

*"Improving Operational Efficiency and Customer Experience in
an RO Machine Store"*

A Final report for the BDM capstone Project

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1. Executive Summary

Rudra Enterprises, a local RO water purifier store located in **Shalimar Garden Extension 2, Sahibabad**, was founded by **Mr. Manoj Sharma** in 2005. The shop has built a **loyal customer base** over the years by offering **RO machine sales, water refills, and maintenance services**. Despite its strong foundation, the store has recently experienced a decline in performance due to **increased competition, operational inefficiencies, and inadequate stock management**.

This project focuses on addressing **two primary operational challenges** faced by Rudra Enterprises:

1. **Frequent customer complaints**, specifically regarding **water flow issues** and **float valve malfunctions**, which negatively impact customer satisfaction and service quality.
2. **Inconsistent availability of critical spare parts**, particularly float valves and carbon filters, which results in **service delays** and lost trust among repeat customers.

To understand and resolve these challenges, a **data-driven approach** was adopted. Over a year's worth of handwritten service and sales records were **digitized and structured using Excel**, while statistical analysis and trend visualization were carried out using **Python (Pandas, NumPy, Matplotlib)**. In addition, qualitative insights were gathered through **interviews with the shop owner** and **on-site observation** of operational workflows.

The analysis revealed several key findings:

- Most **complaints** were about **float valve failures** and **water flow issues**, usually within **6–8 months** of installation.
- Frequent **shortages of critical parts** like float valves and carbon filters led to **delays** in service.
- **Overstocking** of low-demand parts caused **capital to be locked** unnecessarily.
- **Sales and service requests peaked in summer**, emphasizing the need for **seasonal inventory planning**.

Based on these findings, the report offers several targeted recommendations:

- Launch **preventive maintenance plans** to reduce post-sale issues.
- Use an **Excel-based inventory system** to manage stock efficiently.
- Analyze **complaint trends** to plan spare part restocking.
- Improve **installation quality control** to prevent early failures.
- Strengthen **customer communication** for better service experience.

By adopting these solutions, Rudra Enterprises can significantly improve its **operational efficiency**, reduce **customer dissatisfaction**, and gain a **competitive edge** in the local market.

2. Detailed Explanation of Analysis Process

2.1 Data Collection

The data for this study was obtained from Rudra Enterprises, a business specializing in the sales and service of RO water purifiers. The **primary data source** was **handwritten sales and service logs** maintained from **January 2024 to December 2024**, which were transcribed into a structured Excel format for further analysis.

To supplement the quantitative data, qualitative insights were gathered through a **structured interview with Mr. Manoj Sharma**, the business owner. This helped understand patterns in **customer complaints, sales fluctuations, and spare part demand**.

The compiled dataset includes the following:

- **Sales Data:** Number of RO units sold monthly, categorized by **RO brand** (e.g., Swift, Aqua).
- **Service Data:** Types of service requests including **installation, maintenance, and spare part replacement**.
- **Complaint Data:** Most common issues (e.g., **Water Flow, Float Valve Malfunction**) and their **resolution time** based on part availability.

- **Inventory Data:** Spare part stock levels vs. estimated annual demand.
- **Profitability Metrics:** Total amount and profit earned per transaction, captured for both product sales and services.

The combination of handwritten records and owner insights allowed for a comprehensive view of **inventory gaps**, **sales seasonality**, and **service inefficiencies**. Inconsistencies such as missing fields or duplicated service types were addressed during transcription to maintain data reliability.

2.2 Data Description

The dataset analyzed in this study consists of **structured business records** from **Rudra Enterprises**, covering sales, services, and profitability trends over **one year (Jan 2024 – Dec 2024)**. This data has been categorized and cleaned for deeper analysis of the business's **operational, financial, and service performance**.

RO Sales Data: [Click here](#)

- **Dataset Overview:** The dataset contains monthly sales data of RO units, service requests, inventory stock levels, and profitability figures to assess business trends and operational efficiency.
- **Time Period Covered:** The records span from **Jan 2024 to Dec 2024**, capturing seasonal variations and long-term trends.
- **Data Source:** The data has been collected from handwritten logbooks maintained by Rudra Enterprises, which were transcribed into a structured Excel format for analysis.
- **Primary Objective:** The dataset is utilized to analyze sales trends, assess service performance, evaluate inventory management efficiency, and identify profitability patterns. These insights are crucial for improving decision-making and business operations.

