Navigating B2C Expansion and Optimizing Warehouse Efficiency Amid Labour Shortage

Final report for the BDM capstone Project

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1. Executive Summary

SNP is a B2B manufacturing firm engaged in the production of industrial equipment such as ladder type cable trays, APFC panel, MCC panel, etc. Based in Maharashtra, the company employees a total of 12 permanent workers along with some others hired on a daily wage depending on seasonal trends in demand for the products. The major clientele of the company includes electrical firms, hotels, malls, factories and builders, etc. While the company is currently profitable, a labour shortage in the manufacturing industry is impeding its growth and preventing it from expanding into new sectors like B2C.

The project attempts to shed light on the underlying factors that exacerbate the problems faced by the company and discover strategies to mitigate the same. Building upon the insights gained from the previous analyses, this report conducts a further in-depth study to demonstrate potential solutions through data analysis. The data for the years 2022 to 2024 was collected which included sales, purchase and labour data. After thorough cleaning, various data visualisation techniques such as stacked bar charts and pie charts, were used to find the key performing indicators namely top-performing products, loyal customers, etc. These indicators form a basis in formulating strategies for implementing warehousing of products. Furthermore, to verify if providing a higher wage rate to recruit deficit labourers is a feasible approach to tackle labour shortage, forecasting techniques such as time-series and regression forecasting were used. Predicting the labour and performing a cost benefit analysis helped in fortifying the reliability of the solution.

Through insights gained from the above analysis, the company can implement a range of strategies to address the challenges it faces. Warehousing of products, hiring labour at higher cost, optimising labour usage, boosting online presence, implementing strategies to retain loyal customers and reduce dependency on out-sourcing its production processes are some the strategies which can help the company improve operational efficiency and attain sustainable growth.

2. Detailed Explanation of Analysis Process

3. **Interviewing the Business Owner:**

The initial step in the analysis was interviewing the owner of SNP to get an idea about the working of the firm and the various issues faced by them. The interview with was scheduled on June 18, which went on for 2 hours wherein details about the various products manufactured by the firm, the production process, details about the number of employees and working hours were noted. Along with that, information regarding the fabrication market was also recorded which further proves essential in highlighting the problems faced by the firm which affected their profitability.

4. **Data Collection:**

The next step involved was gathering relevant data from the firm which was essential for the analysis. The interview with the owner revealed concerns about the business such as labour shortage, problems with the B2C sector, etc. For the purpose of analysing the cause of these problems, data pertaining to the sales, purchase in the year 2022-23 and 2023-24 was collected. Along with that the daily labour absence and presence data was also collected. The data gathered was not in an analysable format, the sales data was extracted from the Tally software into pdf files, the photos of purchase bills were gathered and the labour presence and absence which was recorded in a traditional register, was collected.

5. **Data Cleaning:**

Cleaning and formatting the data into csv files was necessary before proceeding with any statistical analysis which was done with the help of Microsoft Excel and OpenRefine.

- **Sales data cleaning:** The company sells it products in different dimensions which is recorded when entries are made in Tally. Also, there was no uniformity in the names of the products recorded. To standardize these inconsistencies, the data was processed using OpenRefine, a data wrangling software.
- **Purchase data cleaning:** The purchase data had to be manually entered into spreadsheets. Since the name of the same product differs across companies, to homogenize the same, OpenRefine was used. Also, the units of the same products differed, for example the length of GP Sheets being mentioned in meters and inches, conversion of such units was also done.

- **Labour data cleaning:** The data present in the traditional register had details about the presence and absence of labour recorded daily. This data was again converted into an analysable format by entering the count manually into spreadsheets.

6. Statistical Analysis:

Statistical analysis of the collected data is important as it helps reveal insights about the various trends and patterns the data follows. This started with calculating various descriptive statistics such as mean, median, standard deviation, minimum, maximum, quantiles, etc. Examining these values helped understand the structure of the data such as the distribution, skewness and range of the data. The derived results provided a strong base for further analysis using data visualisation.

7. Data Visualisation:

Understanding the data as it is i.e. in a tabular format is difficult and hence effective data visualisation is important as it helps simplifying complex data and reveal the underlying patters and trend which may not be apparent by plain mathematical or statistical analysis. To disclose the patterns and trends in the data, visualisations such as bar chart, line chart, tree map, heatmap, etc. were used. Python libraries such as Pandas, NumPy, Seaborn and Plotly were used to visualise the data with the help of Google Colab. These visualisations provided key insights about sales made by the company such as their frequently selling products, frequent customers, times of higher sales, etc. Similarly, it helped in analysing the purchase data and also identify the seasonal patterns of the labour availability i.e. low labour supply in the months of April-May and in October-November.

8. Strategies to address the problems:

The problem of shortage of labour faced by SNP is an industry-wide problem. To address this issue, a cost benefit analysis between two approaches were performed.

The first approach was introducing the concept of warehousing of frequently demanded products. To assess the feasibility and reliability of this approach, an extensive analysis of the sales data was performed, the aim was to identify the frequently demanded products, the quantity in which these products were demanded. This helped in constructing a list of products which can be produced in surplus and then stored so that it can cater to the need of firm's customers.

