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Navigating business intelligence: Analyzing and visualizing KPIs of U.S. gas stations with C-store by applying MIS, BI tools charts, graphs, interactive dashboards

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Abstract: The U.S retail landscape has become one of the dynamic and competitive sectors. To remain competitive, retail businesses like U.S. gas stations with C-store are required to develop, measure, analyze, and visualize a set of KPIs (Key Performance Indicator) matrix for making strategic decisions in optimizing supply chain, forecasting demands, excellence in customer experience, extending value propositions, cost minimizing, and enhancing revenue streams. These measures help identify business strengths, opportunities to grow, weaknesses, and potential risks. This article aims to examine how a typical U.S. gas station with C-store can integrate BI (Business Intelligence) and MIS (Management Information System) tools to get real-time business insights into critical matrix. Here, we adopted an applied research approach (including quantitative analysis and qualitative insights). The key findings include a set of KPI matrix, and an interactive dashboard for a typical US. gas station. The integration of MIS-powered BI tools can impact significantly in analyzing and visualizing KPIs for enhancing operational efficiency. This article will contribute to the growing needs of academic literature on MIS-supported BI tools adoption in U.S. gas station with C-store. It will also enable retail investors and stakeholders to visualize the key business insights, business performance, prospects and opportunities.

Keywords: *BI (Business intelligence), Data visualization, Gas station with C-store, KPIs (Key performance indicators), MIS (Management information system), Retail analytics.*

1. Introduction

Today's business world tends to rely on data-driven decision-making process, integrating cutting-edge technologies for measuring and evaluating their business performance, uncover opportunities for further growth, and be aware of any underlying risk associated with their business operations. Business entities like U.S. gas stations with C-store also tend to adopt modern technologies in all their business respects, ranging from POS (point-of-sales) to business performance analyzing and visualizing trends. A typical gas station with C-store generally serves both value-driven fuel consumers, and impulse-driven merchandise shoppers. This hybrid nature of their business model poses challenges in their business operations including fluctuations in fuel margin, inventory optimizations, demand forecasting, customer satisfaction etc. Therefore, the traditional business decision-making process is often unable to present a complete picture of business operations which leads to inefficiency in business operations, even negative growth in revenue stream, fails to grab full potential, customer dissatisfaction etc.

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1.1. Problem Statement

A typical gas station with C-store generates a large volume of data from its day-to-day transactions, and business operational activities. However, most of the gas stations' business owners/operators lack the analytical ability to measure their business performance based on these historical data. Therefore, they often fail to take necessary and faster decision making for their business operation. Sometimes, they fail to uncover their business trends that may remain hidden in excel spreadsheets, and other traditional forms of static report. Therefore, this results in unutilized valuable resources, short/over inventory, under/over pricing, loss of potential sales growth, and reactive rather than proactive business management.

1.2. Research Objective

This research is a continuation of our previous article [1]. Here, we aim to analyze and visualize the KPIs of a typical U.S. gas station by integrating a MIS and business intelligence tools. In this article we will develop an interactive dashboard, necessary line charts, figures, tables, treemap etc. to generate real-time valuable insights for stakeholders to take strategic decisions to improve operational efficiency, optimize supply chains, increase profitability, and excellence in customer satisfactions.

1.3. Case Example

We consider a typical U.S. gas station operating with C-store, we named it *ABC gas station*. We aim to develop an interactive dashboard, line charts, figures, and tables following the KPIs of ABC gas station and compare these KPIs against industry benchmarks/standards. For analytical purpose, we will generate transactional and operational dataset for ABC gas station based on relevant experience at the U.S. gas station. This endeavor will outline retailers on why they need to adopt business intelligence tools into their business operations, also guide them how to integrate these tools to visualize and analyze their retail business for continuous improvement in operational efficiency.

2. Literature Review

2.1. MIS in Retail Operations

Management Information System (MIS) is involved in collecting data, maintaining proper storage, data processing, and then reporting valuable insights to the stakeholders for taking data-driven strategic decisions. Laudon and Laudon [2] stated that MIS enables business organizations to take data-driven decisions on business strategic, tactical and operational issues by integrating day-to-day transactional data across different departments. MIS enables retailers with real-time monitoring of sales revenue, inventory position, as well as customer engagement, which are the basic elements for visualizing KPI tracking [3].

2.2. BI and Data Visualization

For enhancing the managerial actionable insights, researchers focus on the value of data visualization tools which enable creating dashboards, charts, maps, time series trends based on historical data. According to Few and Perlich [4] well-designed dashboards enhance user ability, lower cognitive load, help managers to take faster and informed decisions. In case of gas stations with C-store, BI dashboards can be used in forecasting demand, optimizing price, as well as allocating staff [5].

2.3. The U.S. Retail

The U.S retail landscape has become one of the dynamic and leading sectors in the country, which generates a significant portion of revenue from consumer spendings, creates a good number of employment opportunities, and encourages investors to come up with cutting-edge technologies for further flourishment following consumer choice, preference, and consumer buying behavior [6].

As per the IBIS World, the reported revenue of U.S. retail industry stood at US$7.6 trillion during the period ending Y2024, with an expected growth of CGAR 3.2% over the last 5 years period (2019-

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2014). The overall sales revenue during and post-Covid-19 shows an increasing trend in online sales, which means the sector has been growing steadily with the increasing application of digital platforms and as well as the increasing trend in affiliate marketing spending [7].Therefore, the demand for applications of MIS, BI, and AI in retail business performance analytics has been increasing among the retailers.

