

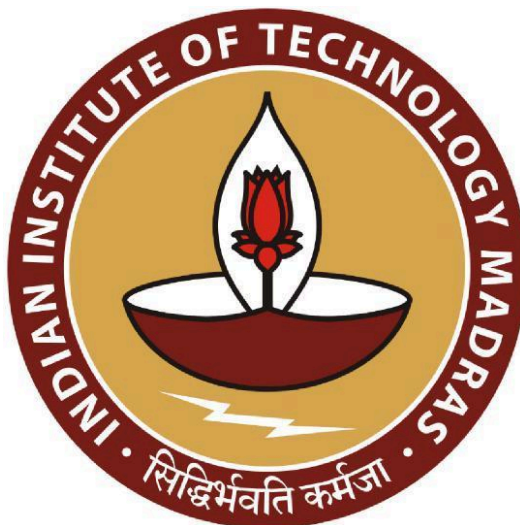
Strategic Market Growth and Efficiency Enhancement in Global Power Plant Consulting

A Mid Term report for the BDM capstone Project

Submitted by

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1 Title

Strategic Market Growth and Efficiency Enhancement in Global Power Plant Consulting

2 Executive Summary

The project focuses on XYZ Engineering Consultants (India) Pvt. Ltd, a power plant consultation company headquartered in Tamil Nadu. The company operates in a Business-to-Business (B2B) environment and deals with a wide range of power plant projects like Renewable energy (Biomass / Solar / Hydro), Gas Engines / turbine plants, Thermal plant and Steel Mill plant. The company offers services such as detailed engineering, project management, technology, and procurement services.

Following conversations with the Director and Head of Sales and Marketing, we have gained a comprehensive understanding of the business. The company's clients are spread across various Indian states, including Gujarat, Maharashtra, Uttar Pradesh, Tamil Nadu, Karnataka, and West Bengal. Additionally, the company has penetrated foreign markets such as Kenya, Nigeria, Uganda, Bangladesh, the Philippines, and Singapore. As global fossil fuel levels decline, the company is trending towards renewable energy sources, primarily solar energy, though coal and thermal sources still dominate the energy sector. In a financial landscape, the company reached its peak in 2019, but the aftermath of the COVID-19 pandemic caused a setback. However, since 2023, the company has resumed its growth trajectory.

3 MetaData

The original data was provided in a combination of Excel and Tally files. The data covers the period of three financial years, from 2021 to 2024. Using software like Tally Prime, writing app scripts in Google Sheets, and some manual intervention, all the data was extracted from these files year-wise and combined into the above-mentioned Google Sheet. Furthermore, the data

cleaning and preparation process is thoroughly explained in the Analysis Method section (5th Section).

Sheet 1 : Overall sales data of all years (Description of each column)

S.NO	COLUMN NAME	DESCRIPTION	TYPE	COLUMN STATS
1	Date	Voucher generated date	YYYY - MM -DD	Starts from Apr 2021 - Mar 2024 , Since data was collected based on financial year
2	Month (additionally added)	Month number derived from date	Integer	Range : 1 - 12
3	Year (additionally added)	Financial Year derived from date	Integer	Range : 2021 - 2024
4	Vch No.	A unique number assigned to the voucher within that particular financial year. Voucher number is set to 1 at the start of every financial year	Integer	min - 1 , max voucher number generated - 441, count - 1335 (unique vouchers)
5	Client	Name of the client	String	Count - 296 (unique client clients)

	name	organization		
6	Service charges	Amount charged for consultation service	Integer	Range : Rs. 725 - Rs. 77,14,960
7	GST	GST charged for service (18 %)	Integer	Foreign clients/ clients from special economic zone : GST = 0 Range : Rs 0 - Rs. 13,88,693
8	Amount	Total amount including GST	Integer	Range : Rs 856 - Rs 91,03,653
9	Receipt amount	The same as the total amount but takes value as NaN, if the amount has not been paid by the client	Integer / NaN	NaN count : 73 (unpaid) Integer count : 1062 (paid)
10	Inland / Foreign (additionally added)	Indicates "Inland" if the client is within India, otherwise "Foreign"	String (binary)	Range : { Inland , Foreign } Inland count : 982 Foreign count : 153
11	Location	Client organization location.	String	Unique count : 33
12	Type	Type of power plant	String	Range : { coal, thermal,solar,hydro,steel millet plant,gas engine/ turbine }