Along with identification of frequently bought products, discovering regular customers was equally important as it helps the firm in estimating the products and quantity demanded by its frequent customers and also the time period during which these customers are active buyers. All of these help the firm formulate a strategy to tackle the labour shortage by boosting the production process when there is surplus labour present.

The second approach was discovered after the interview with the owner, which draws upon the basic principle of demand and supply i.e. low supply and high demand leads to an increase in prices of the goods demanded. In the given context, the problem of low supply of labour can be tackled if the firm is ready to fulfil the deficit labour demand at a higher wage rate. To evaluate the practicality and dependability of this method, a time-series forecasting of the labour data was performed. The reason for conducting this analysis is identifying whether increasing the labour at a higher wage, increases the sales to an extent which covers the increase in variable cost leading to an increase in profit.

The mid-term report, with the help of a calendar heatmap depicted that the labour unavailability was quite high in the months of April-May and October-November. A labour forecasting was performed assuming that the labour requirement in these months can be fulfilled by offering a higher wage. A new value of expected labour requirement for the month of May 2022, November 2022, May 2023 and October 2023 was forecasted with the Microsoft Excel's *FORECAST.ETS* function in order to obtain a value of labour count which would have existed had labour been independent of the external factors.

This forecasted value of labour will have an impact on the sales as there is a moderate positive relationship between the two. Therefore, to account this into the analysis, a regression analysis using *XGBoost,* a machine learning model, was performed. This regression model was trained using the input features- year, month, purchase value and labour count and was used to predict the sales value. The sales value for the afore-mentioned months with forecasted labour was predicted using this regression model which further helped in calculating the revised profit and hence assisting with the decision-making process.

Additionally, SNP also faced challenges while expanding into the B2C sector. Numerous efforts of making its products available to consumers was made with the help of selling products on e-commerce platforms like Amazon and Flipkart but it did not yield desirable results due to lack of communication between the producer and consumer which e-commerce platforms failed to bridge. In order to address the limitations of e-commerce platforms, the idea of design a company website to sell its products can be taken into

consideration. The feasibility of this approach can be analysed by studying the cost of running a company website and revenue generated from the orders of the B2C sectors. For this purpose, costs of website development, advertisements, e-marketing of its products and hosting a website should be taken into account. Depending upon the success rate, this method can be used by the firm to enter the B2C sector, the efforts for which were previously futile.

9. **Recommendations:**

After extensive data analysis using a wide range of techniques, potential solutions for the problems faced by the firm were identified. These solutions were identified using techniques such as regression, time-series forecasting, etc. which may help the firm to deal with the problems in the short term but due to market volatility there is a need for the firm to be on their toes and perform regular analysis in order to identify potential concerns which can compromise the profitability of the firm and also formulate solutions to tackle the same. A data-driven approach can always be a starting point in facilitating this but considering the numerous factors affecting a business, relying only on this might not prove to be useful enough.

3. Results and Findings

This section consolidates the findings from the aforementioned analysis to identify potential solutions.

3.1. Warehousing of Products

By analysis the sales of SNP, frequent demanded products were identified and it was observed that G.I. Perforated Cable Tray was the most demanded product with the total sale value of ₹1,51,52,166.78 in the year 2022-23 and ₹1,14,49,613.82 in the year 2023-24. It was important to identify other frequently demanded products which can then help in formulate a plan for warehousing. To identify such products, G.I. Perforated Cable Tray was excluded from the analysis.

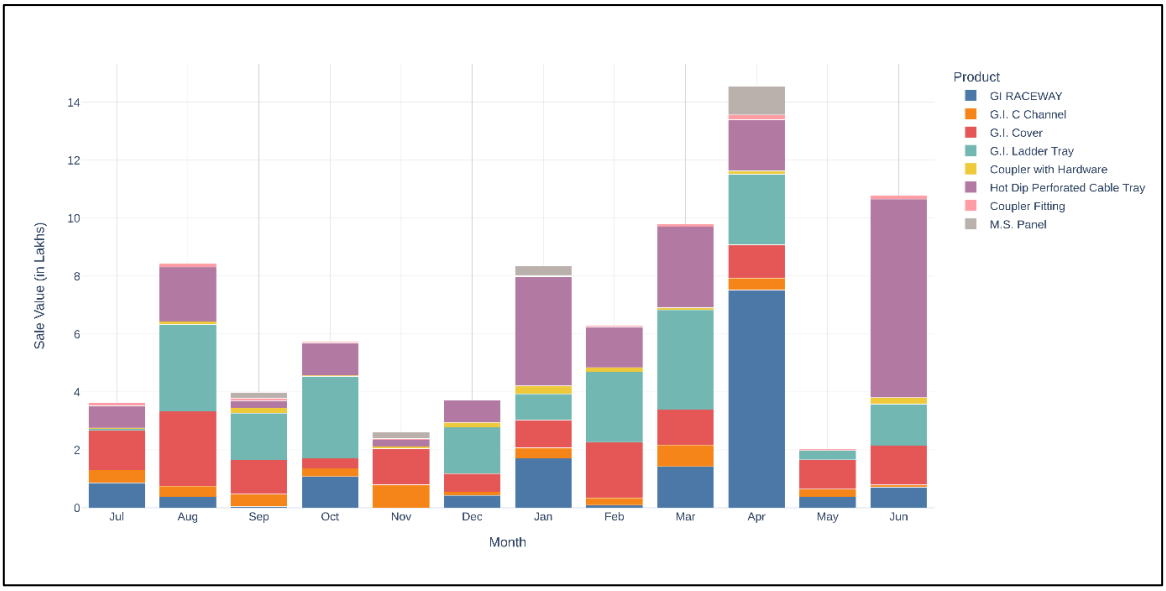

Figure 1. Monthly Sales of Products (2022-23)