We see the tech-integrated business and omnichannel platforms yield higher customer lifetime value. In the post-covid period, we experienced a significant rise of omnichannel platforms, a combination of physical and online sales, to attract potential consumers by offering them personalized customer experience [1]. Investments in tech-tools like mobile POS, buy-online-pick-up-in-store (BOPIS), and real-time inventory visibility make the real difference [8]. In recent years, the application of MIS (Management Information System), BI (Business Intelligence), and AI (Artificial Intelligence) in retail business performance analytics has been the subject-matter of increasing research scholarly attention.

2.4. KPIs in Gas Station with C-Store

Gas station with C-store presents a multifaceted KPI matrix. NACS (National Association of Convenience Stores) identify critical metrics like fuel margin per gallon, sales per square foot, basket size as important KPIs for gas stations. However, the in-store operating system, and siloed nature of fuel often make it difficult for integrated analysis, making BI and MIS integration essential [9].

2.5. Key Performance Indicators (KPIs)

Retail investors, stakeholders of a typical gas station with c-stores tend to monitor Key Performance Indicators (KPIs) of their business entity. KPIs of any business entity showcase the financial performance, operational efficiency, consumer satisfactions index, and market and competitive position. These KPIs help management to make strategic decisions for the smooth flow of their business operations, financial planning for maximizing profitability with better consumer satisfaction. For assessment and improvement of the business entity's performance and effectiveness, it is important to set realistic benchmarks for comparisons. By setting industry averages or benchmarks we can measure the relative performance of the business operations, identify weaknesses (if any), and develop prescriptive suggestions for further improvements. Now, we would like to present the most important KPIs of a typical gas station as below:

2.5.1. Financial KPIs

1) *Gross Profit (GP):* It refers to the total revenues less cost of goods sold for a specific period.
2) *Gross Profit Margin (GP%):* Gross profit margin expresses in percentile form like GP margin (GP%), i.e., the gross profit to revenue ratio. GP% of a typical U.S. gas station with c-store generally ranges from 20% to 30%.
3) *Net Profit (NP):* It refers to the gross profit minus administrative expenses for a specific period.
4) *Net Profit Margin (NP%):* It also expresses in percentile form like NP margin (NP%), i.e., the net profit to revenue ratio. NP% varies widely across the industry, aiming for a positive margin after deducting all the expenses.
5) *Revenue per Gallon:* it represents the revenue generated from sales of a gallon of gas. It varies, can be $0.14 per gallon.
6) *Fuel Sales Volume:* It presents how many gallons of gas (regular, premium, and diesel) sold per day or per month, which ranges between 50,000 and 100,000 gallons per month.
7) *Average Transaction Value (ATV):* It calculates the average consumer spending per transaction. It can be calculated total sales divided by the total number of transactions. Benchmark of ATV for a typical gas station with C-store is between $8 and $12 per transaction. It helps to understand the consumers buying behavior.

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8) *Revenue per Square Foot:* It measures the revenue generated per square foot, which generally ranges from $300 to $500 per square foot. This metric indicates the efficiency of space utilization in generating revenue per square foot.
9) *Convenience Store Sales:* Generally, monthly sales revenue is around $50,000 for a typical C-store. This indicator tells us the capacity of generating average revenues per month, which contributes significantly to the overall business sales revenue.

2.5.2. Operational KPIs

10) *Inventory Turnover Ratio:* this ratio measures the efficiency of inventory management, i.e., how frequently the inventory is sold out, and restocked. It generally ranges between 8-12 times a year.
11) *Employee Productivity Rate:* it also measures the level of efficiency and contribution made per employee to generate sales revenue for a specific time. The industry average shows the annual sales are between $25,000 to $30,000 per employee.
12) *Customer Foot Traffic:* it gives us an idea of how many customers visit the store per day. This number varies by location, depending on how busy the location is, population density etc. This can be measured per day or per week to predict demand and optimize our supply chain.
13) *Time to Restock Inventory:* it measures the time interval on how fast it takes to restock the inventory from different vendors. Normally, it takes 24–28 hours for a typical gas station with c-store to restock the merchandise products. It is important to ensure that merchandise products are always available in the store to avoid stock-out.
14) *Food Waste Percentage:* It measures the percentage of losses caused by wastage of in-store foods, which can be used to control the costs by reducing food wastage. Lower the wastage, better the store food management.

2.5.3. Customer Satisfaction KPIs

15) *ACSI (American Customer Satisfaction Index):* this index measures the level of consumer satisfaction for a typical Gas station with c-store. As per ACSI, the c-store's average was reported at 76 out of 100 points, where Wawa scored top with 82/100 points. So, there is an opportunity to improve the index by offering customers with more value proposition [8].
16) *Customer Retention Rate:* it measures the rate of loyal customers, repeat customer of the store for sustainable revenue streams. This rate can vary between 60% to 70% for a typical gas station.
17) *Average Market Basket Size:* This gives us an idea on consumer buying patterns, and preferences, and the spending habits of the consumers. It can be calculated by dividing total sales revenue by the total number of transactions in a day.

2.5.4. Market & Competitive KPIs

18) *Market Share*: This indicator helps compare the market share of sales revenue among competitors in a specific area. This measure encourages stores to attract more consumers by offering more value propositions, attractive loyalty programs, merchandise discount offers etc.
19) *Pricing Competitiveness:* One of the effective sales drivers is competitive pricing of a gas station with a c-store since consumers tend to look for relatively lower prices. So, a competitive pricing strategy is one of the key factors for business performance.
20) *Promotional Campaign Effectiveness:* To remain competitive in gaining market share, gas stations with c-store conduct promotional campaigns and marketing efforts. This KPI helps measuring the impact of this marketing and promotional efforts in achieving target market share.

A typical gas station with C-store should monitor the above KPIs to measure their business performance against the industry average (benchmarks) to identify their opportunity to improve business performance. An interactive dashboard can enable them to monitor these KPIs effectively and efficiently to be successful in their business performance.