Sheets 2 : Show the expenditure summary of the organization for each financial year. These summaries consist of both direct and indirect expenses. There is a split for direct expenses that has been given for each year for further analysis purposes.

S.N O	COLUMN NAME	DESCRIPTION	TYPE	COLUMN STATS
1	Expense name	It is the name of the expense	String	Unique count : 75
2	Amount	Amount spent on expenditure	Integer	Range : Rs 0 - Rs. 1,51,61,074
3	Type	Type of expense	String	Range : { direct/indirect expense }

Sheet 3 : Provides an overall summary of profit and loss (Balance sheet)

4 Descriptive Statistics

Descriptive statistics help gain insights into data by summarizing and describing its main features. Below, we have provided some descriptive statistics to further analyze our data.

Type	Count	Mean	Std	Min	25%	50%	75%	Max
coal	341	236309.8	283700.53	858.0	49081.0	173067.0	306800.0	2124000.0
gas engine/turbine	22	134850.77	127586.29	8850.0	35400.0	76700.0	224200.0	424800.0
hydro	60	468315.23	918223.84	6522.0	108678.0	171159.0	269703.75	4649200.0
solar	108	229221.05	258730.33	856.0	34560.25	141600.0	321550.0	1133980.0
steel millet power plant	18	213204.17	178896.16	3552.0	60475.0	171690.0	364325.0	631890.0
thermal	433	295404.23	621414.25	1060.0	64900.0	165200.0	354000.0	9103653.0

Figure 4.1 : Comparison of service charge distribution between different types of power plant

4.1 As the above table shows,

1. Hydro power plants have the highest mean service charge amount (Rs. 4,68,315.23) among all types, indicating that services for hydro plants tend to be more expensive. It also exhibits the

highest standard deviation (Rs. 9,18,223.84), This could be due to the complexity of hydro projects.

2. Coal power plants exhibit a wide interquartile range (IQR), with the 25th percentile at (Rs. 49,081) and the 75th percentile at (Rs. 3,06,800). The maximum service charge reaches up to (Rs. 21,24,000) suggesting significant differences in project sizes
3. Steel millet power plants have a smaller sample size (18) and shows more consistent charges

index	count	mean	std	min	25%	50%	75%	max	Unique Client Count
Inland	982.0	273066.04073319753	510475.9658013789	856.0	55573.75	160286.5	311520.0	9103653.0	254
Foreign	153.0	771836.0130718955	797977.6869244213	14800.0	221900.0	566250.0	835145.0	4070000.0	42

Figure 4.2 : Comparison of service charge distribution between Inland and Foreign clients

4.2 As the above table shows,

1. The mean amount for Foreign clients (Rs. 7,71,836) is significantly higher than that for Inland clients (Rs. 2,73,066). However, the standard deviation for Foreign amounts (Rs. 7,97,978) is also higher compared to Inland (Rs. 5,10,476), indicating greater variability in the amounts for Foreign clients.
2. Inland clients have a much higher unique client count (254) compared to Foreign clients (42). This suggests that Inland projects are distributed among a larger number of client bases.
3. The maximum amount for Inland clients (Rs.91,03,653) is higher than for Foreign clients (Rs. 40,70,000). However, the 75th percentile amount for Foreign clients (Rs. 8,35,145) is much higher than that for Inland clients (Rs. 3,11,520), indicating that while the highest values are found in Inland projects, a larger proportion of Foreign projects are of higher value.

