Analyzing Market Trends, Workforce Dynamics, and Customer Loyalty for Growth in a Hardware and Electronics Retail Business

A Mid-Term report for the BDM capstone Project

Submitted by

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Declaration Statement

I am working on a Project titled “Analyzing Market Trends, Workforce Dynamics, and Customer Loyalty for Growth in a Hardware and Electronics Retail Business”. I extend my appreciation to Mahavir Enterprise, for providing the necessary resources that enabled me to conduct my project.

I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered through primary sources and carefully analyzed to assure its reliability.

Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures.

I am dedicated to adhering to the information of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report.

I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority.

I agree that all the recommendations are business-specific and limited to this project exclusively, and cannot be utilized for any other purpose with an IIT Madras tag. I understand that IIT Madras does not endorse this.

Signature of Candidate: (Digital Signature)

Name:Aaditya sawant
Date: 25/12/2024

1 Executive Summary :

Mahavir Enterprise, a hardware and electrical components supplier in Bhandup, Mumbai, faces challenges in labor efficiency, inventory management, and balancing B2B and B2C sales.. The authenticity of the data was verified through a letter of authorization, videos, and photographs from the store. Metadata and descriptive statistics required data collection involving gathering attendance logs and sales records from January 2021 to December 2024. Data cleaning ensured accuracy by removing duplicates, handling missing values, and correcting inconsistencies.

A scatter plot analysis revealed a positive correlation between employee working hours and monthly gross profit margin, highlighting the impact of workforce productivity on profitability. Measures such as mean, median, variance, and standard deviation were used to assess workforce trends and financial stability.A full stacked bar graph analyzed shifts from older to newer product models, showing declining older B2C sales and rising new B2B sales, emphasizing the need for strategic inventory management and marketing efforts. A time-series line graph highlighted sales fluctuations due to operational policy changes, particularly the introduction and reversal of the Monday-off policy in 2022, confirming its negative impact on revenue.

Python libraries like Pandas, NumPy, Matplotlib, and Seaborn were used for inferential analysis. Code implementations measured sales variations, revealing high fluctuations in new B2B products.By leveraging these insights, Mahavir Enterprise can optimize workforce policies, refine inventory strategies, and enhance marketing approaches. Predictive analytics can aid decision-making, ensuring sustainable growth and profitability.

2. Proof of Originality:

All of the items listed below can be found here link to the Google Drive folder

23f3001416 project bdm

The primary data collected is saved in this spreadsheet: 233f3001416 bdm project.xlsx

A compressed video capturing a brief interaction with the business owner is shared here:

23f3001416 bdm project video.mp4

A scanned letter permitting the use of data for this project is linked here:

23f3001416 bdm project permission letter.PNG

Additional photographs of the business site along with ipynb file are included in the link

3.METADATA AND DESCRIPTIVE STATISTICS

3.1 METADATA

After receiving consent, attendance records were collected in January through xerox. These records spanned from January 2021 to December 2024, covering the post-COVID period with the most up-to-date data available.Once digitized, key details about the dataset were noted. The data was organized in the "Attendance" tab of the workbook, consisting of a header row, two initial rows listing employee names and roles, followed by 48 rows of recorded attendance data. The dataset contained seven columns, each representing specific aspects of employee attendance.

A structured explanation of the spreadsheet's columns and their contents is provided in the table below. This format ensures a clear understanding of the data and supports further analysis of attendance trends in the post-pandemic years.

Table 1:Description of Primary Data

Variable Name	Data Type	Repetition	Description
Employee Name	Text	No	Name of the employees ,as it is a micro enterprise, names are not repeated.
Role	Categorical Text	No	Roles of the employees ,as it is a micro enterprise, roles are not repeated.
WH(in particular month)	Continuous Integer	Yes	Working hours of each employee in a particular month
Average employee working hours	Continuous Float	Yes	Average working hours of employees in the particular month
Monthly gross profit margin (in lacs)	Continuous Float	Yes	Monthwise net profit earned by the enterprise

Dataset is structured to show each employee's working hours per month from January 2021 to December 2024. This detailed breakdown allows for a precise assessment of individual working patterns over time. The employee-wise division helps in identifying any fluctuations in work hours that could impact productivity and overall business efficiency.In addition to tracking working hours, the dataset includes monthly gross profit margins (in lakhs) to establish a direct relationship between employee labor and financial performance. By analyzing this connection, the study can determine whether changes in working hours influence profitability.