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Here, we would like to develop tables, charts, figures, interactive dashboards based on these above KPIs for a typical gas station with c-store. For our analytical purpose, we assume ABC Gas Station, a typical gas station with c-store operating in the United States.

2.6. Challenges in Adopting BI

We know the installation and adoption of MIS-supported business intelligence tools benefits business managers in making strategic decisions to increase market share, and profitability, researchers identified some barriers to adopt BI/MIS tools and techniques. According to Wixom and Watson [10] small and medium enterprises face several obstructions including installation and setup cost, complex nature of system operation, and lack of technical knowledge and training facility. A typical gas station with C-store, generally owned/franchised & operated by local business owner independently, these challenges are further amplified by the need to integrate operational data from fuel pumps, POS systems, and inventory software.

2.7. Emerging Trend

In recent times, retailers are more interested in real-time updates of their store through predictive BI tools. Therefore, recent literature focuses on the move to digital platform empower by MIS-supported BI system, where retailers can track their business KPIs on real-time updates, identify any anomalies posed in day-today operation, and get AI-power actionable insights. These insights are particularly important for gas stations with C-store where consumer behavior is highly dynamic and operational agility is key [11].

3. Methods

This research paper aims to analyze and visualize the Key Performance Indicators (KPIs) of a typical U.S. gas station with C-store (Convenience store), we name it ABC Gas Station. In this study, we adopted an applied research approach by integrating MIS (Management Information System) and BI (Business Intelligence) tools like Microsoft Power BI, MS Excel for creating visualizations. Our research methodology includes both quantitative analysis by using industry data/benchmarks and qualitative insights related to ABC gas station.

3.1. Data Collection

In this article, we based our analysis on publicly available secondary information, and industry reports for setting industry benchmarks for measuring KPIs of a typical gas station with C-store. For our analytical and visualization purpose, we assumed and developed POS (point-of-sale) simulation dataset for ABC gas station based on practical experience to make it more realistic. Here, we developed business operational metrics for ABC gas station with C-store for analyzing and visualization purposes.

3.2. Application of BI/MIS Tools

In this article, we used BI and MIS tools like Microsoft Power BI and advance Excel to transform raw data into visualizations, such as interactive dashboard, figures, line charts, ribbon charts, treemap, gauge, tables etc.

4. Results and Discussion

Analyzing and visualizing the KPIs of a gas station with C-store by applying MIS-supported BI tools yields significant insights into business operational dynamics that can lead business growth and profitability. In this article, we created an interactive dashboard for the overall KPIs matrix, line charts for tracking sales trends, gauge to measure gap between expected and actual sales revenue, ribbon chart for comparing profit against sales trends, a tree map for highlighting major expenses etc. In this section,

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we will visualize our findings, compare them with industry benchmarks and analyze the likely impact within the business operations.

Dashboard_01: Shows the overall key performance indicators for ABC gas station with c-store for Y2024.

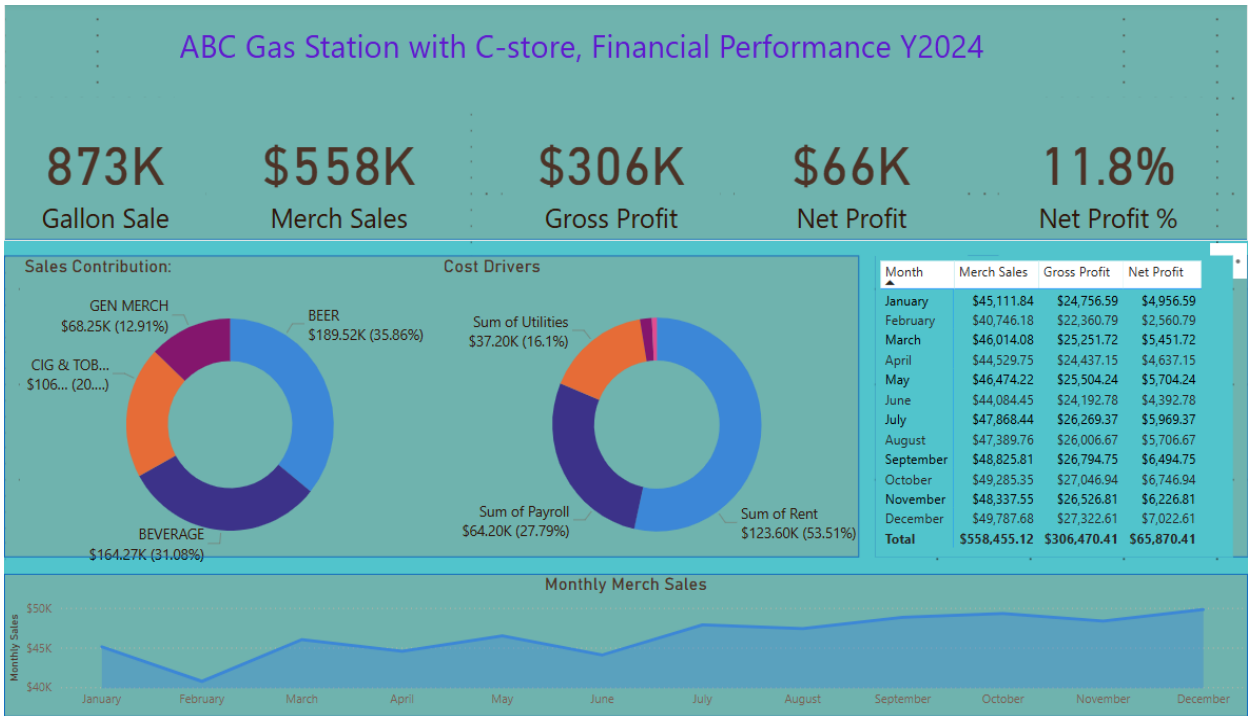

Figure 1.
Dashboard exhibits financial performance (Y2024) of ABC Gas Station with C-store.