The above graph represents the demand of the frequent products (products which were sold more than 100 times in a year). It can be seen that in the year 2022-23, the product 'Hot Dip Perforated Cable Tray' was demanded constantly throughout the year. The demand for the same peaked in the month of June for 2022-23. Along with this, the product G.I. Ladder Tray also saw a constant demand with an average monthly sale of ₹1.45 lakhs, followed by G.I. Raceway with average monthly sales of ₹1.31 lakhs.

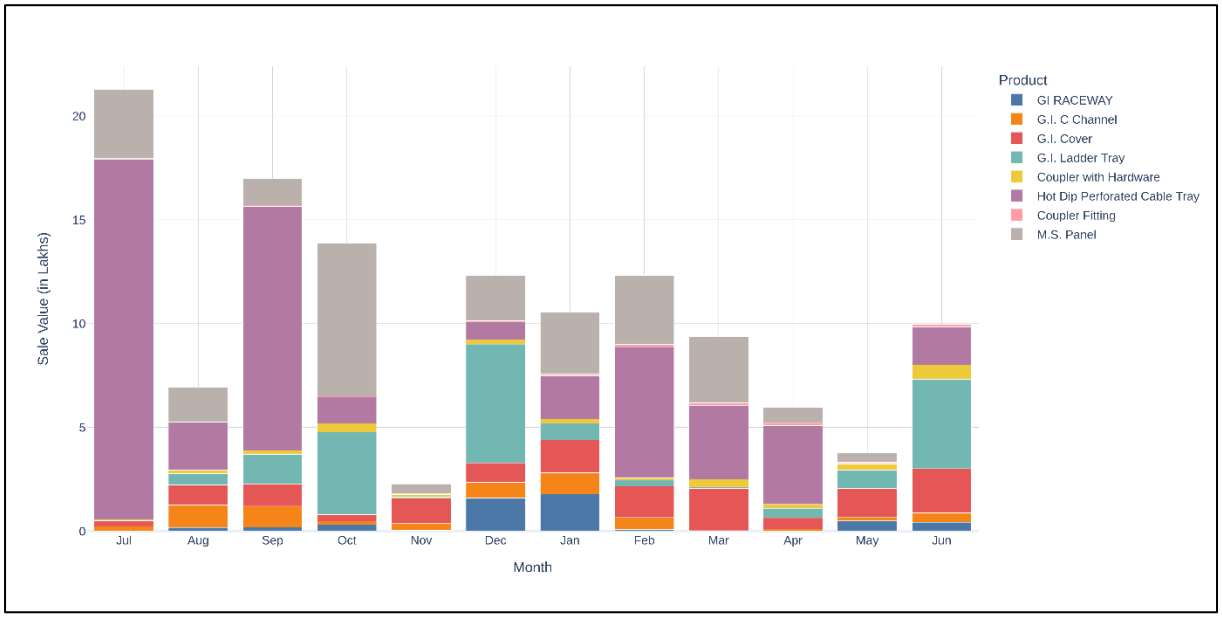

Figure 2. Monthly Sales of Products (2023-24)

The year 2023-24 follows a similar trend of having Hot Dip Perforated Cable Tray as the highest selling product after G.I. Perforated Cable Tray, and had a higher overall demand in the year compared to its previous performance. The year 2023-24 saw a rise in the demand of M.S Panel which had an average demand of only ₹14,000 per month, rose to ₹2.23 lakhs in 2023-24 indicating the rise in the popularity of the product. Other products such as G.I. Cover, G.I. Ladder Tray, etc saw demands similar to that of 2022-23.

