Strategic Workforce Development: Analysis for Addressing Labour Shortage

A Midterm Report for the BDM Capstone Project

Submitted by

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1. Executive Summary

Quality Instruments and Equipments, is a B2B firm based in Maharashtra, engaged in the manufacturing of pharmaceutical and laboratory equipment such as industrial ovens, heaters, water baths, dryers and cashew nut processors. The firm has two manufacturing units, the primary unit is located in Kudal, Sindhudurg and the other is located in Goregaon, Mumbai. The company employs a permanent workforce strength of 13, hiring additional workers on a daily wage as per seasonal requirement.

The manufacturing of such highly nuanced equipment requires extensive knowledge and technical skills. Such skilled labour comes at a high cost which significantly impacts the production budget and hiring capacity of the firm. Hence, it becomes crucial to maximize the utility obtained from the resources invested in the production process.

For providing potential solutions to tackle the challenges, the data pertaining to sales, purchases and payroll was collected from the firm for two fiscal years 2021-2022 and 2022-2023. This project focuses on quantifying the efficiency of the labour input, so as to identify the bottlenecks. This report entails analysis of underlying patterns and trends in the inputs and outputs of the firm using data visualization techniques such as bar plots, line charts, etc. A high-level overview of the meta data and distribution of data provides understandings of key relationships between variables such as sales revenue and labour supply, overtime hours and output, etc. Productivity analysis conducted in this report provides useful insights on the efficiency of labour throughout the year. These findings will then be used as inputs in the cost benefit and regression analysis which will be conducted in the Final Report to estimate the labour strength required and help the organization choose a cost-effective strategy to develop the required workforce.

2. Proof of Originality

Proof	Description	Link
Primary Data	It includes excel sheets of Sales, Purchase and Payroll data for the firm	Confidential
Letter from Organization	Image of the letter from the organization has been uploaded	Confidential
Images of the firm	Images of the factory in Mumbai and the catalogue of the products is uploaded	Confidential

Interview Video	Interview with the Accounts' Manager, Mr. Jayesh Mestry, has been uploaded.	Confidential
Company Website	The company has a website whose link is provided.	Company Website

Table 1. Proof of Originality

3. Meta-Data and Descriptive Statistics

For the fiscal years 2021-2022 and 2022-2023, comprehensive data pertaining to both inputs and outputs was collected to analyse the productivity of the firm. The data includes, sales data, purchases data and payroll data. The company manages their data in Tally software, from which the aforementioned data was extracted.

1. **Sales Data**

   The data for each fiscal year is stored in a separate excel sheet, hence the year is not mentioned in the sheets. The unit of measurement of the quantity of the products is 'Nos' or pieces of the product.

Column	Data Type	Description
Month	String	Month when the product was sold.
Product	String	Name of the product sold
Quantity	Integer	Quantity of the product sold.
Rate	Float	Price per unit of the product
Total	Float	The total price is the product of quantity and rate

Table 2. Meta Data about Sales

Column	Count	Mean	Std	Min	1st Quartile	2nd Quartile	3rd Quartile	Max
Quantity	334	3.71258	8.094117	1	1	1	2	64
Rate	334	54970.4	91743.2555	100	1854.89	18298	75213.8	1000000
Total	334	100266	204178.3	150	5275	32275	108163	2193120

Table 3. Descriptive Statistics about Sales

- The mean total amount is approximately Rupees 1 lakh and the mean rate of a product is Rupees 54970, however, the maximum rate and the maximum total amount are very high. This is due to the high price of some products such as large industrial ovens and heaters, etc.
- There is a significant difference between the maximum quantity and the 3rd quartile which indicates that there are some order quantities which are outliers.

2. **Purchase Data**

   The purchase data is stored in separate sheets for separate years. The data regarding purchases in the Tally software includes only the name of the supplier company and the amount paid for each purchase, without specifying the product names.