4.1. Fuel Sales & Profit Margin Analysis

From the *Interactive Dashboard_01*, we can visualize how many gallons of gas (regular, premium, diesel) sold per month, or per week or even per day. As per the benchmark (*Table_01*), we see, a typical gas station sells between 50,000 and 100,000 gallons of gas per month. In this case, we see ABC Gas station with the C-store selling more than 72,000 gallons per month, which falls within the average range. So, ABC can focus more on increasing fuel sales by offering more loyalty programs, competitive prices, uninterrupted fuel supply etc. Besides, the profit margin from gas sales varies depending on location, states, company policy. In this case, ABC earns $0.14/g which we assume to be an industry average.

Table 1.
Financial KPIs of a typical U.S. gas station with c-store (ABC Gas station).

KPI Matrix	Benchmarks	ABC Gas Station	Variance	Performance
Financial KPS:				
C-Store Merch Sales: ($/month)	$50,000	$68,034	$18,034	Good
Gross Profit Margin	20%-30%	30.0%	In range	Good
Net Profit Margin	varies	11.8%	positive	Good
Revenue per gal $	varies	$0.14	positive	Ave
Fuel Sales Vol. (g/month)	50,000 to 100,000	72,718	In range	Ave
Ave Transaction Val (ATV)	$8 to $12	$11	In range	Ave
Revenue per Square Foot	$300 to $500	$550	$50	Good

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From the line chart (Figure 1), we see a NP% line fluctuated throughout the year Y2024. The minimum NP% dropped to 6.28% in February 2024, where the maximum NP% recorded at 14.11% in December 2024. Throughout the year, the average NP% was 11.80%, which is a good sign for a typical gas station with C-store. They can further improve NP% by controlling costs, reducing wastages, updating competitive pricing, and maintaining creditworthy relationships with various suppliers.

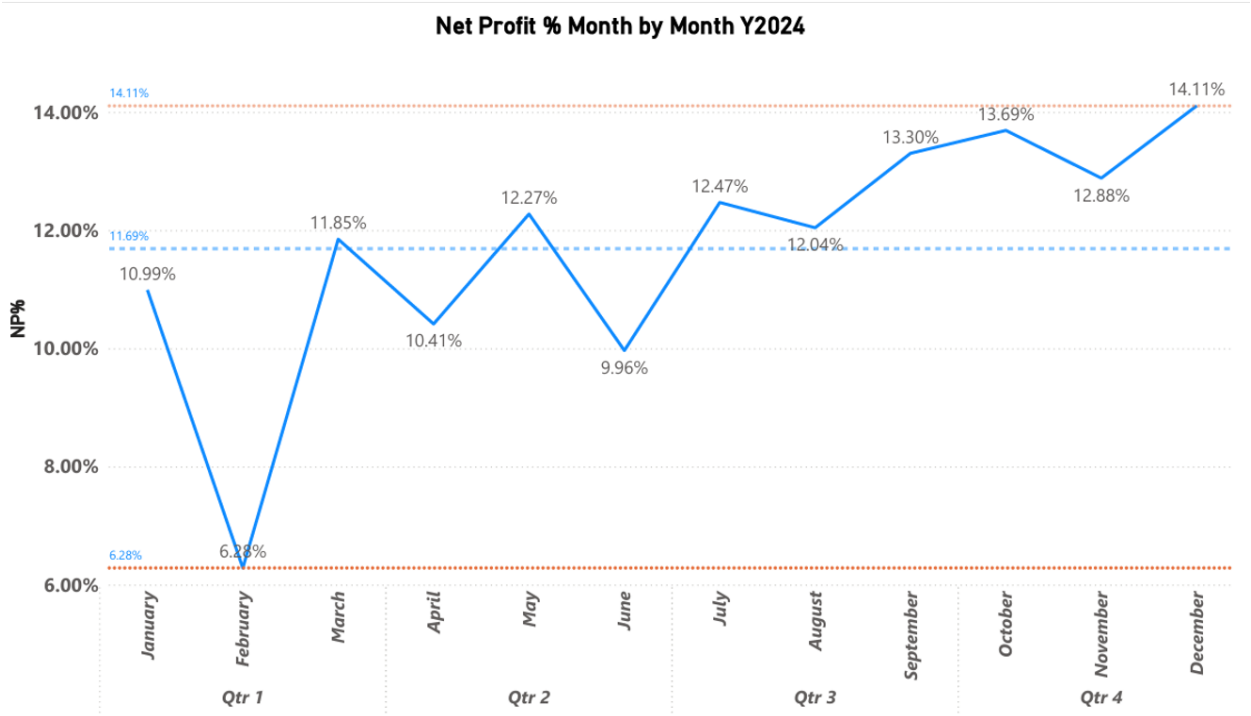

Figure 2.
Line chart shows Net Profit Margin of ABC gas station with C-store by months for Y2024.

The Ribbon chart (Figure 3) displays the movements of monthly profits along with monthly sales revenue for the store. The chart provides a steady sales insight during the year 2024 with an increasing trend, which indicates the consistent performance of the store. ABC store should maintain this momentum and focus on further opportunities to grow over the next periods.