Contents of the Data:

The dataset consists of the following key attributes:

- **Date:** Specific day of sale or service.
- **Month:** Month of sale/service for trend analysis.
- **Customer Name:** Name of the customer (if available).
- **Service Type:** Whether the request was for installation, maintenance, or spare part replacement.
- **RO Brand:** The brand of the RO unit (e.g., Aqua, Swift).
- **Quantity:** Number of units sold or services performed.
- **Total Amount:** Revenue earned per transaction.
- **Profit:** Profit generated from each sale/service.

By systematically organizing and analyzing these records, the dataset provides valuable insights into **inventory planning, complaint resolution efficiency, and sales performance**, helping Rudra Enterprises improve its operations and service efficiency.

2.3 Data Cleaning and Preprocessing

The process of data acquisition was a significant time-intensive effort that involved gathering handwritten financial records from the shop. Given the manual nature of record-keeping, the data was scattered and required thorough validation before analysis. The primary challenge in this phase was ensuring that all transactions were accurately recorded and free from inconsistencies.

- **Data Digitization:** The handwritten records were systematically transcribed into Excel to create a structured digital dataset.
- **Error Handling:** Missing values were identified and addressed through logical imputation or exclusion where necessary.

- **Duplicate Removal:** Redundant records were filtered out to prevent skewed analysis results.
- **Standardization:** Dates, product brand, and service descriptions were formatted uniformly for seamless interpretation.
- **Categorization:** The dataset was organized into meaningful groups (e.g., sales, services, and profit) to facilitate efficient analysis and visualization.

2.4 Data Analysis Techniques

A comprehensive set of analytical techniques was applied to derive meaningful insights from the dataset.

1. Complaint Frequency Analysis

Customer service records were analyzed to identify the most frequent issues reported by clients. The analysis revealed that **water flow problems** and **float valve malfunctions** accounted for the **majority of complaints**. These issues typically emerged within **6 to 8 months** of product use, indicating gaps in installation quality and post-sale maintenance. Visualizations, such as bar charts, were used to highlight the frequency of each complaint type. These insights help in identifying recurring problems that require urgent process improvements or better spare part planning.

2. Inventory vs. Demand Mapping

A comparison of current stock levels and estimated annual demand was conducted using descriptive analytics. Critical spare parts like **float valves** and **carbon filters** were found to be understocked, whereas components like **sediment filters** and **solenoid valves** were overstocked. This mismatch led to delays in resolving customer complaints. The analysis helped classify items into three categories: **Shortage Risk**, **Balanced Stock**, and **Overstocked**, enabling smarter procurement planning. This inventory mapping directly links operational inefficiencies with customer service outcomes.

3. Service Turnaround Impact

Resolution time was evaluated in relation to part availability. Complaints involving **out-of-stock parts** had significantly longer turnaround times—often **3–5 days of additional delay**. This negatively impacted customer satisfaction and increased the likelihood of repeat complaints. Improved tracking of service requests and better stock alignment with common complaint types were identified as key strategies to reduce turnaround time and enhance service efficiency.

4. Sales Trend & Statistical Data Analysis

To establish a strong foundation for further analysis, **descriptive statistics** were applied to understand the distribution and variability of sales, profit, and quantity sold.

Statistical Summary of the Dataset:

Measure	Total Amount (₹)	Profit (₹)	Quantity Sold
Mean	₹3,738.15	₹1,213.72	1.11
Median	₹1,948.00	₹940.50	1.00
Mode	₹7,500	₹1,799	1
Standard Deviation	₹3,832.07	₹891.46	0.51
Minimum	₹541.00	₹440.00	1.00
Maximum	₹30,000.00	₹8,500.00	5.00
Skewness	3.43 (Positive)	5.57 (Positive)	5.82 (Positive)
Kurtosis	20.56 (High)	44.10 (High)	38.25 (High)

Fig 2.1

- **Central Tendency Measures:** The **mean sales amount is ₹3,738.15**, with an **average profit of ₹1,213.72** per sale. The **median and mode values indicate** that most transactions involve lower-priced products with relatively stable profit margins.
- **Variability & Dispersion:** The **high standard deviation** in sales and profit suggests significant fluctuations in transaction values.
- **Skewness & Kurtosis:**
 - **Positive skewness** indicates that most sales are on the lower side, but occasional

high-value transactions impact the overall trend.