Column	Data Type	Description
Date	Date	Date of the Purchase
Company	String	Company from which the purchase was made
Amount	Float	Total amount paid for the purchase

Table 4. Meta Data about Purchases

Column	Count	Mean	Std	Min	1st Quartile	2nd Quartile	3rd Quartile	Max
Amount	1570	18734.9339	42678.0645	58	2950	7050.5	18161.25	769962

Table 5. Descriptive Statistics about Purchases

- For two years, there were a total of 1570 purchases made. The mean amount of the purchase is approximately Rupees 18735 but the maximum amount paid for a purchase is quite large at Rupees 769962 which indicates bigger purchases like purchase of machinery.
- The minimum amount of the purchase is very small, which indicates purchase of nuts, bolts or such small hardware equipment.

3. Payroll

   The payroll contains the names of the employees along with the total days they worked in a particular month and their respective wages. The company maintains separate excel

sheets for each month of a year. These sheets were combined into a single sheet by adding a column for the month.

Column	Data Type	Description	Relation
Employee Name	String	Name of the employee	-
Rate	Float	Daily Wage Rate	
PD (Paid Days)	Float[1]	Number of regular paid days/working days	
PDS (Paid Days Salary)	Float	Total Salary for regular paid days	PDS= Rate * PD
OT (Over Time Hours)	Float[2]	Number hours worked over time in a month	-
OTS (Over Time Salary)	Float	Total Overtime Salary to be paid which is calculated by converting hours to days and then multiplying by the Rate.	OTS=OT/8*Rate (OT/8 indicates conversion of hours to days as working day consists of 8 hours.)
Total	Float	Total salary including over time.	Total= PDS + OTS
Deductible	Integer	Loans/Advances to be deducted from salary.	-
Payable	Float	Payable Salary after deductions	Payable=Total - Deductible
Month	String	Month for which Salary paid	-

Table 6. Meta Data about Payroll

Column	Count	Mean	Std	Min	1st Quartile	2nd Quartile	3rd Quartile	Max
RATE	298	387.802	202.5709	300	300	440	520	665
PD	298	19.63255	6.319233	2	18	22	24	28
PDS	298	7621.946	4796.521	900	4302.5	8416.25	11426.25	17160
OT	298	18.39295	16.92986	1	8.5	15.5	25	114
OTS	298	1110.014	1120.961	56.875	442.5	827.5	1510.781	7466.25
TOTAL	298	10712.23	4113.182	966.875	8160.469	11387.19	13760.94	20666.25
DEDUCTION	298	777.1812	1155.436	0	0	500	1000	6500
PAYABLE	298	9952.213	4043.843	966.875	7355.156	10668.91	12638.52	19466.25

Table 7. Descriptive Statistics about Payroll

[1] The paid days are calculated based on the number of hours worked in an eight-hour work day and the values are not rounded off if an employee works only half a day, hence the PD column has float values.
[2] The over time is in hours and half an hour is indicated as 0.5 hours, hence the appropriate data type for OT column is float.

- The mean daily wage (rate) is Rupees 385.80 and the standard deviation is approximately 202 indicating the high variability in the wage rates.
- The mean working days/ paid days for a month is 21 with a deviation of 6 which suggests that the organization operates for majority of the days in a month though there is some variability in paid days across employees.
- The mean over time hours is 19.70 which is equal to 2.46 days. Therefore, on an average, the employees work overtime 2-3 days a month.
- The mean total salary is Rupees 11234.71 and the mean deduction from the salary is Rupees 777 which is a 7% deduction in the salary. The maximum deduction is Rupees 6500 which is greater than 50% of the mean salary.
- The variability of the payable salary is quite high. Lower 25% of the employees earn less than Rupees 8016.5 per month whereas the upper 25% of the employees earn more than Rupees 12988 per month.

4. Details Explanation of Analysis

Quality Instruments & Equipments has been facing the challenge of labour shortage after the pandemic. Skilled and unskilled labour shortage leads to incurring higher costs which in turn leads to lowered profitability. Hence, conducting a comprehensive analysis of resource utilization of the organization is essential. For doing the same, the process followed is described further.