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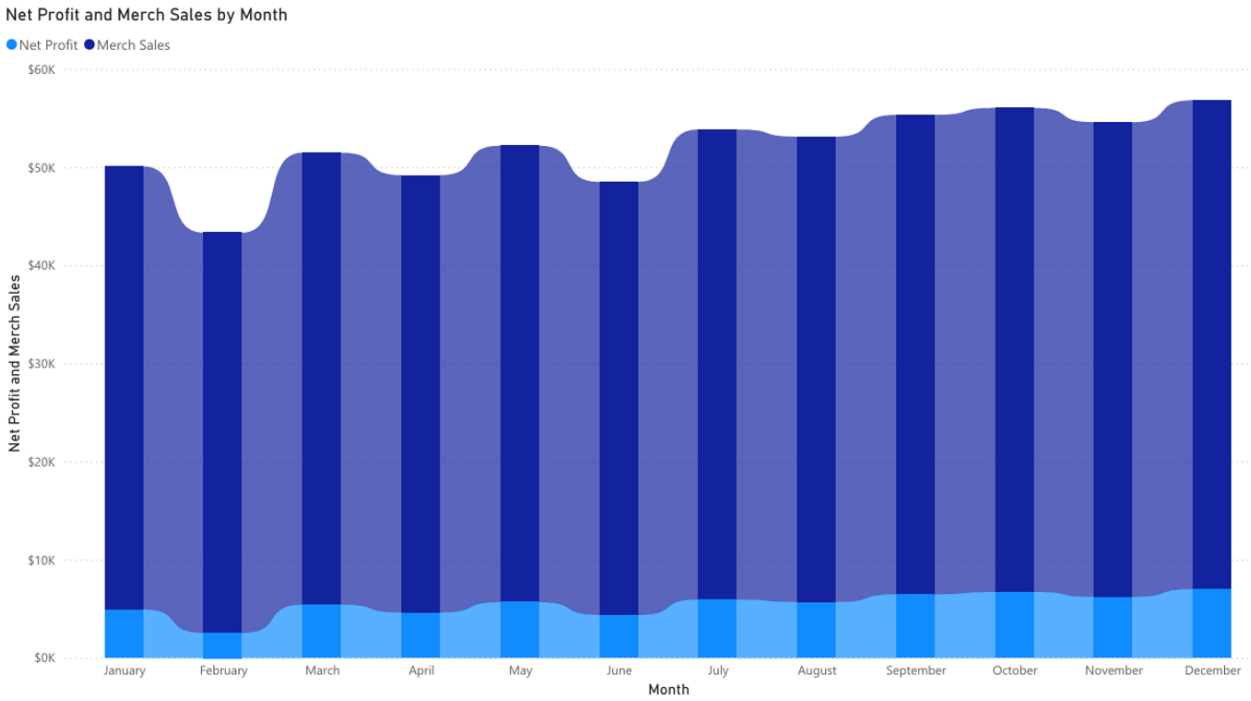

Figure 3.
Ribbon chart shows the net profit against sales revenue by months for Y2024.

Treemap (Figure 4.) highlights major cost structures, utility expenses, and other operational expenses. Retailers like ABC store can monitor and control their costs by applying a treemap. We see, rental expense is the major cost driver for ABC store, followed by payroll, utilities, and others.

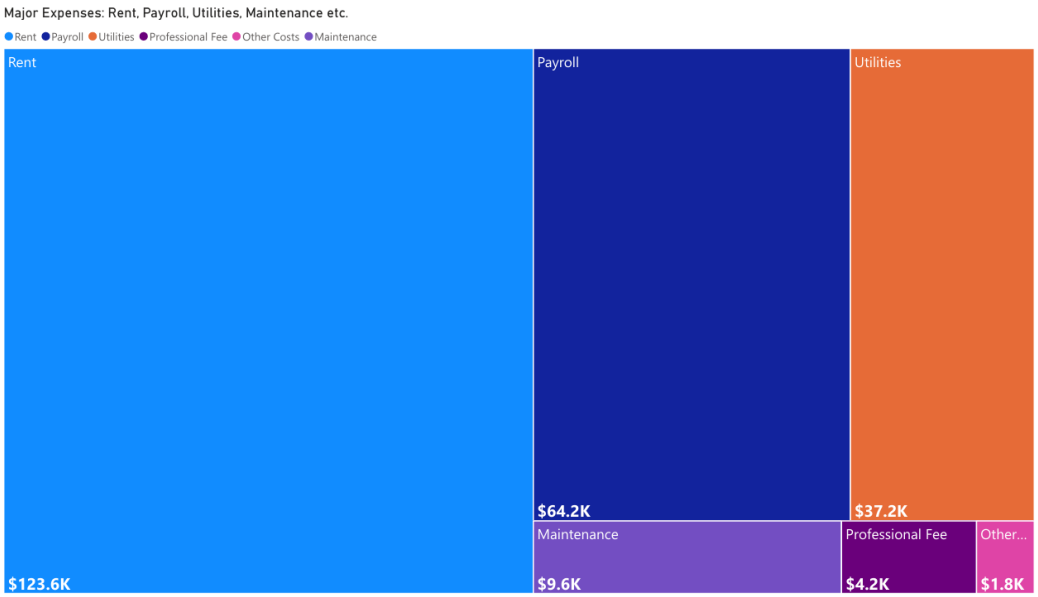

Figure 4.
Treemap shows major expenses for ABC gas station with c-store for Y2024.

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4.2. Merchandise Sales & Supply Chain

Retailers can track the merchandise sales trend and set up the sales target for the current month/year and measure the employees' operational performance by developing a gauge for comparing actual vs. target sales. From Figure 5, we see the target annual sales for ABC gas station was set at $60,000, but their actual annual sales were reported at $558,000 during Y2024, which indicates a shortfall in achieving target. Besides, ABC gas station can monitor dashboards on regular basis to get actionable insights into consumers' choice, their buying habits, consumers' traffic patterns, product sales trends, vendor offers and competitors' price. This strategy will help them to optimize the supply chain following the product consumers' choice and preference.

