Enhancing Global Competitiveness in Machinery Manufacturing: A Strategic Case Study of Macse Enterprises

A Mid-term report for BDM capstone Project

Submitted by:

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1. Executive Summary:

Macse Enterprises, a B2B machinery manufacturing and trading company headquartered in Patna, Bihar, is facing two major business challenges: low customer retention and declining profit margins. This study aims to analyze key business data to identify trends and patterns affecting customer engagement and financial performance.

This **mid-term submission** presents preliminary findings based on primary data collected through surveys and direct interactions with the company founder. The data collection process includes structured interviews with management, employees, and customers, supplemented by on-site photographs and video documentation.

The analysis leverages metadata and descriptive statistics to evaluate business performance indicators. Key metrics such as customer retention rates, sales volume trends, and revenue patterns are examined using statistical methods to derive meaningful insights. These methods are chosen for their ability to summarize complex datasets and extract actionable business intelligence.

Preliminary findings reveal distinct patterns in customer behavior, supply chain inefficiencies, and pricing strategies impacting profit margins. Graphical representations and data visualizations illustrate these trends, offering a clearer understanding of the business landscape.

Future steps include refining these insights through advanced analytics and proposing data-driven strategies to enhance business operations. The final submission will present a comprehensive report with in-depth conclusions and actionable recommendations to improve customer retention and profitability.

2. Proof of originality of the Data:

2.1. Letter from organization in letter head with stamp and sign (Drive Link):

https://drive.google.com/file/d/1CkXYeePql1IqbPFDb4cev4E5KWV1Yhrv/view?usp=drive_link

2.2. Images of the firm (Drive Link):

https://drive.google.com/drive/folders/1T1rGdXc0D4Y3RZw-A6tFgTxhHyepJ7V9?usp=sharing

Storage Area

2.3. Images of data (snapshot) Drive Link:
https://drive.google.com/drive/folders/1P_A2J2QxIRDzFJIunmaeIEXeGKGWWk3J?usp=drive_link

2.4. A short video 3-8 mins interacting with the founder (Drive Link):
https://drive.google.com/file/d/1V4GWQ8efUbEXU-MeSgn7PExDE7KyfPOz/view?usp=drive_link
Transcribe file link:https://drive.google.com/file/d/1ufmrGi2rZLVQERS3M8-ShShsLGEaVVkg/view?usp=drive_link

3. Metadata:

Metadata Summary

Metric	Value
Total Records	165
Total Customers	79
Total Orders	165
Total Sales (INR)	₹2,79,52,100
Average Order Value (INR)	₹1,69,407
Repeat Customers	19
Repeat Customer Rate (%)	24.05%
Customer Churn Rate (%)	75.95%
Average Profit Margin (%)	5.67%
Top-Selling Product	Iron Automatic Wire Nails Making Machine
Least-Selling Product	Single Die Automatic Paper Plate Making Machine
Most Profitable Product	Notebook Paper Stitching Machine
Least Profitable Product	3 Hp Pulverizer Machine

3.1 General Business Metadata:

- The dataset contains 165 sales transactions from 79 unique customers, generating total revenue of ₹2.79 crore.
- The average order value is ₹1.69 lakh per transaction.

3.2 Customer Retention & Churn Metadata:

- Only 24.05% of customers are repeat buyers, while 75.95% are one-time customers, indicating low retention.

3.3 Profitability Metadata:

- The average profit margin is 5.67%, reflecting low profitability.
- The Notebook Paper Stitching Machine is the most profitable, while the 3 Hp Pulverizer Machine has the lowest margin.

3.4 Product Sales & Demand Metadata:

- The Iron Automatic Wire Nails Making Machine is the top-selling product, while the Single Die Paper Plate Making Machine has the least demand.

4. **Descriptive Statistics:**

Metric	Quantity	Purchase Price (₹)	Selling Price (₹)	Total Sale (₹)
Count	165	165	165	165
Mean	1.47	1,08,521	1,14,712	1,69,407
Std Dev	0.50	93,743	98,308	1,66,406
Min	1	40,000	41,500	41,500
25th %	1	50,000	53,000	75,000
50th %	1	70,000	75,000	1,06,000
75th %	2	1,25,000	1,31,000	1,73,000
Max	2	3,80,000	4,00,000	8,00,000

4.1. **Measures of Central Tendency (Average values of data)**

- **Mean (Average Value):**
  - **Quantity:** 1.47 (On average, customers purchase around 1 to 2 machines per transaction.)
  - **Purchase Price:** ₹108,521 (The average cost at which machines are procured.)
  - **Selling Price:** ₹114,712 (The average price at which machines are sold.)
  - **Total Sale Value:** ₹169,406 (The mean total revenue per transaction.)
- **Median (50th Percentile):**
  - This is the middle value that divides the dataset into two halves.
  - The median purchase price is ₹70,000, indicating that most purchases are around this price.
  - The median selling price is ₹75,000, meaning that nearly half of all sales occur below ₹75,000.