Sales inventory records were collected for the post-COVID period up to the present, as pre-COVID data was unavailable. This dataset, recorded in the **"Sales"** sheet of the workbook, captures product sales over time.The sheet consists of a **header row** listing the top four categories of both traditional and modern products, each further divided into **B2B and B2C** segments. Additionally, a **frozen column** contains financial quarters from the last four years, ensuring easy reference while scrolling.

In total, the sheet comprises **17 rows and 17 columns**, with each cell representing the quantity of a specific product sold in a particular financial quarter. A structured explanation of the spreadsheet's columns and their contents is provided in the table below. This format enhances clarity and supports a detailed analysis of sales trends in the post-pandemic years.

Table 2:Description of Primary Data

Variable Name	Data Type	Repetition	Description
Product name	Categorical and Binary Text	No	Product is classified into its traditional and updated model and further into B2B and B2C model
Financial Period	Discrete Integer	No	Four financial quarters in year-16 in total

Spanning from Q1 2021 to Q4 2024, it provides insights into how sales of newer models compare to older versions still available in the market.By incorporating both B2B and B2C segments, the data offers a comprehensive view of how each product performs across different customer bases. This contrast between old and new models helps assess market shifts, adoption trends, and business strategies, revealing how effectively the industry balances traditional and modern offerings in the evolving marketplace.

3.2 DESCRIPTIVE STATISTICS

	Average employee working hours	Monthly gross profit margin (in lacs)
Std Deviation	31.76356329	0.7111074172
Variance	1008.923953	0.5056737589

	Average employee working hours	Monthly gross profit margin (in lacs)
Average	358.484375	1.666666667
Median	360.125	1.55
Mode	-	1

Table 3:Measure of Spread and Central Tendency of Avg employee WH and Monthly gross profit margin (in lacs)

Category	Mean	Median	Mode	Standard Deviation	Variance
Older B2B Model	95	85.5	50	40.63	1650.8
Older B2C Model	52.63	43.5	40	23.63	558.25
New B2B Model	176.88	165	43	92.11	8484.38
New B2C Model	93.69	86.5	27	50.62	2562.36

Table 4:Measure of Spread and Central Tendency of different business models

The descriptive statistics of employee working hours , monthly gross profit margins,and different business models include key measures like mean, median, mode, standard deviation, and variance. The mean represents the average value, while the median, the middle value in an ordered dataset, is less affected by outliers. The mode identifies the most frequently occurring value, though it may not always be present. The standard deviation measures how much data points deviate from the mean, indicating variability. The variance, as the square of the standard deviation, quantifies this spread.

The average working hours exhibit left skewness since the median is greater than the mean. In contrast, all other variables, including the monthly gross profit margin across the four business models, display right skewness, as their means exceed their medians, indicating the presence of higher extreme values pulling the mean upward.

4.ANALYSIS PROCESS METHOD:

4.1 DATA COLLECTION:

The data collection process involved analyzing attendance logs and inventory sales records to address the business problem. Meetings were conducted on January 9, 11, and 29, 2025 to ensure clarity and relevance of the data.

- The first meeting introduced the project and aligned expectations with stakeholders.
- The second meeting refined the problem statement through a video presentation.
- The third meeting finalized the selection of relevant data for analysis.

After proposal approval, its originality was verified through documented records on January 29. Data was gathered from multiple sources, including order numbers, work-related metrics, and financial

records. Employee attendance data captured entry and exit times, while inventory records categorized sales as either B2B (business-to-business) or SHOP (direct local sales). Additionally, gross profit per month (2021 onward) was recorded to analyze revenue trends alongside labor input (attendance).

4.2 DATA CLEANING:

To ensure data accuracy, rigorous cleaning measures were implemented during collection and entry. Proper lighting conditions were maintained to prevent transcription errors, and unclear or inconsistent entries were removed without affecting dataset integrity. Missing values were imputed using the mean, applied selectively where necessary.