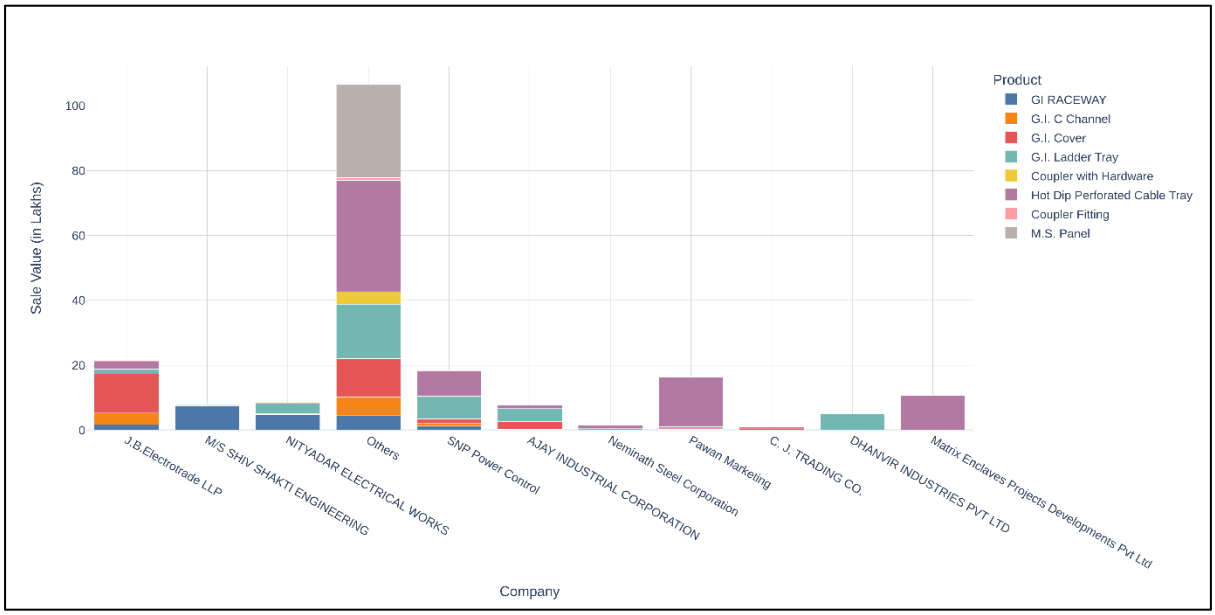

Figure 3. Demand of Products (Company-wise)

The above bar plot demonstrates the demand of the frequently sold products company-wise. Only the products which were ordered more than 100 times in both the years are considered (excluding G.I. Perforated Cable Tray). Similarly, it only considers companies which purchased products of worth more than ₹10 lakhs in both years combined, the remaining companies are grouped into the 'Other' category. It can be inferred from the graph that Hot Dip Perforated Cable Tray is the highest demanded product by 4 out of the 10 companies, depicting the popularity and need for this product in the market. Some companies, such as Matrix Enclaves Project Development, Pawan Marketing, and Neminath Steel Corporation, have either exclusively purchased Hot Dip Cable Trays or have made it their primary purchase. A similar pattern can be seen with the companies such as M/S Shiv Shakti Engineering and Dhanvir Industries. Although the companies belonging to the 'Other' category do not make an appreciable contribution individually but the consolidated demand of these companies make a significant impact on the sales of SNP. Hence taking into account the products demanded by these companies will also help to boost the overall profit of the organization. It can be seen that

the sale made to these companies are dominated by the products such as Hot Dip Perforated Cable Tray and M.S. Panel, following a similar trend that of other frequent companies.

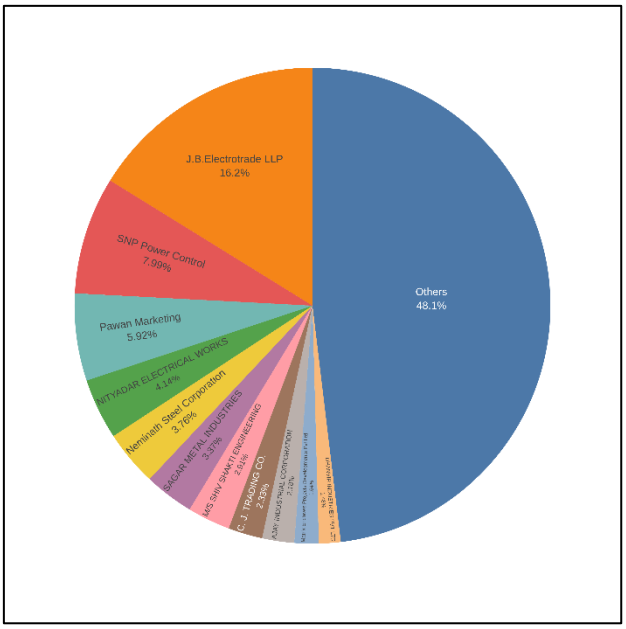

Figure 4. Company-wise Revenue Contribution

The above pie chart aims to display the company-wise contribution to revenue. The previous method of grouping the companies with the total revenue contribution less than ₹10 lakhs as 'Other' is used. The pie chart further supports the findings from the stacked charts, highlighting that the 'Other' category, which despite being insignificant in terms of individual revenue contribution, collectively generates the largest share of the company's revenue, accounting for nearly half (48.1%).

Based on the above insights, the products such as G.I. Perforated Cable Tray, Hot Dip Perforated Cable Tray can be produced in larger quantities and stored so as to meet the demand of its frequent customers such as J.B. Electrotrade, SNP Power Control, etc. especially in the months of April-May and October-November when the labour shortage hampers the production process.

Cost Benefit Analysis:

SNP do not engage in the practice of storing its frequently sold product (see Figure 1 and Figure 2), hence the initial stages involve the setup for making warehousing possible such as renting a warehouse, finding ways for secure packaging of manufactured products, etc.

An estimate on the cost the renting a 1000 sq. ft warehouse was taken from the owner of SNP which came out to be ₹30,000-₹35,000 a month. For the cost analysis, the rent will be taken as ₹32,500. Further other miscellaneous cost such as security and packaging of the products is considered to be ₹30,000/month.

Assuming that the demand for the above-mentioned products remain fairly constant in the months of April to June and then again during the festival of Diwali, the average monthly revenue generated by G.I. Perforated Cable Tray is taken to be ₹14,53,489.11, for Hot Dip Perforated Cable Tray is taken to be ₹1,61,556.65 and for G.I. Ladder Tray as ₹2,03,197.27.

