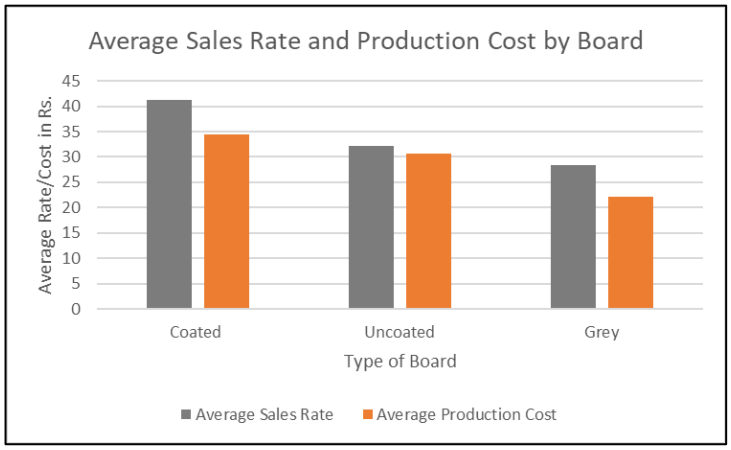

Fig 3.4.1: Average Sales Rate vs Production Cost

From fig 3.4.1, we found that Uncoated Duplex Boards have the least margin, while Coated Duplex boards have the highest. Interestingly, grey boards also seem to have a relatively high margin.

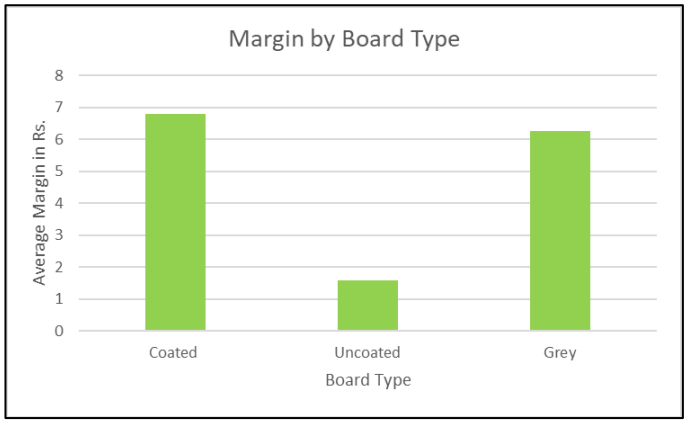

Fig 3.4.3: Average Margin by Board

From fig 3.4.2, we see that coated boards have a margin of almost Rs. 7 per kg while uncoated boards offer only a margin of ~Rs. 1.5. This shows pricing adjustments can be made to increase the profitability of the mill. Specifically, the price of Uncoated Boards could be increased.

5. Profitability and Price Sensitivity Simulation:

Adding on from the previous section, 3.4, we need to explore some possible situations that could arise from price increases in Uncoated Duplex Boards. Hence, some simulations and hypothetical situations were considered. First it is necessary to understand the context of the mill and understand how much the mill is reliant of production of Uncoated Duplex Boards.

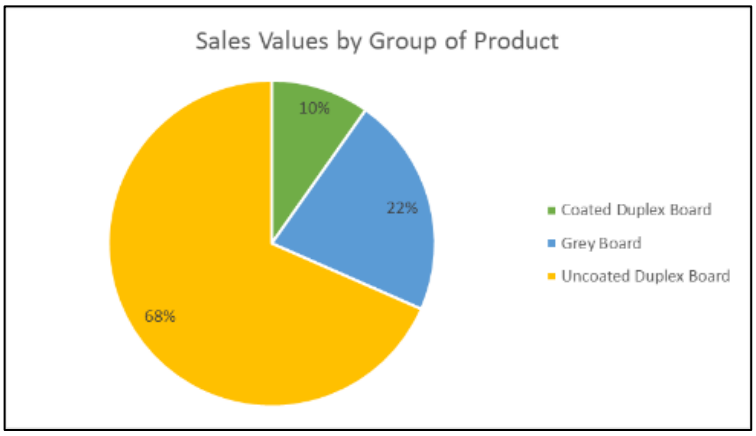

Fig 3.5.1: Sales Value by Board Type

From fig 3.5.1, we see that 68% of the sales value is contributed by Uncoated Duplex Boards. This makes them a Low margin, High volume group. Which is important to understand for further analysis.