The company stores their data in Tally software. The tally zip files for two fiscal years 2021-2022 and 2022-2023 were collected in order to extract the data. The entries for sales from the Tally system were exported into excel. This extracted data contained erroneous entries such as cancelled orders, entries with no amount mentioned, these entries were discarded. Also, scrap material sale entries were present in the dataset which had to be excluded from analysis. The purchase entries in the tally system had a mention of the supplier and the purchase amount not the product purchased. This data was also extracted into Excel. The company maintains the monthly payroll on Excel Sheets. These excel sheets were acquired from the purchase officer of the organization through mail and then concatenated into a single sheet for each year. This data contains null (0) values for some rows which indicates that the employee was not present for an entire month. These were excluded from analysis.

The aforementioned datasets were then structured into CSVs to construct key visualizations. The visualizations used and their justification is as follows:

1. Line Chart- Line Charts are the most appropriate tool when it comes to identifying trends and fluctuations in the data. As there is a need to spot any seasonal trends in the sales and purchases, the line charts for key variables such as sales, purchases, average wage rate are constructed.
2. Bar plots- Bar plots prove to be beneficial when trying to compare the quantities of numerical variables across another categorical variable. Bar plots make it easier to understand which categorical variable has the highest magnitude. Hence, bar plots are used for plotting variables like average paid days across months, productivity across months, etc.

The visual data representations and the insights gained from them are mentioned below.

1. Revenue From Sales

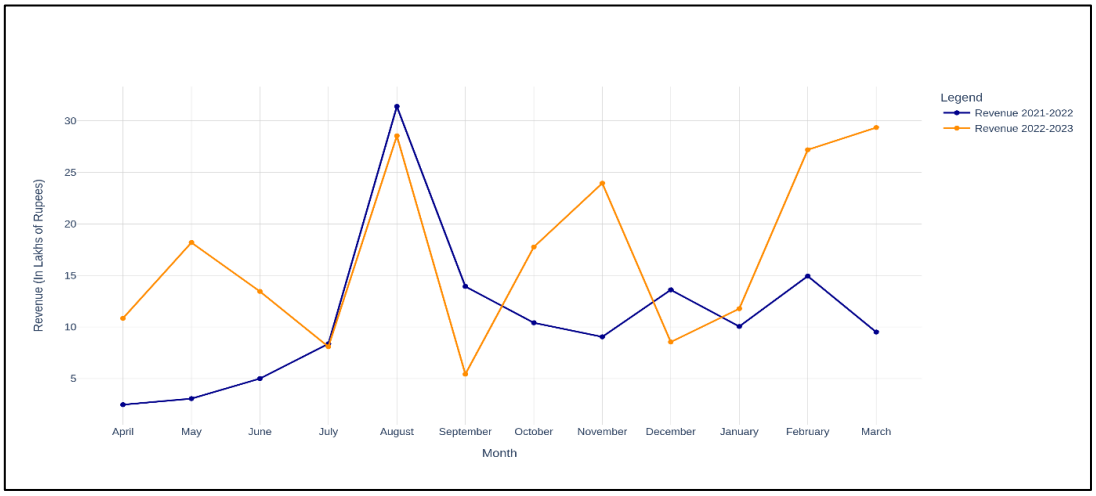

Figure 1. Revenue Trend for the Fiscal Year 2021-2022 and 2022-2023

Figure 1 depicts the trend of the sales revenue. It can be observed that the month of August for both the years has a very high revenue. For the year 2022-2023, the months of November and March have recorded high sales.

These figures help us identify periods of high labour requirement, for example, the months of August, November and March are periods of high sale, hence, the manpower requirement is intensive during those months. This will help the company prepare for the imminent rising labour demand.