Suppose SNP decides to store only the above three products,

Production and Labour Cost = 75% of Total Revenue generated

$$= 0.75 \times (18,18,243.03)$$

$$= ₹13,63,682.27$$

$$\text{Profit} = \text{Revenue} - \text{Cost}$$

$$= ₹18,18,243.03 - ₹13,63,682.27$$

$$= ₹4,54,560.76$$

The above profit does not take into the account the cost of warehousing of these products, which comes out to be approximately ₹62,500, deducting this from the profit,

$$\text{Modified Profit} = \text{Profit} - \text{Cost of Warehousing}$$

$$= ₹4,54,560.76 - ₹62,500$$

$$= ₹3,92,060.76$$

The above calculation suggests that the firm can make a profit of approximately ₹4 lakhs in the months in which the firm experiences revenue crunch due to labour shortage if it warehouses its frequently demanded products.

3.2. Labour Forecasting

The labour unavailability in the months of April-May and in October-November is a result of various external factors. The labours tend to visit their native places in April-May and again in October-November which is the festive season in India.

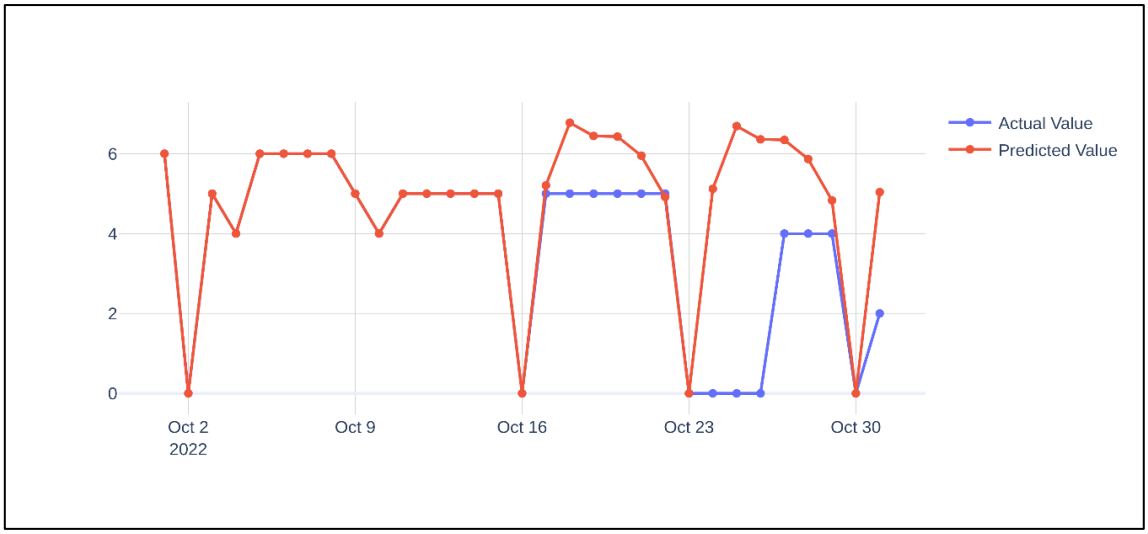

Figure 5. Actual v/s Forecasted Value of Labour (October-22)

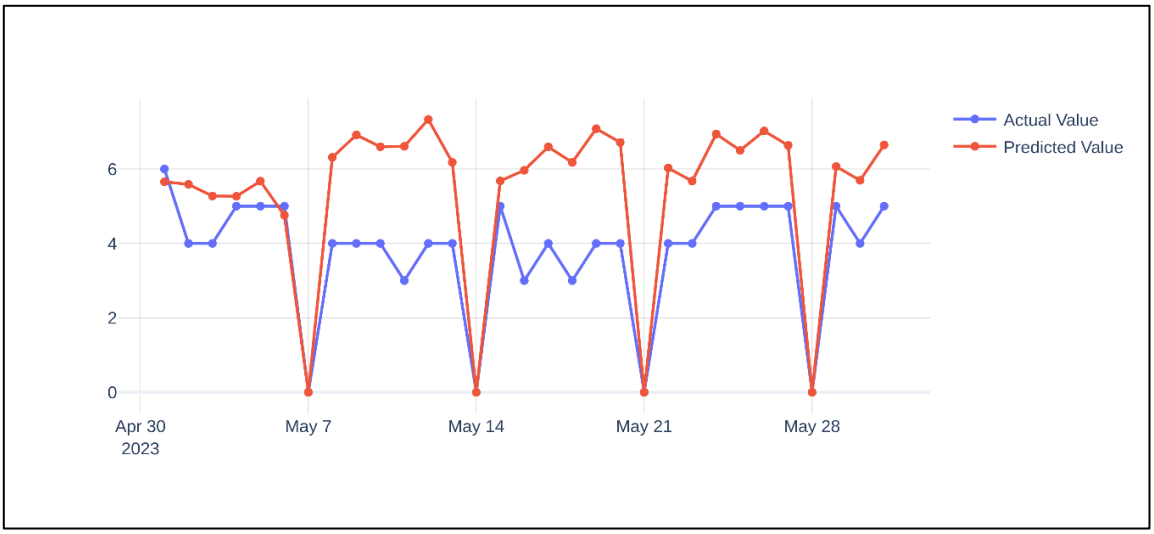

Figure 6. Actual v/s Forecasted Value of Labour (May-23)