Year	Expense Type	count	mean	std	min	25%	50%	75%	max
21 - 22	direct expense	12.0	5086518.083333333	12489377.11077103	2731.0	113758.25	471706.0	2219596.5	43876795.0
21 - 22	indirect expense	38.0	703216.7497368421	1346584.3597733318	159.9	17900.07	152667.5	630631.6625	6051451.0
22 - 23	direct expense	3.0	18720343.333333332	15015784.35838043	2634057.0	11897106.0	21160155.0	26763486.5	32366818.0
22 - 23	indirect expense	53.0	504749.0275471698	872964.8359087008	500.0	33413.0	92000.0	396645.84	4141102.0
23 - 24	direct expense	11.0	7691875.363636363	15384077.609941307	82157.0	257405.0	1709293.0	4524430.0	51161074.0
23 - 24	indirect expense	35.0	941505.1011428571	1744505.1554994949	42.37	28791.5	191485.61	846712.0	8162481.0

Figure 4.3 : descriptive statistics of expense


4.3 As the above table shows,

1. Direct expenses show significant variability across all years, with very high standard deviations. For instance, in 21-22, the mean direct expense is Rs. 50,86,518 with a standard deviation of Rs.1,24,89,377, and in 23-24, the mean is Rs. 76,91,875 with a standard deviation of Rs.1,53,84,078. This variability might be due to high-value direct expenses such as total salaries, whereas expenses like PF and ESI for employees are relatively low.
2. Indirect expenses are more stable and predictable than direct expenses, as indicated by their lower standard deviation values. This means that indirect expenses vary less around the mean. Since the mean of indirect expenses is consistently lower, even similar standard deviation values represent a smaller proportion of the mean, making them appear more consistent. Furthermore, the tighter quartile spread of indirect expenses highlights their lower variability and greater predictability compared to direct expenses.

5 Analysis Method

5.1 Data extraction : The data was initially collected as Tally files. Using the export option in Tally software and configuring the necessary details, the data was converted into Excel sheets. These sheets were then transferred to Google Sheets for convenience.

5.2 Data cleaning and preparation : The service charges data and client-related data (location and type of power plant) were combined using the VLOOKUP formula. The date column was converted to the YYYY-MM-DD format using the formula `=TEXT(DATE(RIGHT(A1,4), MID(A1,4,2), LEFT(A1,2)), "yyyy-mm-dd")`. Additionally, two new columns, month number (`=MONTH(A1)`) and year (`=YEAR(A1)`), were derived from the date column. An App Script was employed to create the Inland/Foreign column. The expenses were then summarized using the SUM functions.

App script used :  app script.JPG

5.3 Segmentation of data and Statistical analysis : The data has been segmented to perform descriptive statistics. The different segments considered are:

1. Distribution of service charges among different types of power plants (e.g., coal, thermal, etc.).
2. Distribution of service charges between projects inside and outside India.
3. Distribution of expense amounts over various financial years.

5.4 Pivot table : The pivot table has been plotted to analyze the result of descriptive statistics and perform quantitative analysis for the above mentioned segments. The rows show the different segments and the column shows the distribution of the amount for each segment. This was very crucial for generating the insights which are mentioned in the forthcoming section.

5.5 Data visualization : Excel charts and libraries like Pandas and Matplotlib were used to plot the required graphs and show the data trends within various segments.

6 Analysis Process (Findings)

1. We find there is quite the imbalance between the frequency of the clients and the revenue trend. Coal and thermal power plants make up 78.8% of the total clients but only contribute 33% to the overall turnover. In contrast, hydro, gas engine/turbines, and steel millet power plants, which constitute only 10% of the total clients, contribute a significant 52% to the overall turnover.