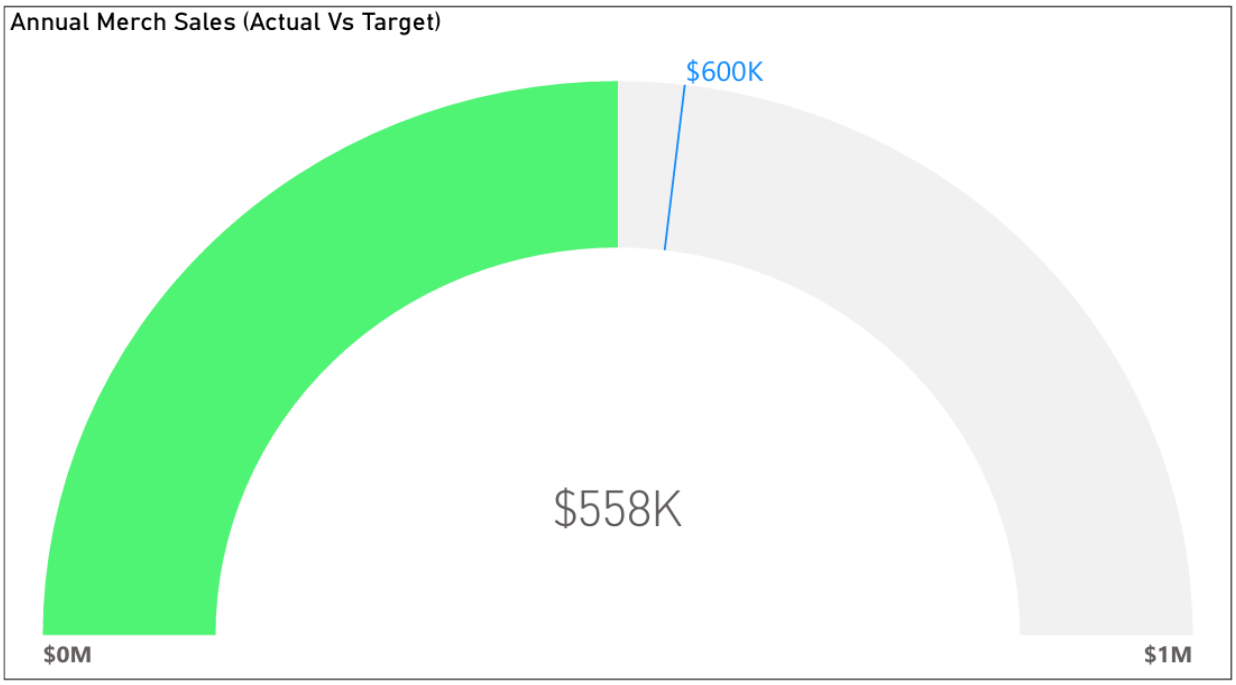

Figure 5.
Gauge shows the deficiency/shortfall of annual sales against target sales generated by ABC gas station with c-store for Y2024.

Table 2 exhibits operational performance of ABC gas station against the industry benchmarks. We see the overall performance of ABC was good in maintaining higher employee productivity ratio and controlling food wastage down to 3% than the industry benchmark of 5%. Besides, they performed with average efficiency in maintaining inventory turnover ratio, customer foot traffic and time to restock inventory indicators.

Table 2.
Operational KPIs of a typical U.S. gas station with c-store (ABC Gas station).

KPI Matrix	Benchmarks	ABC Gas Station	Variance	Performance
Operational KPS:				
Inventory Turnover Ratio (annual)	8 to 12 times	12 times	In range	Ave
Employee Productivity Rate (annual)	$25,000 to $30,000	$93,076	$63,076	Good
Customer Foot Traffic	varies	140-150	0	Ave
Time to Restock Inventory	24 to 48 hours	48	0	Ave
Food Waste Percentage: (assumed)	5%	3%	2% low	Good

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Figure 6 shows a constant fluctuation in ABC's beer and beverage sales over the months with an increasing trend. Average monthly sales for beer & beverages were reported at $15.8k and $13.7k respectively, which means local consumers spend more on beer consumption.