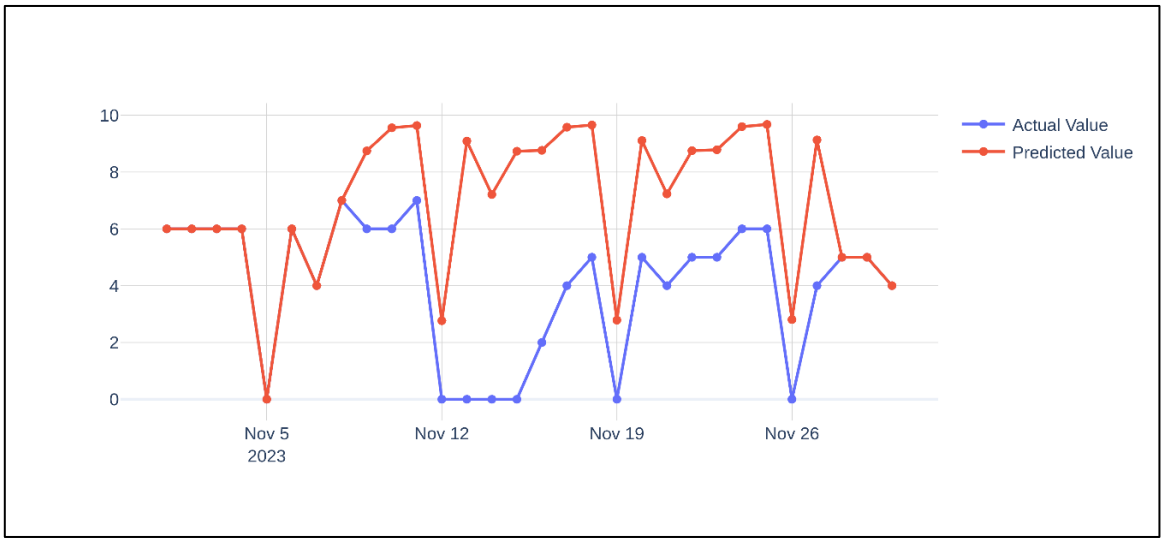

Figure 7. Actual v/s Forecasted Value of Labour (Nov-23)

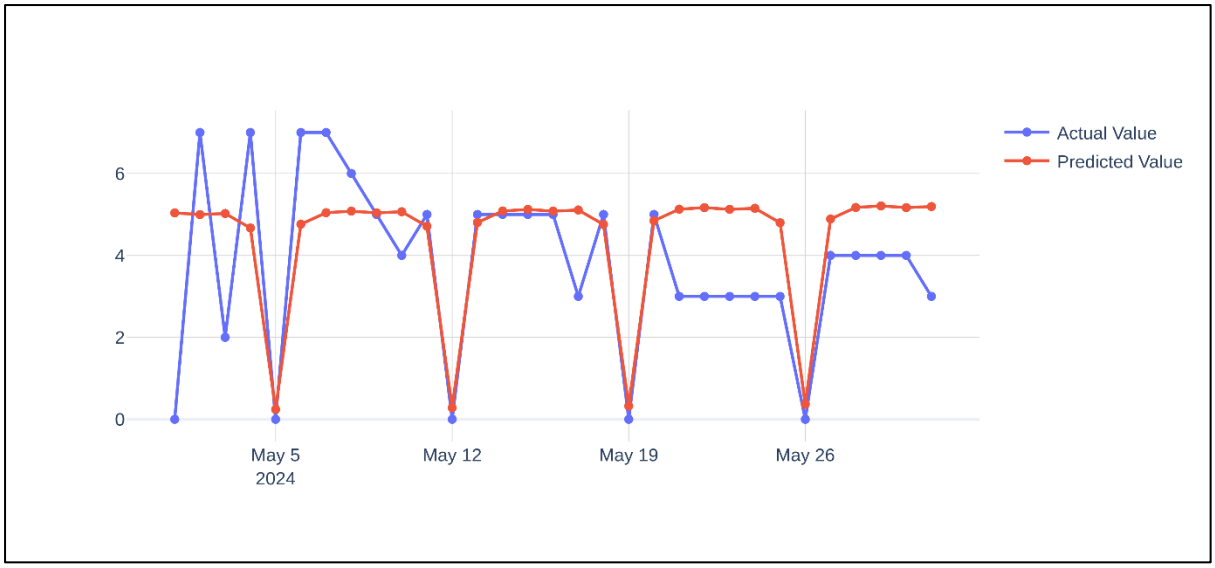

Figure 8. Actual v/s Forecasted Value of Labour (May-24)

The above time-series graphs represent the actual value and the predicted value of labour in the months of October-22, May-23, November-23 and May-24 where the labour count dropped due to factors mentioned above. The predicted value depicts the labour count that would have existed if the external factors had not come into play. This difference, in actual labour count and predicted labour count, can be reduced if the firm offers a higher wage rate to the employ the daily-wage workers.

Cost Benefit Analysis:

This section aims to compare current scenario of SNP, where they operate with reduced labour in several months of the year and the prospective scenario, where the firm is ready to hire labour at a higher wage-rate.