4.2. Measures of Dispersion (How data is spread out)

- **Standard Deviation (Std):**
  - Indicates how much values vary from the mean.
  - The standard deviation for purchase price is ₹93,743, which means there is a wide variation in machine costs.
  - The selling price standard deviation is ₹98,308, showing similar variability in selling prices.
- **Range (Min & Max):**
  - Purchase price ranges from ₹40,000 to ₹380,000.
  - Selling price ranges from ₹41,500 to ₹400,000.
  - Total sale values vary from ₹41,500 to ₹800,000.

4.3. Quartile Analysis (Distribution of values)

- **25th Percentile (Q1):**
  - 25% of purchase prices are below ₹50,000.
  - 25% of selling prices are below ₹53,000.
- **50th Percentile (Q2/Median):**
  - 50% of purchase prices are below ₹70,000.
  - 50% of selling prices are below ₹75,000.
- **75th Percentile (Q3):**
  - 75% of purchase prices are below ₹125,000.
  - 75% of selling prices are below ₹131,000.

5. Detailed Explanation of Analysis Process/Method and Justification:

The analysis of **Macse Enterprises' business data** follows a structured approach that combines **metadata evaluation, descriptive statistics, and Pareto analysis** to extract meaningful insights. Given the primary challenges of **low customer retention and declining profit margins**, the chosen methods provide a **comprehensive and data-driven framework** to assess underlying trends, identify key business patterns, and recommend actionable strategies.

5.1 Metadata Analysis:

Metadata provides critical information about the dataset, including data attributes, structure, sources, and definitions. For this study, metadata analysis helps in understanding customer details, sales transactions, and pricing data. This is essential for ensuring data accuracy, consistency, and relevance to the business problem. By establishing a clear data framework, metadata supports efficient data preprocessing and minimizes the risk of misinterpretation.

5.2 Descriptive Statistics:

Descriptive statistics are employed to quantify and summarize business performance metrics, including:

- **Customer Retention Rate** – Measures the proportion of returning customers.
- **Sales Trends** – Analyzes variations in sales volume over time.
- **Revenue & Profit Margins** – Examines pricing structures and overall profitability.

Key statistical measures such as mean, median, standard deviation, and quartiles help identify deviations, anomalies, and central tendencies. These measures offer a high-level view of business health, enabling Macse Enterprises to pinpoint critical operational inefficiencies.

5.3 Pareto Analysis (80/20 Rule):

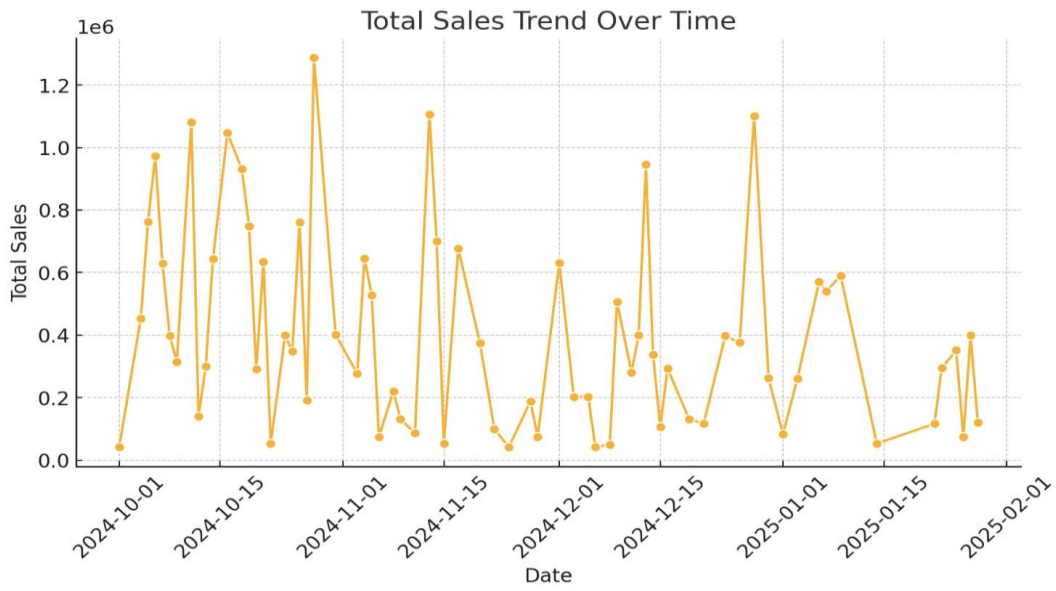
The Pareto Principle suggests that 80% of business outcomes stem from 20% of contributing factors. In this context, Pareto analysis is used to identify:

- The **top 20% of customers contributing to 80% of total sales**.
- The **key factors impacting customer churn and low retention**.
- The **most profitable product segments driving revenue**.

5.4 Data Preprocessing & Justification for Method Selection:

The dataset was preprocessed by handling missing values, removing duplicates, and standardizing price data. Descriptive statistics were chosen over predictive modeling due to limited historical data, with potential future use of clustering for customer segmentation. Using metadata, descriptive statistics, and Pareto analysis, the study ensures practical insights, accuracy, and ease of interpretation for Macse Enterprises' mid-term evaluation.

6. Results and Findings:



6.1 Key Findings:

6.1.1 Total Sales Insights

- The **average total sale per transaction** is **₹169,407**, indicating that most purchases involve high-value machinery.
- Sales range between **₹41,500 (minimum) and ₹800,000 (maximum)**, showing a **wide variation in customer spending**.

- The **median sales value is ₹106,000**, meaning that more than half of the transactions are on the lower side of the range.
- **Trend Observation:**
    - The **line chart** reveals that sales follow a fluctuating pattern, with noticeable peaks in certain months.
    - The **sales spikes** indicate periods of increased demand, possibly due to seasonal factors, industry trends, or promotional campaigns.
    - **Low sales periods** could be linked to external influences such as business slowdowns, budget constraints, or lack of marketing efforts.
- **Why is this happening?**
    - The demand for machinery could be tied to seasonal business expansion cycles or government subsidy disbursements, leading to spikes in purchases during specific months.