- **High kurtosis** suggests the presence of outliers, meaning a few high-profit transactions dominate the dataset.

These insights help in identifying revenue-driving transactions, managing inventory effectively, and strategizing promotional efforts.

3. Results and Findings

3.1 Complaint Frequency

Most of the customer complaints were related to **water flow issues** and **float valve malfunctions**. These problems typically occurred **6–8 months after purchase**, indicating recurring technical issues that affect customer satisfaction and service quality. Service logs show that these complaints form the majority of service requests. Delays in resolving them were often caused by **unavailability of the required spare parts**, particularly **float valves and carbon filters**.

Pie chart – Customer Complaint Frequency by Type:

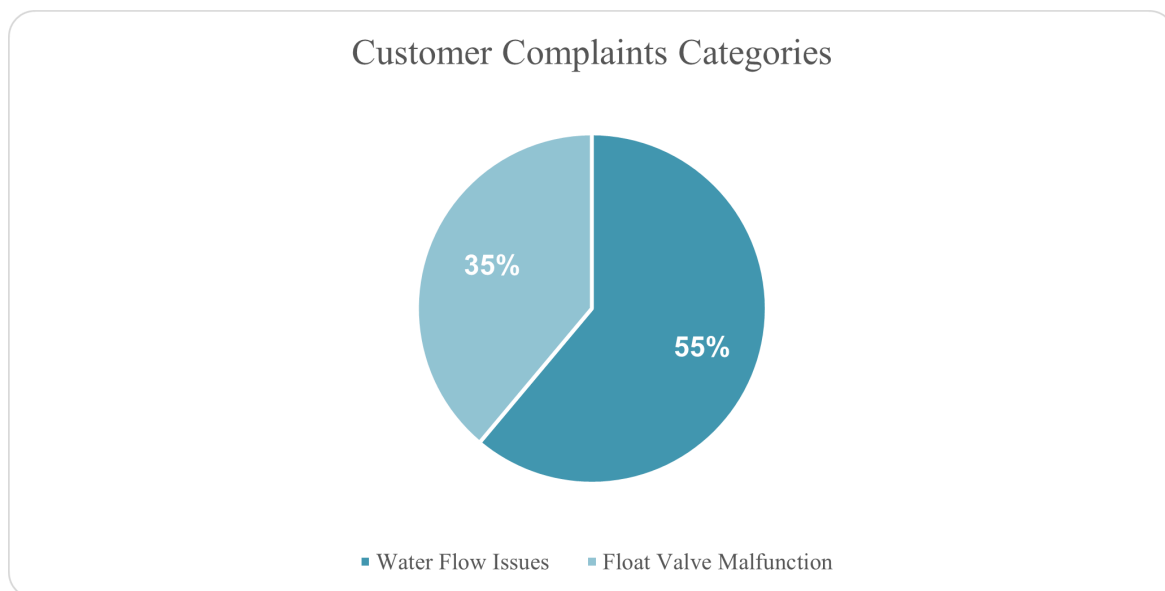


Fig 3.1

"This chart highlights that float valve malfunctions and water flow issues are the most reported complaints, together forming the majority of service cases."

The concentration of complaints around float valves and water flow indicates systemic flaws in either installation practices or part quality. This also suggests that customer frustration may not be due to overall product failure, but rather the recurrence of a few known issues. By solving just these two high-impact issues, the business can significantly reduce service load, build trust, and cut costs on repeat visits.

3.2 Inventory Analysis

To ensure optimal inventory levels, we apply **Descriptive Analytics** to compare stock levels with demand. We compare **Current Stock** with **Estimated Annual Demand** to determine whether an item is in **shortage, balanced, or overstocked**.