Actual Values				
Month	**Labour**	**Salary (in ₹)**	**Purchase (in ₹)**	**Sales (in ₹)**
Oct-22	117	64350	2110479	2487803
May-23	117	64350	2330241.41	992407
Nov-23	120	66000	1870531.9	2337938
May-24	117	64350	2217391.25	1807749.56

Table 1. Actual Values of Labour/Sales/Purchase

Forecasted Values				
Month	**Forecasted Labour**	**Forecasted Salary (in ₹)**	**Forecasted Purchase (in ₹)**	**Forecasted Sales (in ₹)**
Oct-22	148.97	96829.65	2211118.2	2855856.5
May-23	167.57	108918.31	2249081.5	2802224.8
Nov-23	206.61	134296.10	2143901	2877724
May-24	136.44	88686.14	2259433.5	2575827.5

Table 2. Forecasted Values of Labour/Sales/Purchase

Table 1 represents the actual values of labour the company had in the given months. The firm employees its current labour at ₹550 per day, hence the salaries are calculated as;

$$Salary = Labour \times 550$$

The sales represent the actual value of revenue generated and the purchase value represents the cost of purchases incurred for the raw materials.

Table 2, on the other hand represents the forecasted values. The forecasted labour was calculated using *FORECAST.ETS*. The resultant impact of forecasted labour was accounted for by forecasting the sales and purchase values using a regression model. It was assumed that the firm would be able to fulfil the difference in the labour count by offering higher a wage rate of ₹650, an 18% increase as compared to the previous value of ₹550. Hence the forecasted salaries were calculated as;

$$Forecasted\ Salary = Forecasted\ Labour \times 650$$

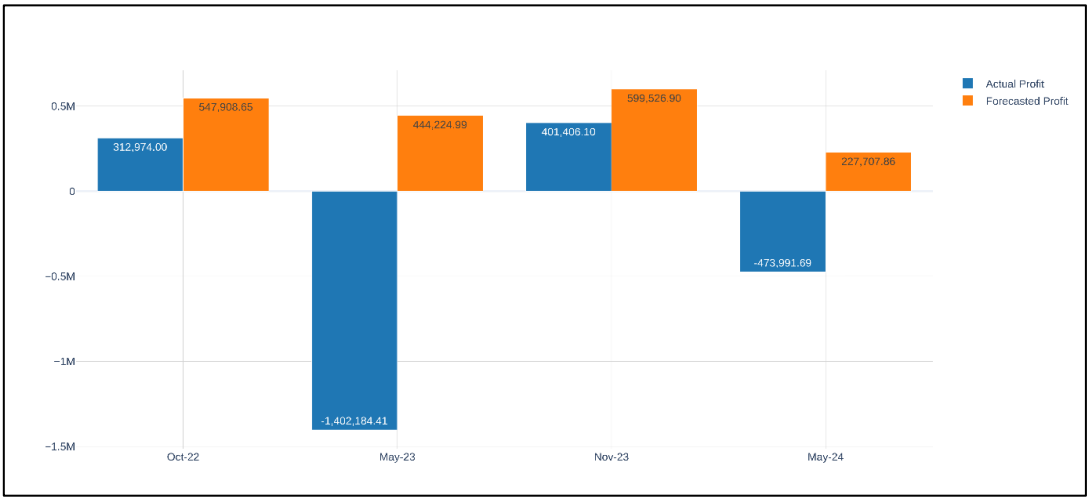

Figure 9. Actual Profit v/s Forecasted Profit

The above bar plot compares the profit of the months with modified labour counts. It can be seen that the months of Oct-2022 and Nov-2023, previously affected due to the Diwali season, see a considerable increase in the profits, 75% and 49% respectively. On the other hand, the months of May-2023 and May-2024 where the firm previously incurred losses of more than ₹14 lakhs and ₹4.7 lakhs respectively, saw a vast rise of 139% and 148% respectively.

3.3. Starting a Company Website

The aspiration of SNP to enter the B2C sector remained unaccomplished despite numerous efforts to sell their products on e-commerce websites such as Amazon and Flipkart. The major reason was consumer's inconvenience in ordering correct sizes of products as per their requirement which further led to cancelling of order or returning the products back. These cancellations cause the company to incur losses, forcing it to halt its business on e-commerce websites.

A potential solution to tackle this problem of communication between and the seller and the buyer can be addressed if the firm sets-up its own company website, mainly for two purposes, advertising its products on the web which will strengthen its online presence and also start an e-commerce service to sell its product on the website.

Firstly, the identification of the products demanded by the general public from the products that the company sells is required. Smaller products such as cable trays, various types of bends, ladder type cable tray and MCB Box are some of the products that are used outside of industrial purposes. Hence, these are the products that can be advertised on relevant websites to boost company's online presence and can be sold on the company website.

The targeted consumer group of the products sold on the company website will generally be retail shops such as hardware stores, electricians, and other handymen. The demand for the products by such consumers will be relatively small as compared to larger industrial corporations. Thus, there is a need to increase the prices of products in order to cover the expenses of offering the products for sale online.