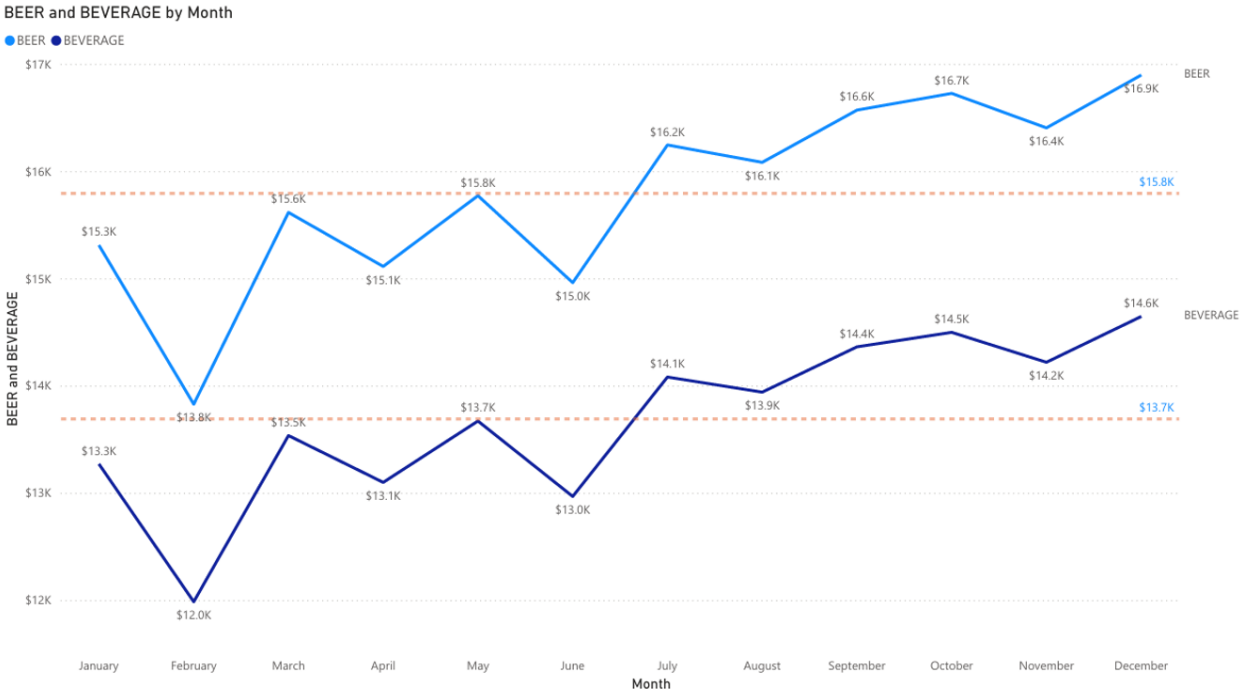

Figure 6.
Line chart shows the preference or buying habits of the local consumers between Beer and Beverages for ABC gas station with c-store for Y2024.

The following ribbon chart (Figure 7) and line chart (Figure 8) provides the insight that beer and beverages yield the highest sales contribution among merchandise products. So, retailers should focus more on these items to make sure there are uninterrupted supply chains to avoid any shortage of supply.

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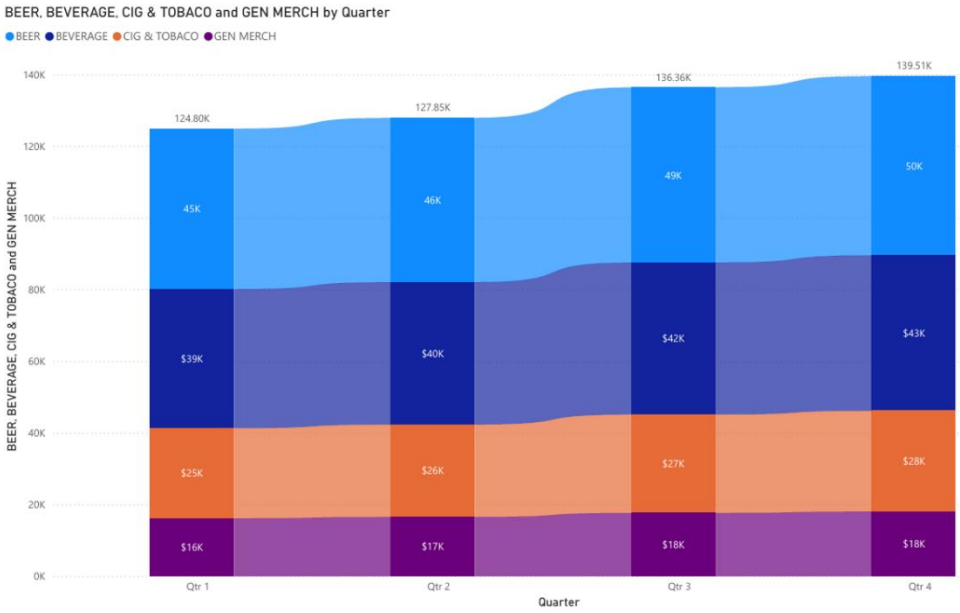

Figure 7.
Ribbon chart shows sales contributions by departments for Y2024.