2. Purchase Trend

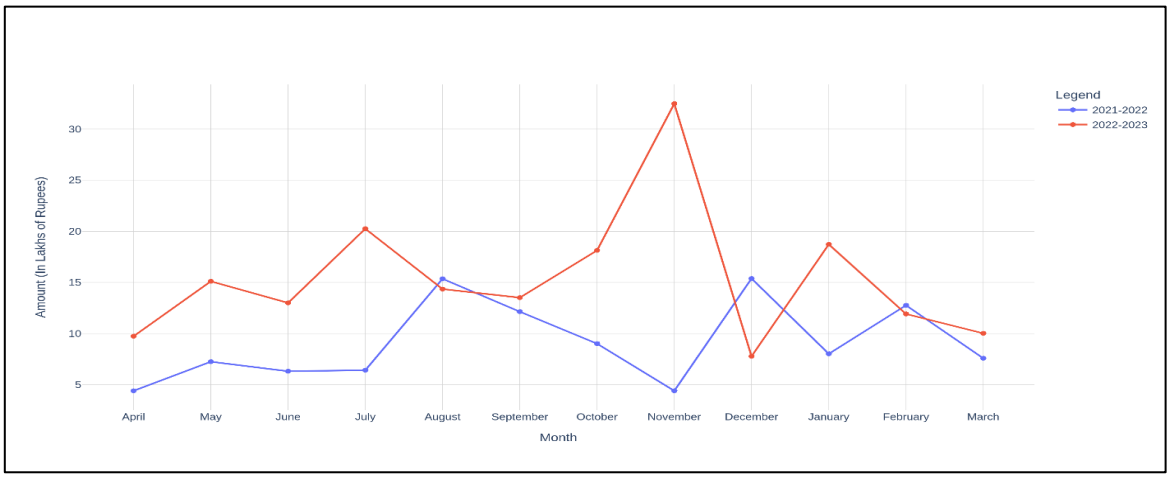

Figure 2. Amount paid for Purchases for the Fiscal Year 2021-2022 & 2022-2023

Figure 2 shows the purchase trend of the organization. A line chart makes it easy to recognize that the trend of purchases closely follows the trend of sales. The line for the year 2021-2022 is lower than the line for the year 2022-2023, which indicates increase in the average purchases across the years. Instinctively, the months of high sales have high purchases, for example, August for the year 2021-2022 and November for the year 2022-2023. It is important to analyse the purchase trend as it becomes one of the cost factors in profit analysis.

3. Average Wage Rate and Average working days

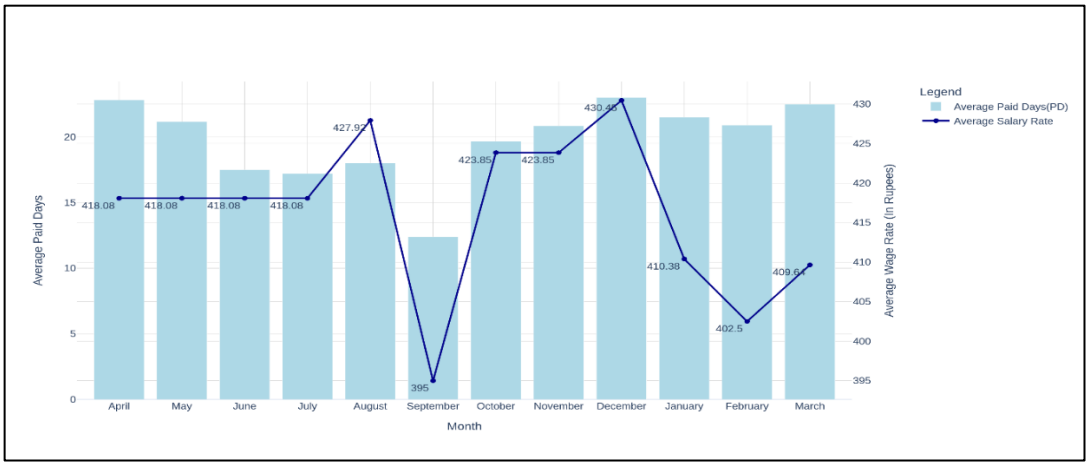

Figure 3. Average Salary Rate and Average Paid Days for the Fiscal year 2021-2022