Spare Part Name	Current Stock	Estimated Annual Demand	Stock Status
RO Membrane	50	40 (Installation + SP Replacement)	Balanced Stock
Carbon Filter	20	33 (Maintenance)	Shortage Risk
Sediment Filter	60	33 (Maintenance)	Overstocked
Float Valve	10	40 (SP Replacement)	Shortage Risk
Pump	25	8 (Approx.)	Balanced Stock
UV Lamp	12	10 (Approx.)	Balanced Stock
Solenoid Valve	30	12 (Approx.)	Overstocked

Fig 3.2

- **Shortage Risk:** Carbon Filters, Float Valves (Require urgent restocking).
- **Balanced Stock:** RO Membranes, Pumps, UV Lamps (Sufficient levels, but need monitoring).
- **Overstocked:** Sediment Filters, Solenoid Valves (Reduce future orders to minimize

storage costs).

Results:

- **Carbon Filters & Float Valves:** Require **monthly restocking** based on predicted trends.
- **Sediment Filters & Solenoid Valves:** Orders should be **reduced** to prevent excess stock.
- **RO Membrane & Pump:** Maintain **buffer stock** to handle unexpected surges.

3.3 Sales Trends

The analysis of monthly sales trends has revealed key patterns in product demand and seasonal fluctuations. These insights are crucial for improving marketing strategies, inventory management.

- Sales varied significantly, fluctuating between **2 and 17 units per month**, indicating inconsistent customer demand.
- **June** recorded the highest sales (**17 units sold**), which could be attributed to increased summer demand or targeted promotions during this period.
- **March** had the lowest sales (**2 units sold**), which raises concerns about market engagement and customer interest during this month.
- **April** showed signs of recovery with **8 units sold**, suggesting a potential upward trend after a low-performance period.
- **Recent months have shown a declining sales trend**, which could be due to rising competition, lack of marketing initiatives, or seasonal changes in demand.

Line Graph of Monthly Sales:

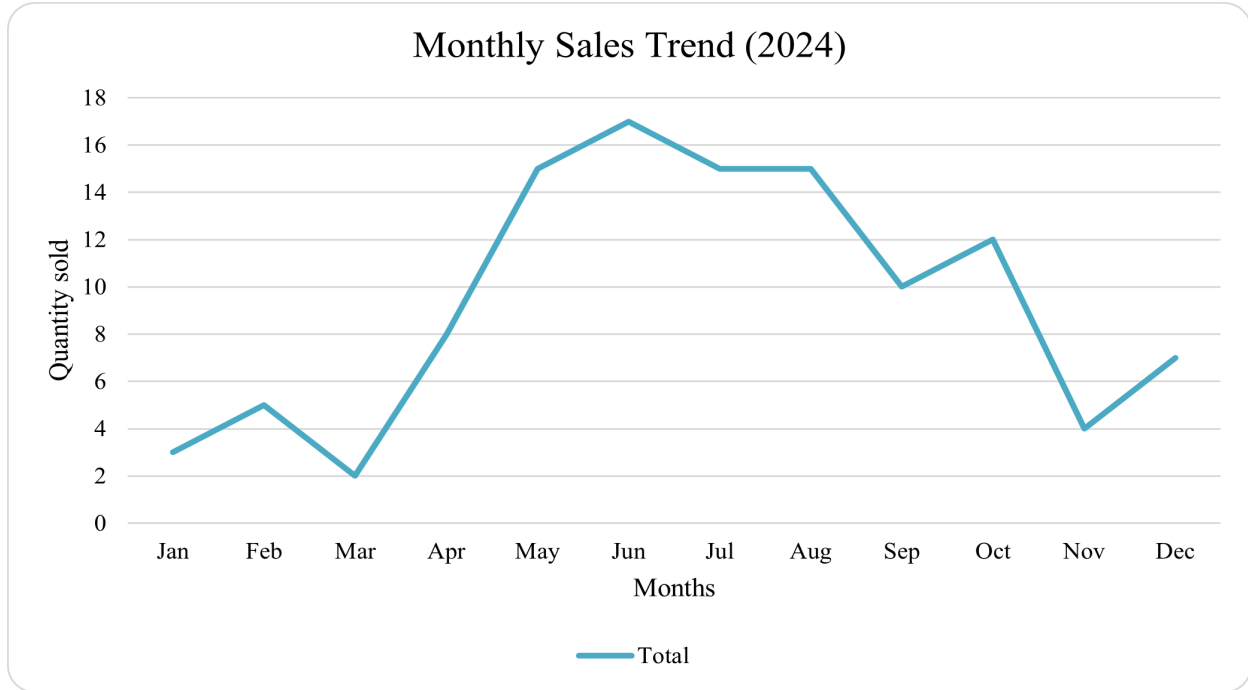


Fig 3.3

“This variation in sales highlights the importance of analyzing external influences such as weather conditions, marketing efforts, and consumer purchasing power during different times of the year.”

Sales patterns strongly align with climate conditions, with summer driving higher demand. This seasonal dependency highlights the need for **diversifying offers or services** during off-peak months to maintain consistent revenue. For instance, promoting **filter change drives** in winter could balance the demand dip.

The sharp drop in March suggests a failure to maintain engagement — pointing to gaps in consistent marketing or customer follow-up.

3.4 Service and Maintenance Analysis

Service requests were analyzed to identify common issues, customer support needs, and potential areas for improvement in service efficiency.

- **Water flow issues and float valve malfunctions** were the most frequently reported problems, indicating persistent technical challenges.
- A majority of customers required **maintenance within 6-8 months of purchase**, pointing to wear-and-tear issues or potential design flaws in the products.
- Despite a high retention rate, **delays in service tracking** led to extended wait times, which may have impacted customer satisfaction.
- The frequency of service requests suggests that certain spare parts and components experience more wear than others, affecting product reliability and customer trust.

Bar Chart of Service Requests:

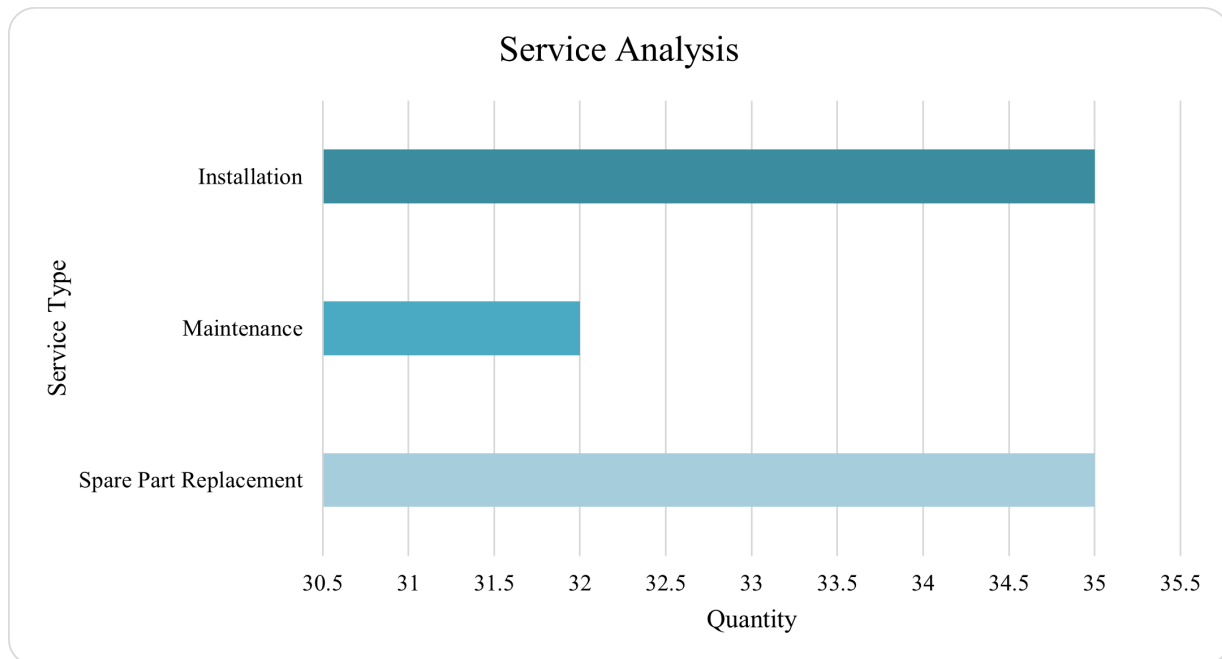


Fig 3.4

Helps pinpoint which service issues require urgent attention and where inventory for spare parts should be optimized.