Monthly working hours, recorded for salary calculations by Mr. Vijay, were verified before inclusion. The dataset primarily focused on inventory sales, particularly older models experiencing declining demand. MS Excel's data validation was used to standardize data types, ensuring consistency. Duplicate entries were eliminated, outliers assessed for anomalies, and formatting inconsistencies corrected to preserve data integrity and minimize errors in subsequent analysis.

4.3 ANALYSIS METHODS:

After data collection and cleaning, data analysis is being conducted to examine patterns, trends, and correlations. Actionable insights are being derived to enhance business decisions, optimize operations, and improve profitability. A deeper understanding of key performance indicators is achieved through visual tools such as graphs and statistical methods. The following methods have been implemented

4.3.1 Descriptive Statistics for Sales Performance

- Mean, median, variance, and standard deviation are used to measure central tendency and data spread.
- A statistical summary is generated using Python (Pandas library) to evaluate sales performance across different business models.

4.3.2 Trend and Comparative Analysis through Visualization

- A scatter graph is created to document the average working hours vs.monthly gross profit margin in lacs, allowing better visualization of business trends.
- A full-stacked bar chart is used to compare older vs. newer product models and their B2B vs. B2C sales distribution. This chart effectively highlights the shift from outdated to modern components, showing market trends and adoption rates.
- Line graphs are plotted using Matplotlib to illustrate sales trends over financial periods, identifying growth patterns and the impact of policy changes.

4.3.3 Inferential Analysis for Business Insights

- Using NumPy and Pandas, inferential statistics assess fluctuations in sales before, during, and after policy changes.
- The variance in different sales categories (e.g., New B2B, Older B2C) helps determine demand stability, with New B2B showing the highest variance, indicating fluctuating demand.
- Mode values reveal the most frequent sales figures, highlighting varying adoption rates of newer models. Older B2B peaked at 50 units, whereas New B2C's most common value was 27.

4.3.4 Regression for Predictive Analysis (To be included in final term)

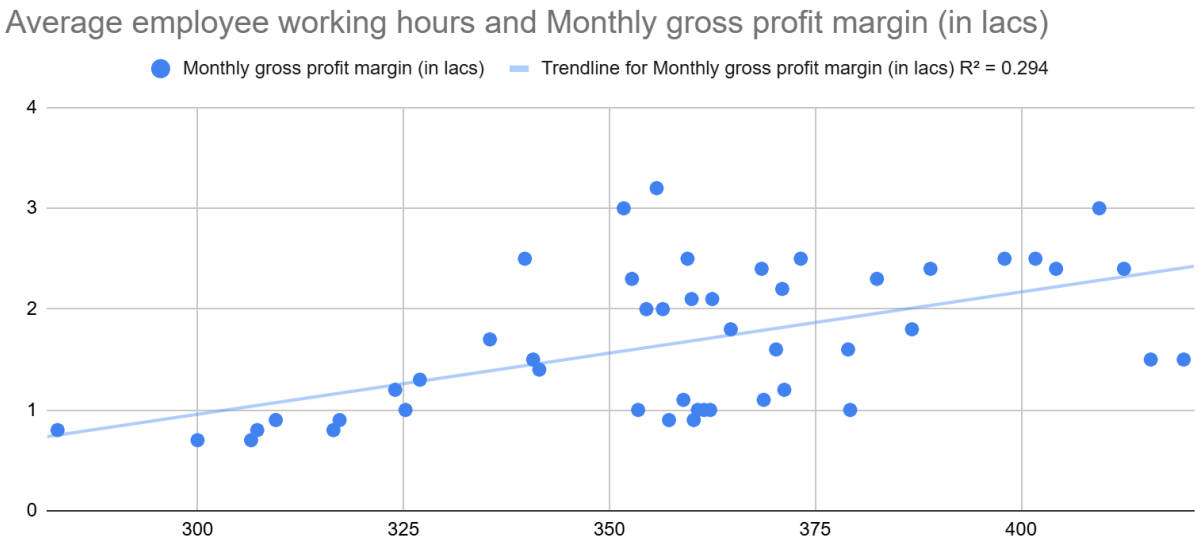
- Regression techniques to be used to model relationships between key variables, such as sales and inventory holdings dependent on financial quarters and employee working hours and gross profit margin (as seen in Scatter Graph 1).
- This method can help forecast future trends by analyzing correlations for improving business performance.