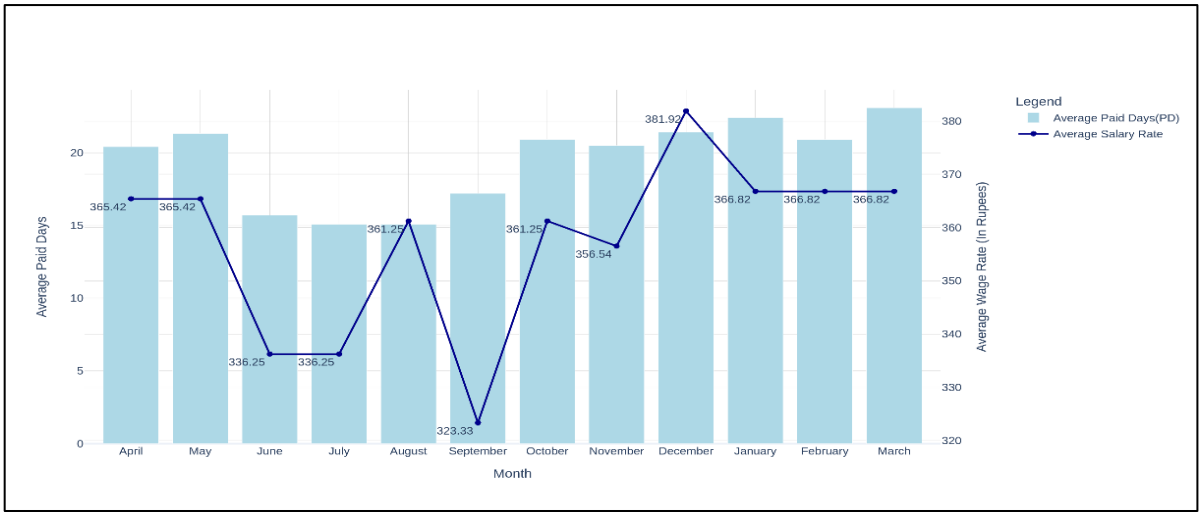

Figure 4. Average Salary Rate and Average Paid Days for the Fiscal year 2022-2023

The Figures 3 and 4 show the average wage rate given to the employees and average paid days i.e. working days across the year. The reason for using a line chart for the average wage rate and a bar chart for the average paid days is to compare the trend of the salary with the average paid days in a month. For example, a peculiar trend is observed in the chart that during the month of August when the sales are high, the average working days are less, which means the labour is more productive during that month than the other months.

The workforce is employed at varying wage rates and also works for different number of days. Hence, averaging across the values is beneficial for identifying the trend. The general trend that seems to be seen is that there is less attendance during the months of June, July and August. The average wage rate seems to drastically drop down in the month of September.

5. Results and Findings

The above analysis is helpful in visualizing the problems mentioned by the firm during the interview. The average working days in the months of monsoon is low which is not ideal as the firm sees a surge in sales during that period. Moreover, the average wage rate is at the lowest in September for both the years which is one of the potential reasons of the average working days in September being reduced.

These findings require an analysis of productivity of labour in order to estimate the labour demands and plan accordingly to adjust to the lowered attendance during different periods of the year.

To analyse the productivity of the employees, the following metric was calculated-

$$Productivity = \frac{Output\ per\ paid\ day}{Total\ employees\ in\ a\ month}$$

where output per paid day is $Output\ per\ paid\ day = \frac{Total\ Sales\ in\ a\ month}{Average\ paid\ days + Average\ overtime\ days}$

The interpretation of the productivity metric is output per paid day per employee which indicates the output produced by each worker on each paid day of a month. The above metric is then calculated for each month and plotted as follows:

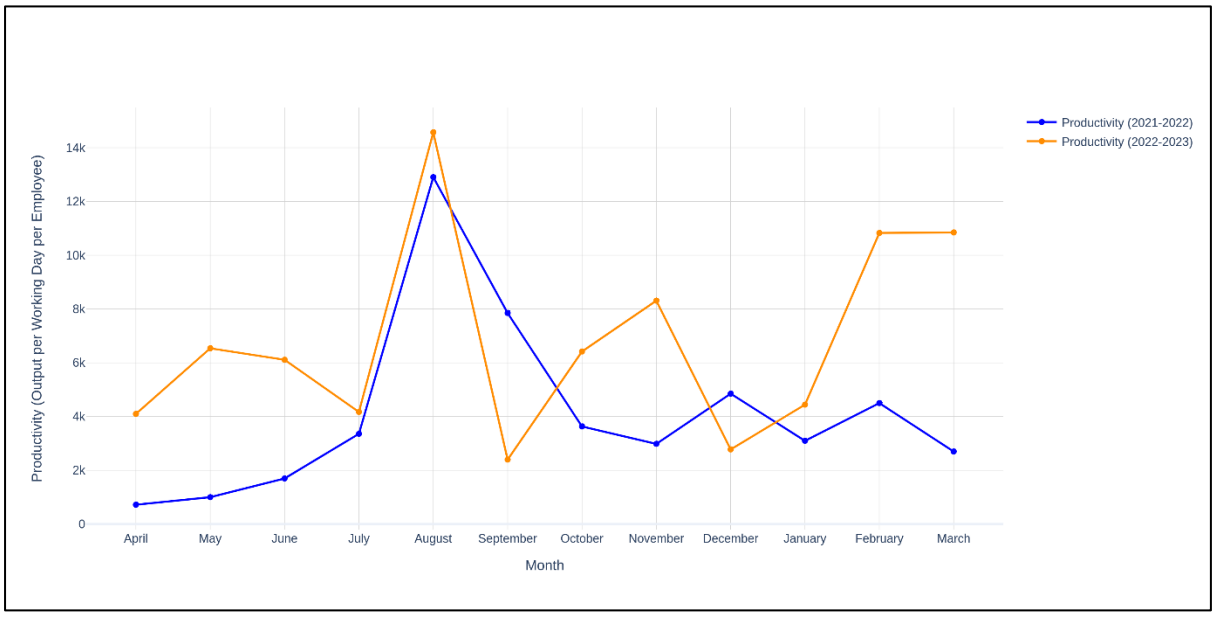

Figure 5. Productivity for the Fiscal Year 2021-2022 and 2022-2023

Figure 5 shows the line chart of the productivity value. The productivity can be interpreted as, for the month of April 2022, the productivity was close to Rupees 4000 which means that an

employee contributed Rupees 4000 to the sale value each working day of that month. It can be seen that the productivity is high for the month of August for both the years as the sale is high during those months. However, the labour availability is low in that month (See Figure 3 and 4). This indicates that a smaller number of people are able to produce a lot. This suggests that in other months of the year, despite having more labour available, productivity remains suboptimal, indicating potential inefficiencies or other limiting factors that need to be addressed.

The insights gained can significantly benefit the company as follows:

- Peak performance periods- The analysis concludes that the months of August and November are peak sales periods for the firm. Although, August performs high in terms of productivity, the performance in November seems to be suboptimal.
- Improvement in Resource Allocation- The human resources are being under-utilized as seen in Figure 5 and 6. Inefficiencies in staffing or over-hiring can be addressed by estimating the labour demand.
- Output produced during overtime- The analysis of productivity in Figure 5 includes the output produced during overtime hours. This analysis helps to identify whether working overtime hours is beneficial or the company should rely on the regular shifts in a day. As seen in the Figure, the overtime hours do not prove to be beneficial as productivity remains low for most of the months.

The estimate of productivity can contribute further as an important factor in conducting a regression analysis to estimate labour demand. To help company choose, the best strategy between employee hiring and employee training, these estimates of labour demand will help to factor in the employee hiring and training cost.