The expected cost of website development with a payment gateway costs around ₹20,000 in India and the cost of running the same is approximately ₹7,000/month. The cost of a basic plan of Google Ads is around ₹5,000 to ₹10,000 per month. Given the cost of website development is a one-time investment, and the company can minimize the cost of running ads by timing it according to periods of higher demand, the total cost of running a website would come out to be ₹1,50,000/year. The owner estimated that the firm expects to generate a revenue of ₹2.5

lakhs to ₹3 lakhs from the B2C sector based on its past performances on websites like Amazon and Flipkart. Hence, the overall move starting a website looks foreseeable and profitable.

4. Interpretation of Results and Recommendations

4.1. Interpretation of Results

The examination of SNP' sales, purchase and labour data helped unravel various trends and patterns about the firm's performance. The observation of these patterns can help the firm on various fronts such as optimisation of its resources, especially labour, help shift its focus on greater demand products and catering to the needs of its loyal (regular) customer group which help the company boost its revenue.

1. The in-depth analysis of the sales data yielded some crucial insights about the company's progress. The detailed study of the data in the mid-term helped in the identification of the firm's top-performing SKU. It can be noted that the firm follows the Pareto principle i.e. the top 20% products contribute to 80% of the revenue. In SNP' case, the firm sells 142 unique products generating a total revenue of more than ₹7.3 crores (both the years combined). Out of the 142 products, the top 20% i.e. the top 28 products alone generate a total revenue more than ₹6.4 crores which is 88.7% of the firm's total revenue. The application of Pareto principle can also be seen in the case of the firm's customers. SNP have a customer base of 266 businesses, out of which the top 20% businesses i.e. top 53 businesses contribute 82.4% to the total revenue.

2. Analysing a firm's purchase data is equally crucial as analysing its sales data as it helps in cost management and efficiency, identifying key raw materials and the magnitude of firm's dependency on its business partners. The analysis revealed that the key raw materials required in the production of almost all the products are metal sheets. Hence, the firm's purchase data showed that a considerable number of purchases being made for GI Sheet/ GP Sheet, HR Sheets, and other types of metal sheets. The data also revealed that the firm outsources some of its production processes such as hot dipping, galvanizing, spray painting of its products, etc. This depicts the firm's dependence on other businesses which might lead to delay in dispatching the finished product.

3. The firm's overall business activities have proved to be profitable as a whole but the analyses unfolded contradictory trends when the profitability for each month was taken into

account. It was observed that in 5 months the firm incurred losses. In the month of April, the firm's productivity was the lowest where it incurred losses of more than ₹20 Lakhs (both the years combined).

4. The unavailability of labour has a negative impact on the firm's overall performance. This is evident when examining the firm's profit in April and May, which were negative. Though all of the analyses proves that there was a shortage of labour which hampered the production process, when the profit of the firm and the labour count were compared, using the normalised values, on a monthly basis, it revealed that even labour availability led to losses in some months, for example in the month of August.

4.2. Recommendations

After extensive analysis of SNP' sales, purchase and labour data and also after understanding the market dynamics, the following recommendations have been formulated so as to help the firm optimise its production process and marketing strategies.

1. **Warehousing of frequently demanded products:**

   The above cost benefit analysis of warehousing stated the benefits of storing its frequently demanded products. The company can identify the time periods with excessive labour availability. These time periods can then be used to produce surplus of products such as cable trays, ladder trays, etc. which are high in demand throughout the year. This can potentially empower the firm to navigate periods of labour shortage more effectively and capitalize on instances where market demand exceeds expectations.

2. **Hiring labour at a higher cost:**

   The months of May when the labour availability is below the required number, the firm struggles to meet the demand requirements of the market, resulting in losses. A potential solution to deal with the same can be to offer a higher wage rate to recruit more labourers. Offering a wage increase of 20%-25% could potentially enable the firm to attract and retain the necessary workforce, thereby addressing its labour requirements. Additionally, this could lead to a scenario where the company not only breaks even in months that historically incurred losses but also potentially generate profits in those periods.

3. **Optimising labour usage:**

   The analysis indicates significant under-utilization of labour in most months. To address this, the firm should closely monitor employee productivity and identify gaps where labour resources are not being fully utilized. To tackle underperformance, the firm can implement targeted strategies to optimize labour efficiency and improve overall productivity. This can help the firm reduce the cost and improve the overall productivity, in turn increasing the profits.

4. **Boosting online presence:**

   In today's technology-driven world, having an online presence is absolutely essential. By not utilizing the perks of advertising online, SNP is potentially deprived of a substantial number of customers. Starting a company website is crucial as it will help the firm to advertise its products and also provide an e-commerce service to its potential customers. The initial years may not be as profitable as anticipated, as the company would take time to establish itself online. However, once a strong presence is established, this decision is likely to become profitable in the long run.

5. **Retain loyal customers:**

   Although SNP have huge customer of more than 250 unique businesses, a substantial amount of revenue is generated from only a few of them. It is crucial for the firm to retain these customers which can be facilitated by providing better offers to these companies such as additional discounts as compared to other customers and also better services with respect to the punctual fulfilment of orders made by them. A healthy relation outside of business can also help facilitate the same.

6. **Reduce dependency on out-sourcing processes:**

   To produce finished products, SNP depends on its business partners for processes like hot dipping, galvanizing and spray painting. These processes cause the firm to incur additional costs which can be reduced if the company tries to insource the above-mentioned processes. Reducing dependencies may help the business sustain in the long run.