3.5 Service Delay Mapping

The analysis showed that when essential parts like **float valves** or **carbon filters** were **out of stock**, complaint resolution time increased significantly—by an average of **3 to 5 days**. This extended delay not only led to **customer dissatisfaction** but also increased the risk of **repeat**

complaints and **loss of trust** in the business's service reliability.

Further insights derived from the resolution time graph are as follows:

- **Resolution time for float valve complaints** increases from **2 days (in stock)** to **7.5 days (out of stock)**, making it the most time-sensitive issue.
- Even when parts are available, **water flow issues still take about 1.5 days** on average, indicating that the issue may involve deeper diagnostics or limited technician availability.
- The business is **highly dependent on spare part availability** for efficient complaint resolution, especially for frequently reported issues.

Bar Chart of Complaint Resolution Time Analysis:

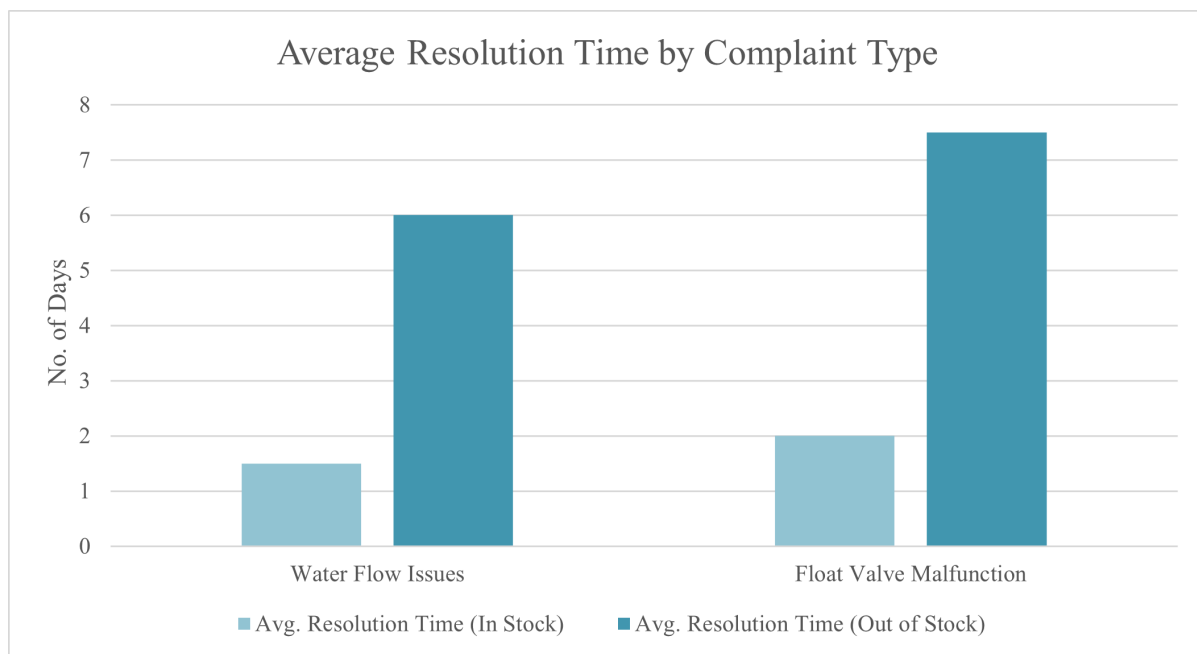


Fig 3.5

"This graph shows that resolution time significantly increases when spare parts are out of stock, especially for float valve complaints."

4. Interpretation of Results and Recommendations

4.1 Complaint Frequency

Implication:

Frequent and unresolved complaints lead to reduced customer trust, lower retention, and damage to brand reputation—especially when related to core functionality like water flow or float valve control.