Now, the break-even prices for the different boards were calculated. The break-even price is the price at which there is neither a profit or a loss. For our purpose we can assume the same to be the average cost of production. They are given as:

Break-even price of Coated Duplex boards = Average cost of coated board = 34.50
Break-even price of Uncoated boards = Average cost of uncoated board = 30.57
Break-even price of Grey boards = Average cost of grey board = 22.16

Now since Uncoated Duplex Boards are large volume products, even a small increase in price can affect profitability significantly. Let us assume an elasticity of demand of 0.1, to simulate a situation where the buyers are not extremely sensitive to changes in price. As should be the case in case of goods like packaging paper.

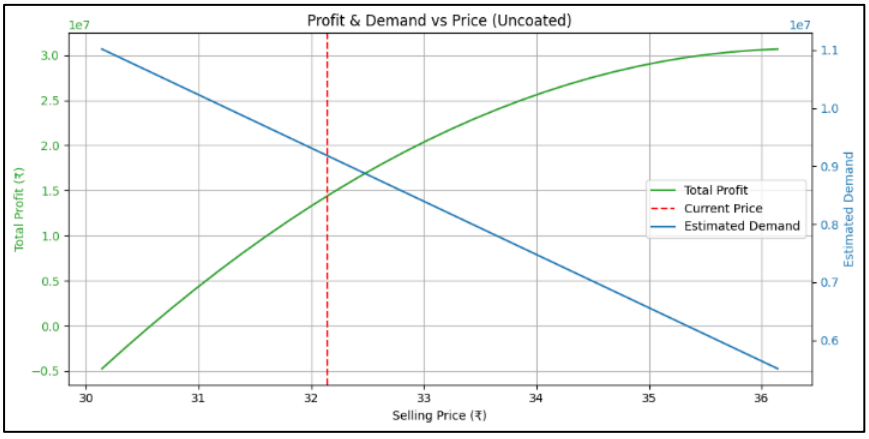

Fig 3.5.2: Profit and Demand vs Price Simulation with elasticity 0.1

Now with an elasticity of -0.1, it is still found that Total profit will increase despite a reduction in demand. Further, we see an optimal equilibrium arising at ~32.5 which further supports a price increase. Hence, if the buyers of Uncoated Duplex Board are

not too price sensitive, then this graph shows a logical reason to increase prices for a Low-margin, High-volume board like Uncoated Duplex Boards to increase profits.

6. Pricing Impact and Break-Even Comparison:

As an extension to the previous sections, 3.4 and 3.5, some further hypothetical grids were made to simulate different conditions which would lead to profit or loss. A Gain/Loss table was made to understand how certain price increases and demand drops will affect the profitability of Uncoated Boards.

Price Increase	Demand Drop(%)	New Profit	Difference (%)	Gain/Loss
0	0	14330030	0	→ Break-even
0.5	10	17008436	15.74751274	↑ Gain
0.5	24.18	14328662	-0.009546996	↓ Loss
1	20	18773195	23.66760065	↑ Gain
1	38.94	14328641	-0.009694528	↓ Loss
1.5	30	19624308	26.97816265	↑ Gain
1.5	48.89	14328548	-0.010342683	↓ Loss
2	40	19561775	26.74473241	↑ Gain
2	56.05	14329000	-0.007191254	↓ Loss

Table 3.6.1: Gain/Loss table

From table 3.6.1, we can see that with a price increase of Rs. 0.5, it is profitable to increase prices unless the demand drops by at least 24%. Similarly, for a price increase of Rs. 1, 1.5 and 2, the demand drop thresholds are found to be 38%, 48% and 56%. These high numbers of demand drop threshold show that there is room for the price to be increased.

7. Raw Material Usage Efficiency:

The trend analysis from fig 3.7.1 and 3.7.2, shows that the mill has been quite efficient in turning the raw materials into products, without too much waste. We see that the efficiency has remained consistent without too much of a change in efficiency. It is to be noted that months with lesser orders seem to be more efficient than months with more sales quantity and orders, as is to be expected.