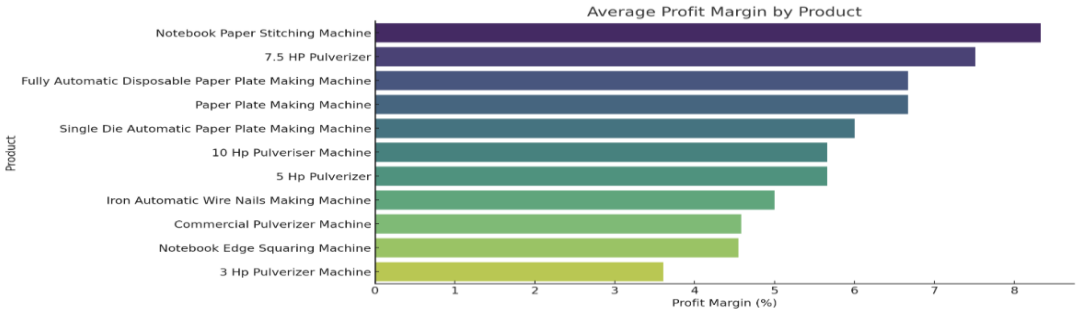
6.1.2 Profit Margin Analysis

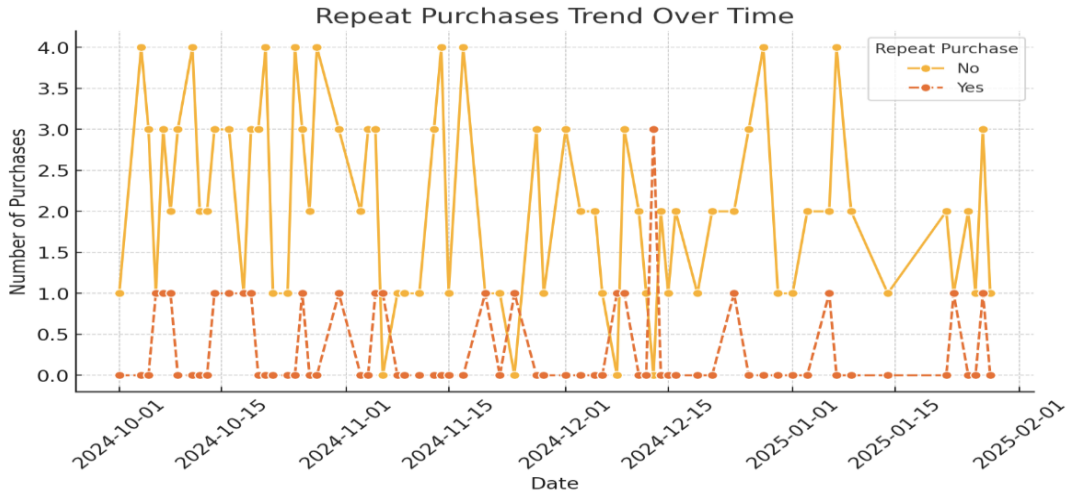
- The **average profit margin** is **5.67%**, with a range between **3.61% and 8.33%**.
- This suggests that while **some products have higher profitability**, others operate on **thin margins**.
- **Trend Observation:**
    - **Higher-margin products** tend to be niche, specialized machines that are **less price-sensitive** and **offer greater value-addition to customers**.
    - **Lower-margin products** are likely **commodity-type** machinery with higher competition, leading to **price pressure and reduced profitability**.
- **Why is this happening?**
    - Products like the **Notebook Paper Stitching Machine (8.33%)** and **7.5 HP Pulverizer (7.51%)** have **higher margins** due to **unique features, limited competition, or higher perceived value**.
    - Products like the **3 HP Pulverizer Machine (3.61%)** have lower margins, possibly due to **price sensitivity and multiple alternatives in the market**.

6.1.3 Customer Retention & Repeat Purchases

- **Only 22 out of 165 transactions (13%) are repeat purchases**, indicating a **low customer retention rate**.
- **Trend Observation:**
    - Customers tend to make **one-time purchases**, and **repeat purchases are infrequent**.
    - **There are occasional spikes**, but the **overall trend suggests most customers do not return for additional purchases**.
- **Why is this happening?**
    - The company sells **heavy machinery**, which has a **long lifecycle** and is **not frequently replaced**.
    - Customers may prefer to **diversify their suppliers** rather than relying on a single vendor.

- Lack of **loyalty programs or post-sale engagement** could be limiting retention.