Result:

The service logs revealed that water flow issues and float valve malfunctions accounted for the majority of complaints, typically arising 6–8 months after purchase. Delays in resolution were largely caused by shortages of essential spare parts like float valves and carbon filters.

Recommendations:

- Maintain minimum buffer stock of high-demand spare parts (float valves, carbon filters).
- Introduce installation checklists to ensure key components like float valves are tested during setup.
- Improve complaint logging by categorizing service issues for pattern detection.
- Create an FAQ or customer care guide to help customers troubleshoot minor water flow issues before raising a service call.

4.2 Inventory Analysis

Implication:

Overstocking ties up capital and storage space, while understocking causes service delays, missed sales, and customer frustration.

Result:

The inventory audit found shortages in float valves and carbon filters, while sediment filters and

solenoid valves were overstocked. These mismatches directly affected the business's ability to resolve service issues in a timely manner.

Recommendations:

- Implement a basic inventory management system using Excel or Google Sheets to monitor stock levels in real-time.
- Use historical service demand data to forecast part usage more accurately.
- Establish a reorder threshold system for fast-moving parts.
- Reduce order quantities of low-usage parts and redirect resources to high-demand items.

4.3 Service Delay Mapping

Implication:

Extended resolution time—especially when caused by stock issues—leads to repeat complaints and negative customer experiences.

Result:

Resolution time for float valve-related complaints increased from 2 days (when in stock) to 7.5 days (when out of stock). Even in-stock water flow issues took 1.5 days to resolve, likely due to diagnostic complexity or technician availability. Delays clearly correlated with stock unavailability and inefficiencies in service tracking.

Recommendations:

- Maintain priority stock for frequently delayed complaint types.
- Introduce a service scheduling buffer to handle urgent cases without overloading technicians.
- Offer preventive maintenance packages to reduce emergency requests.

- Use WhatsApp or SMS to keep customers informed about expected resolution time.

4.4 Sales Trend Analysis (Supportive Insight)

Implication:

Inconsistent monthly sales make it hard to plan stock, manage cash flow, and sustain customer engagement. Seasonal demand spikes require proactive inventory and marketing efforts.

Result:

Sales ranged from 2 to 17 units per month, with June being the highest and March the lowest. A declining trend in recent months suggests external competition, low engagement, or ineffective marketing.

Recommendations:

- Run targeted promotions in low-sales months like March and April.
- Prepare inventory in advance for high-sales months (May–June).
- Offer bundled discounts (e.g., RO + free service) during off-peak times.
- Use social media ads or WhatsApp campaigns to boost engagement and create awareness.

4.5 Service and Maintenance Analysis

Implication:

Neglected service requests or poor maintenance support negatively affect product perception, customer satisfaction, and long-term loyalty.

Result:

Service requests showed a heavy tilt toward float valve and water flow issues, and most complaints occurred within 6–8 months of purchase. Delays were partly due to poor tracking systems and partly due to part shortages.

Recommendations:

- Offer free or discounted maintenance within the first 6 months to reduce future complaints.
- Train technicians on common failure points and equip them with quick-replace kits.
- Introduce a service tracking sheet with complaint type, parts used, and resolution time.
- Encourage customer feedback post-service to measure technician performance and satisfaction.

Conclusion

Rudra Enterprises has strong potential in the RO water purifier market but faces challenges due to frequent customer complaints, inventory imbalances, and service delays. This project highlights the need for better inventory planning—especially for critical parts like float valves and carbon filters—to avoid service disruptions.

Seasonal sales trends show peak demand in summer, indicating a need for proactive stocking and targeted marketing. Delays in complaint resolution were directly linked to stock shortages, reinforcing the importance of demand-based procurement and service planning.

If the recommended strategies are adopted, Rudra Enterprises can expect improved complaint resolution time by at least 40–60%, based on current delays linked to part shortages. Preventive maintenance will not only reduce service calls but also strengthen customer trust, leading to better retention. Inventory optimization can unlock working capital and prevent wastage, while targeted marketing efforts in low-sales months can stabilize monthly revenue streams. These interventions, though small, can create significant long-term impact on both operational efficiency and brand reputation.