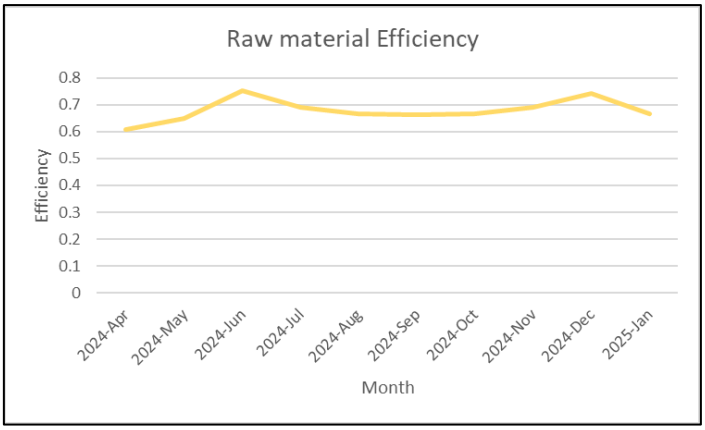

Fig 3.7.1: Raw material Efficiency trend

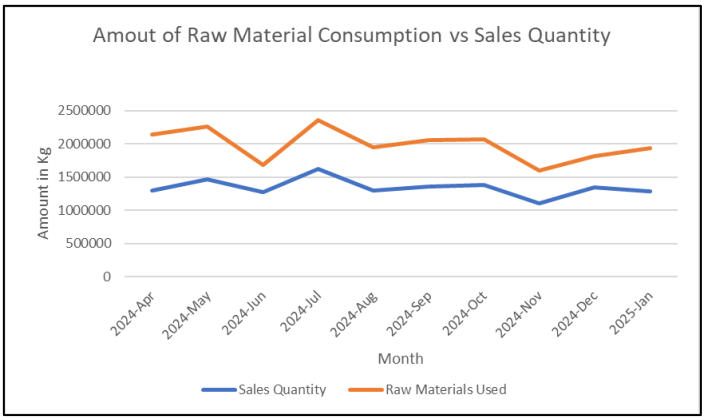

Fig 3.7.2: Raw material Consumption vs Sales Quantity

Interpretation of Results and Recommendations

Interpretation

The results of the analysis reveal several critical insights into cost contributors, supplier efficiency, purchasing behaviour, pricing strategies, and operational margins. These findings provide a foundation for actionable improvements in procurement, pricing, and production processes.

First, given that waste paper and boiler fuel were two of the major contributors to overall production costs, we looked at their average cost trends. Noticed that cost of waste paper stayed about the same throughout the period. However, also noticed that in boiler fuel there are 2 main suppliers. It was noted that Nambiyattukudy Food & Spices offered the best prices with least variability. Now since Boiler fuel is a significant expense in the mill, even small shifts to buy more of the required fuel from the best supplier will lead to reduction in procurement costs. This indicates an opportunity to optimize cost efficiency.

Supplier performance analysis was conducted, and was another essential part of the analysis. By evaluating suppliers' reliability, scale, average costs and cost variability, the best suppliers were found. Adding to this, the best supplier for boiler fuel was found to be Nambiyattukudy Food & Spices, best supplier for retention aid was found to be Axchem Solutions India Private Limited, following which, the best supplier for Sizing Agent were found to be Elixa Technologies Private Limited and Rishabh Metals & Chemicals Pvt. Ltd and finally the best suppliers of PAC were found to be Grasim Industries Limited- Madhya Pradesh and Al-Fah Associates. These suppliers not only provided cost advantages but also maintained better delivery and quality performance, justifying their preferred status

Next, the analysis showed that bulk purchasing led to reduction in purchasing costs. Specifically, the procurement of Retention Aid in bulk offered the best value. Additionally, it was noted that PAC purchase from Grasim Industries Limited- Madhya Pradesh was the cheapest. Hence, more bulk orders should be made to these 2 suppliers to further optimize raw material costs and reduce procurement costs. We noted from relevant graphs that there was no upsurge in sales quantity or in orders received, however this difference in purchasing habits had led to a positive profit and loss trend, hence it is significant to explore to further increase profitability.