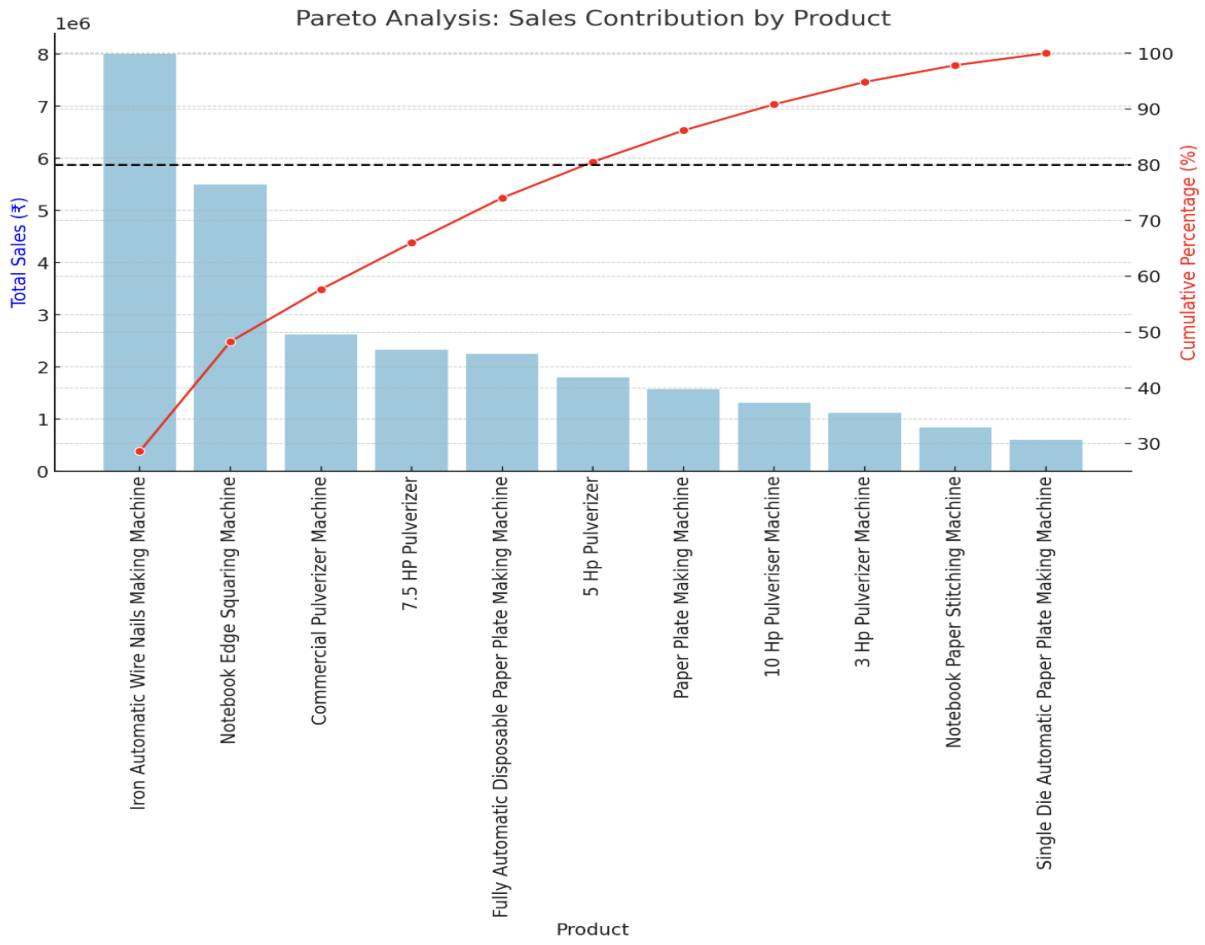


6.2 Profitability by Product (Insights)

- **Most Profitable Products:**
  - Notebook Paper Stitching Machine (8.33% profit margin)
  - 7.5 HP Pulverizer (7.51% profit margin)
  - Fully Automatic Disposable Paper Plate Making Machine (6.67% profit margin)
- **Least Profitable Products:**
  - 3 HP Pulverizer Machine (3.61% profit margin)
  - Notebook Edge Squaring Machine (4.55% profit margin)
  - Commercial Pulverizer Machine (4.58% profit margin)
- **Trend Observation:**
  - High-margin products are either specialized machinery or high-value automated systems.
  - Lower-margin products are likely more commoditized**,** price-sensitive, and face high competition.

- **Why is this happening?**
    - Lower-margin products are price-competitive, requiring frequent discounting to close deals.
    - High-margin products may have lower competition and offer features that justify premium pricing.

6.3 Pareto Analysis (80/20 Rule):



6.3.1 Top Products Driving Sales (80% Contribution)

- **Iron Automatic Wire Nails Making Machine** → 28.62% of total sales
- **Notebook Edge Squaring Machine** → 19.68% of total sales (cumulative: 48.30%)
- **Commercial Pulverizer Machine** → 9.37% of total sales (cumulative: 57.67%)
- **7.5 HP Pulverizer** → 8.36% of total sales (cumulative: 66.03%)
- **Fully Automatic Disposable Paper Plate Making Machine** → 8.04% of total sales (cumulative: 74.07%)
- **Trend Observation:**

- Just 5 products generate nearly 74% of total revenue, following the **Pareto Principle (80/20 Rule)**.
- The remaining products contribute only ~26% of total sales, meaning they have lower market impact.

- **Why is this happening?**
  - Certain products have strong market demand, while others are **niche or** secondary purchases.
  - Customers prefer widely used and versatile machines, leading to concentrated sales in a few categories.

6.4 Seasonal Sales Trends:

- **Trend Observation:**
  - Sales show a cyclical pattern, with peaks in specific months.
  - The spikes correlate with financial quarters, suggesting corporate and industrial buyers may be making purchases at year-end or quarter-end.
  - Some months show significant sales drops, possibly due to low demand or lack of promotional efforts.
- **Why is this happening?**
  - Business buyers often allocate budgets at specific times of the year, leading to concentrated purchase periods.
  - Certain products may be in higher demand due to external factors, such as infrastructure projects or government grants.