These methods provide a structured approach to analyzing business performance. The corresponding codes and visualizations are detailed in **Section 5**, where findings and graphical representations validate the analysis.

5.RESULTS AND FINDINGS:

The analysis aims to evaluate business performance by examining sales trends, employee work policies, and product transitions over time. By integrating Excel-based visualization with Python-powered inference, we uncover how various factors influence profitability. The findings are supported by graphical representations, statistical calculations, and trend evaluations to extract meaningful insights.

A scatter plot is chosen to visualize the relationship between average employee working hours and monthly gross profit margin from January 2021 to December 2024 because it effectively shows correlations between two continuous variables. The graph helps identify trends, clusters, and outliers in the data.

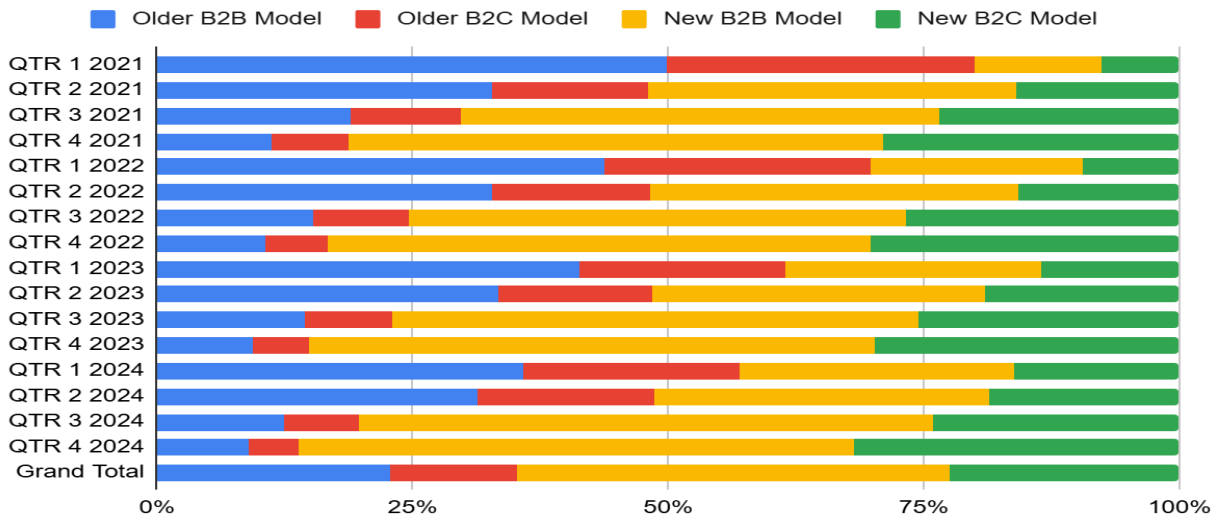


Graph 1:Scatter Graph of Avg employee WH vs Monthly gross profit margin (in lacs)

The trendline suggests a positive correlation, showing that increased working hours generally lead to higher profits and vice versa.

A full stacked bar chart is used to show the shift from outdated to modern components while distinguishing B2B and B2C sales.By making a pivot table and adding the particular columns and values the sheet ‘old vs new,b2b vs b2c’ was documented. This chart type highlights proportional changes, making it easy to see how businesses and consumers have adopted new technologies.