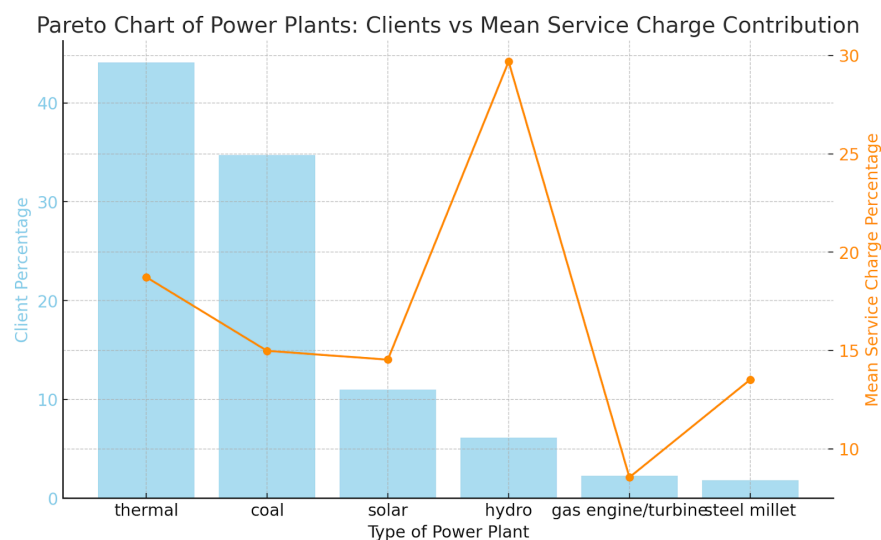


Figure 6.1 : Pareto chart - Type of power plant vs mean service charge

2. Although the count of inland clients is much higher (982 vs. 153), the higher mean service charge for foreign clients indicates that foreign projects might be more lucrative. The box plot for foreign clients shows a higher median service charge and a wider range of values compared to inland clients.

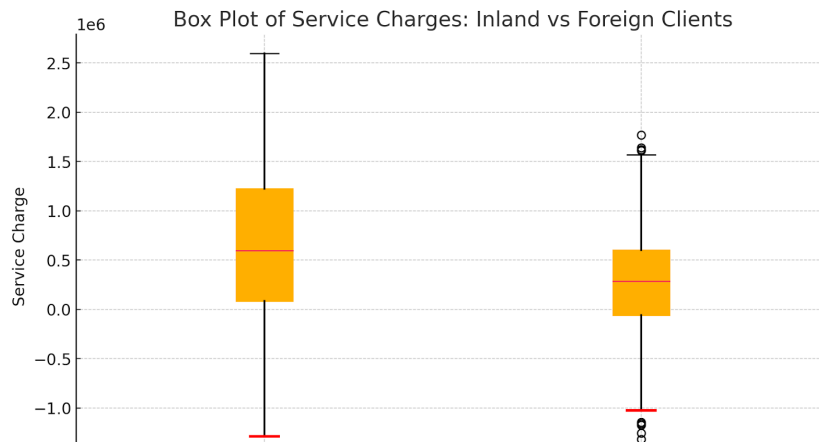


Figure 6.2 : Box plot - Inland/Foreign vs Service charge received

3. The year-wise expenditure is depicted in the stacked bar chart below. It indicates that indirect expenditures have remained relatively consistent, whereas direct expenditures, such as salaries and engineer offloading, have significantly increased in the most recent financial year.