Following this, Margin analysis and average cost analysis was done. We found that Coated duplex boards have the highest production cost but also give the highest margin. Additionally, we found that the Grey board also gave an impressive margin. However, Uncoated Duplex Boards have a very small margin despite being a high-volume product. This analysis provides a significant insight into profitability. Since it is a high-volume product, even a marginal increase in the price will lead to huge gains in profit. Hence, it is necessary to optimize the pricing of the Uncoated Duplex Board. To increase profitability.

Further analysis was done to address this by considering hypothetical pricing scenarios. A simulation that assumed a marginal increase in price of uncoated board and low demand elasticity showed a positive profitability effect. Further, a table was made that considered difference increase in prices and demand drops to understand if a price hike would be suitable and logical. These tests suggested that small, controlled price hikes may not significantly affect sales volume but could meaningfully enhance profit margins. The analysis confirmed that unless demand is highly elastic, there is sufficient justification for slight price increases to boost margins on low-profit, high-volume products.

Finally, an operational review revealed that the mill operates with an impressively high level of efficiency. The performance has remained consistent, while room for improvement exists. The mill should aim to maintain its efficiency and increase the same gradually if possible.

Recommendations

Informed by the above findings, several recommendations are proposed to address the identified challenges and leverage strengths.

Problem Statement 1: Low Profitability

- Use Top Performing Suppliers for Boiler fuel, Retention Aid, Sizing Agent, and PAC. This will help reduce procurement costs and thus immediately help in the profitability of the mill. Specifically, Boiler fuel should be bought from Nambiyattukudy Food & Spices, Retention Aid should be bought from Axchem Solutions India Private Limited, Sizing Agent from Elixa Technologies Private Limited and Rishabh Metals & Chemicals Pvt. Ltd and PAC from Grasim Industries Limited- Madhya Pradesh and Al-Fah Associates. These suppliers should be preferred over other suppliers, since they already exist in the existing supply chain, and have proven to be cost efficient and reliable. This optimization of supplier choice will help increase the profitability of the mill.
- Make use of Large Bulk Procurements for Better Unit Costs. The analysis showed that bulk purchases from Axchem Solutions India Private Limited for Retention Aid and PAC from Al-Fah Associates offer the best unit costs. This is a strong argument to prioritize bulk purchasing of good to reduce costs and hence increase profitability. The analysis already shows a positive trend in the Profit and Loss due to this. Hence, it is important to continue the same increase the use of bulk purchases when possible.
- Re-evaluation of the Pricing of the Uncoated Duplex Board. The analysis shows that the Uncoated Duplex Board, while being high-volume, is still a very low-margin product. Hence, even a small increase in the price can significantly increase the profitability of the same. A minor increase in price of the board by Rs. 0.5 or 1 per kg is an immediately achievable goal and should serve to increase profitability granted that the market is not highly price sensitive.

Problem Statement 2: Poor recording of relevant operational data

- Improve Data Recording and Monitoring Practices. More operational data should be collected and analysed to further help with optimization of production and procurement. Critical data like daily inventory levels, down time of machines, material usage, amount of output and wastage data will critically improve the production and procurement process. Some of this data is recorded manually, which could lead to mistakes, inefficiencies, and losses. Recording the data digitally will give the mill a better idea of the operational efficiency, and better understand trends and patterns during the procurement and production process. Data about daily inventory levels could help inform purchases and further help in optimized procurement and placing bulk orders as required. Similarly, machine down time and data about the usage of raw materials and amount of output daily will provide a better understanding of the production efficiency of the mill. This data can be compared with historical performance to gauge if the mill is becoming more efficient over time and gives a quantifiable and reliable measure to improve the production process.

Implementation

The above recommendation could have a significant impact on the profitability of the mill. If implemented, it could lead to a reduction in procurement cost of raw materials, increase the margin of the Uncoated Duplex Board and could lead to more optimized operational efficiency of the mill. The mill currently faces frequent losses. To help with the profitability, some changes can be made in the procurement and pricing strategies. By using the recommended suppliers which have proven to be reliable and cost efficient, the procurement costs can be significantly reduced. Next, increasing the price of Uncoated Duplex Boards marginally will help in the profitability significantly. Finally, better data recording practices can help facilitate the above two recommendations and further provide valuable insights into the efficiency of the mill. In this way the profitability of the mill can he improved.