Graph 2:100% Full Bar stack Graph of different business models vs financial period

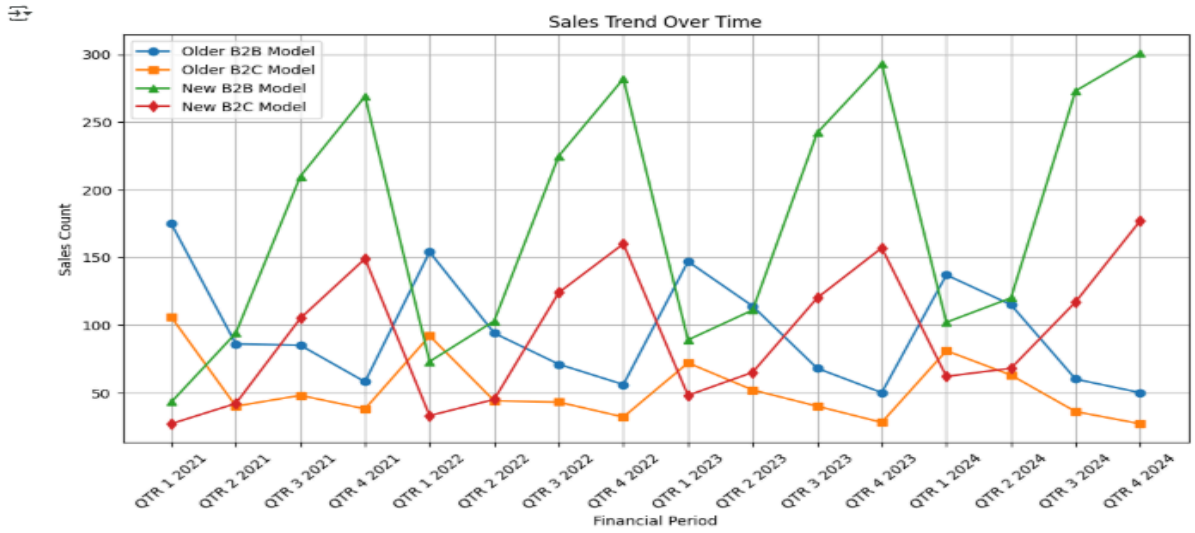


The analysis revealed distinct trends in sales performance across different business models. The full-stacked bar chart effectively compares older vs. newer product models and their B2B vs. B2C sales distribution across financial quarters. It highlights the shift from traditional models to modern alternatives.The older B2B model showed a declining trend, while the new B2B model exhibited significant growth, suggesting a strategic shift towards newer offerings. Similarly, the older B2C model experienced a decline, whereas the new B2C model gradually gained traction, indicating changing consumer preferences.The variance is highest in New B2B(8484) , indicating fluctuating demand, whereas it is more stable. The mode values show that Older B2B peaked at 50 units, while New B2C's most common value was 27, emphasizing the varying adoption rates of newer models.A larger new component share indicates a market shift, while the B2B vs. B2C ratio reveals whether businesses or consumers drive adoption.

During discussions with Mr. Vijay, it was reported that in 2022, a Monday off policy was implemented to improve work-life balance. However, declining sales led to a revision within six months, introducing a half-day Monday instead. As profits continued to decline, the company eventually reverted to a full workweek within the next two quarters to stabilize revenue and meet customer demand. A line graph is used to track sales trends across financial quarters and methods, particularly to assess the impact of policy changes and seasons.

Google Collab file containing the code needed to generate the following graph:

23f3001416 project bdm.ipynb



Graph 3:Line Graph of different business models sales count over financial quarters

The red dashed line (Q1 2022) marks when the Monday-off policy began.A sharp drop, proving that the policy negatively impacted sales.Post-2023 recovery aligns with policy reversal, indicating that employee availability directly affects sales.

Time-series analysis highlighted seasonal variations in sales, with Q4 consistently showing peak performance and Q3 high due to festive marketing. likely due to increased demand during the holiday season.Higher variance in Q2 & Q3 2022 shows instability in revenue.Mean sales values dropped during Monday-off quarters, confirming that the policy hurt business.Post-2022, mean B2B sales increased faster than B2C, indicating a shift in market focus.

This analysis explored sales trends, workforce policies, and product transitions using Excel-based visualizations and Python-powered statistical methods. A key finding was that the Monday-off policy in 2022 had a negative effect on sales, causing a sharp decline in revenue. While reversing the policy helped stabilize revenue, further optimization strategies are needed to balance workforce productivity and business growth.By examining historical data, we identified clear shifts in business performance, the impact of operational decisions, and seasonal variations in revenue.