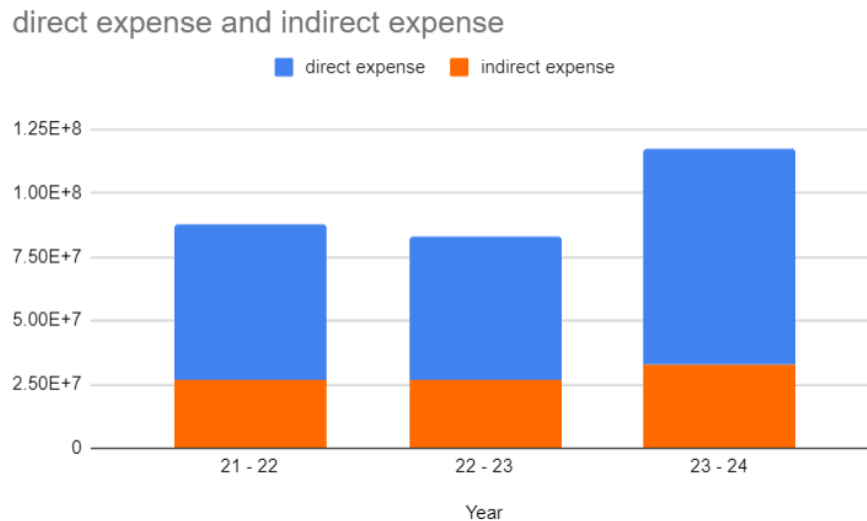


Figure 6.3 : Stacked bar chart - Year vs expense

4. A total of 6.4 clients have not yet repaid their service charges.
 - a. **Inland Clients:** 87.2% of the total loss is attributed to inland clients, with significant contributions from states like Gujarat, Tamil Nadu, and Maharashtra.
 - b. **Foreign Clients:** Only 12.8% of the total loss comes from foreign clients, with the Philippines being the sole foreign country with unpaid amounts. No other foreign country has pending payments.

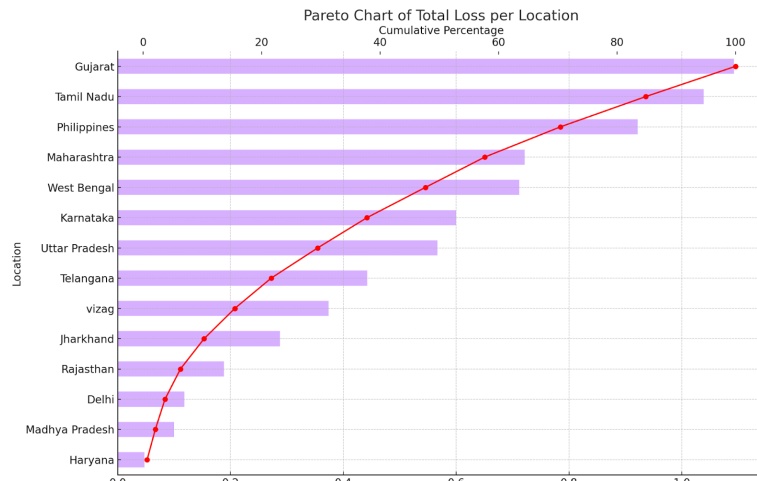


Figure 6.4 : Pareto chart - Location vs cumulative percentage of loss

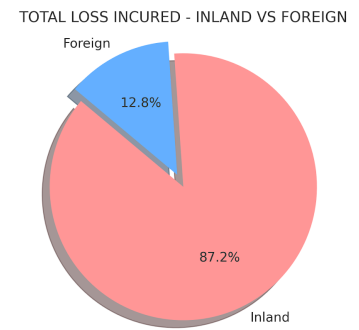


Figure 6.5 : pie chart

7 Results and Conclusion

7.1 The coal and thermal power plants constitute 78.8% of the total clients but contribute only 33% (on average) to the overall turnover. In contrast, hydro, gas engine/turbines, and steel mill power plants make up only 10% of the total clients but contribute 52% (on average) to the overall turnover.

7.2 Foreign markets are lucrative due to higher mean service charges compared to the Indian market. This is partly because charges in foreign markets are billed in dollars, which, when converted to Indian rupees, significantly increases the amount. Another reason to focus on market expansion in foreign countries is that foreign clients incur fewer losses for the company.

7.3 The overall expenditure and direct expenses have surged in the past year, while indirect expenses have remained steady. This spike in expenditure isn't necessarily a negative indicator; it could signify the company's growth and expansion. To understand this better, we need to delve deeper into the data and conduct further analysis.