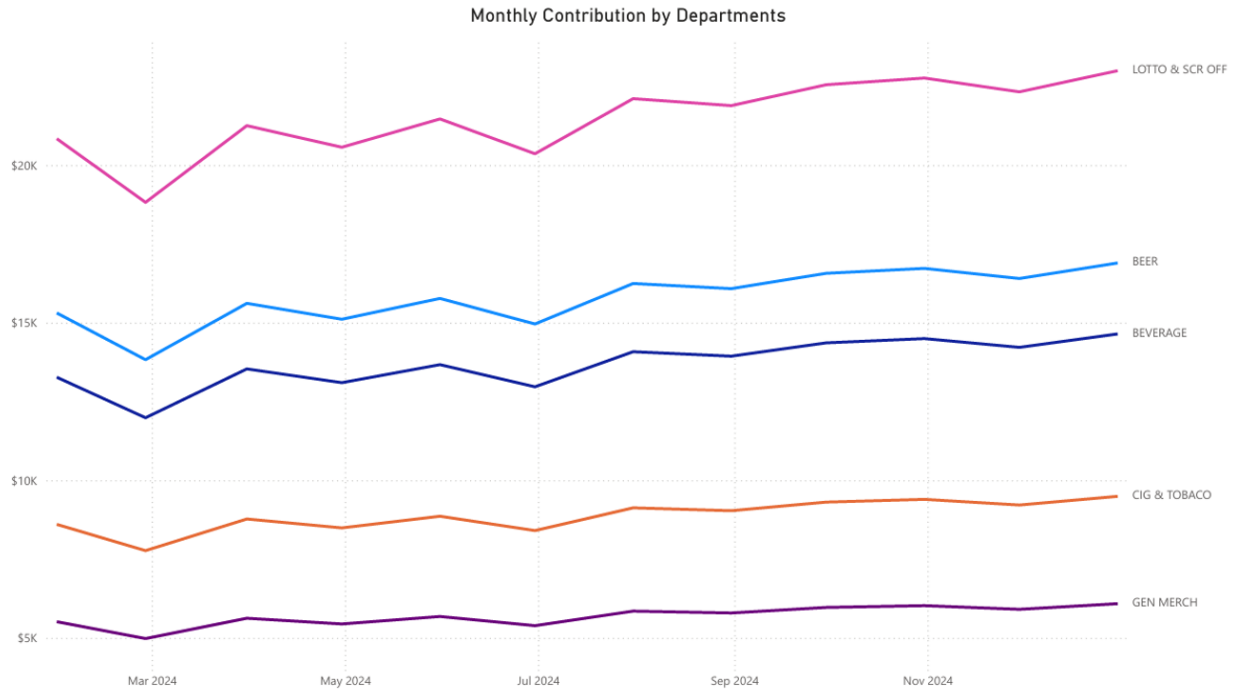

Figure 8.
Line chart shows the sales contributions by various departments of ABC gas station with c-store for Y2024.

4.3. Customer satisfaction and Market Share

As per ACSI index (table_03), the benchmark for customer satisfaction for a typical gas station with C-store is 76 points, where ABC gas station has been operating business with 78 points which indicates

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they are managing customers with greater satisfactions. Therefore, the customer retentions rate also shows higher 80% beyond the benchmark range between 60% to 70%.

Table 3.
Customer Satisfaction KPIs of a typical U.S. gas station with c-store.

KPI Matrix	Benchmarks	ABC Gas Station	Variance	Performance
Customer Satisfaction KPIs:				
American Customer Satisfaction Index (ACSI)	76 points	78 points (assumed)	2 points	Good
Customer Retention Rate	60% to 70%	80% (assumed)	10%	Good
Average Market Basket Size	$8 to $12	$11	In range	Ave

From Table 4, we see ABC captured the market share (local area sales) of around 55% which is due to the excellent customer satisfaction index and growing sales revenue trend.

Table 4.
Market & Competitive KPIs of ABC Gas station with C-store.

KPI Matrix	Competitor	ABC Gas Station	Variance	Performance
Market & Competitive KPIs:				
Market Share	45%	55%	10%	Good
PricingCompetitiveness	5% high	5% low	5%	Good
Promotional Campaign Effectiveness		Increase by 5%		Effective

5. Recommendations

Throughout the article we explained a set of KPI matrix of a typical gas station with C-store in the United States. We created an interactive dashboard, charts, figures, tables by applying MIS-supported BI tools (such as MS Power BI, Advance Excel, etc.) for analyzing and visualizing KPIs of ABC gas station and comparing them against the industry benchmarks to measure their operational performance and efficiency. Based on our findings some recommendations are proposed for a typical gas station to maximize their operational efficiency, minimize costs, increase sales growth & profitability with excellent consumer personalized experience. Recommendations are as follows:

Investment in integration of MIS/BI platform: retailers need to invest and adopt MIS/BI solutions which combine fuel sales, merchandise sales, inventory/vendor management, and consumers behavior analytics. This will provide retailers with real-time updates, and reports (daily, weekly, monthly etc.) with valuable insights and retailers can visualize the business trends and track any anomality.

1) *Develop Dashboard following KPIs:* design and develop interactive dashboard, charts, figures, treemap, gauge, KPI matrix as per the business goals/requirements. These visualizations will support retailers with real-time actionable insights for taking faster and necessary steps for constant business growth and profitability.
2) *Training on MIS/BI management:* operational staff need to be well trained on this MIS/BI application through proper training which improves their ability to adapt to this technology and enhances their skills to understand and monitor interactive dashboard and translate valuable insights into operational actions for ensuring smooth flow of business operations.
3) *Utilize insights for product pricing & promotions:* retailers should use actionable insights to adjust pricing for fuel and non-fuel items, and launch promotional offers following consumers' traffic patterns, product sales trends, vendor offers and competitors' price.
4) *Optimize inventory to avoid over/under stocking:* C-store should monitor consumers' buying habits and predict their demands by using BI inventory turnover reports to avoid any sort of overstocking or understocking. This strategy will help to identify slow-moving items, minimize the inventory holding costs, reduce wastage and prevent potential loss of sales from stockout situations, ultimately improving cash flow and profitability.
5) *Continuous updates and improvements:* management should monitor the dashboard on a regular basis to maintain consistency and accuracy of the KPIs insights. Any changes in management policy or

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requirements, the KPIs on the dashboard needs to be updated accordingly through the integration of real-time data sources.

6. Conclusion

The integration of Business Intelligence (BI) and MIS tools in the U.S. gas station with C-store can impact significantly in analyzing and visualizing operational and financial KPIs for continuous improvements in operational efficiency, sales growth, and profitability with excellence in consumer experience. An interactive dashboard can provide retailers with timely, actionable insights into KPI metrics including sales revenue growth, profit margin, merchandise sales, fuel sale (gallon), consumer satisfaction index, inventory management, cost minimizations, control cost drivers etc. The research findings demonstrate that visual analytics (dashboard) can improve operational transparency and empower business owners/stakeholders to take data-driven strategic decision making that drives profitability by adding more revenue streams and controlling operational costs.

Though there are immense benefits from the integration of MIS-supported BI solutions, we see some challenges related to system integration, associated costs, and user adoption. However, gas stations with C-store operator/stakeholders seeking business growth and operational efficiency should adopt business intelligence solutions for improving transparency and efficiency. Finally, we believe, future research work should be based on developing scalable business intelligence solutions focusing on unique constraints and prospects of this domain so that investors/retail business operators come forward to adopting these MIS-supported BI solutions for maximizing their business impact.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

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