A Case Study on the Implementation of Business Intelligence in a Retail Company

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Abstract

This paper presents a case study on the implementation of business intelligence (BI) in a retail company with the main aim to analyze the benefits of BI implementation and the confronts encountered during the process. The case study involves a large retail company that operates in multiple countries and offers a wide range of products. The implementation of BI was driven by the need to improve decision-making processes, increase operational efficiency, and enhance customer satisfaction. We also cover the different phases of BI implementation, including planning, data integration, data modeling, and dashboard development. The results of the study indicate that the implementation of BI has led to significant improvements in the company's performance, such as increased revenue, improved inventory management, and better customer segmentation. We investigate how artificial intelligence can provide great support for improving and automating the implementation of BI in retail companies. However, we also highlight some challenges encountered during the implementation process, such as data quality issues and resistance to change. The paper concludes by emphasizing the importance of careful planning, stakeholder engagement, and ongoing evaluation in ensuring the success of BI implementation in retail companies.

Keywords: Business Intelligence; Retail Company; Business Analysis; Artificial Intelligence.

1. Introduction

Business Intelligence (BI) plays a crucial role in the retail industry by providing insights into customer behavior, sales trends, and inventory management. By leveraging BI tools, retailers can gain a better understanding of their business operations, identify inefficiencies, and make informed decisions about pricing, promotions, and product offerings. BI also helps retailers to personalize their marketing strategies by analyzing customer data, such as purchase history and browsing behavior, to create targeted campaigns that resonate with customers [1-3]. However, the adoption of BI in the retail industry also poses several challenges for retailers. One of the main challenges is the integration of disparate data sources, such as point-of-sale systems, inventory management systems, and customer relationship management systems. These data sources may use different formats, making it difficult to extract meaningful insights from the data. Another challenge is the need to create a culture of data-driven decision making within the organization. This requires retailers to educate their employees on how to interpret and use BI insights to make informed decisions, which can be challenging in organizations that have traditionally relied on intuition and experience. Additionally, retailers need to ensure that their BI systems are scalable and can handle large volumes of data, as the retail industry generates vast amounts of data on a daily basis [3-5].

The implementation of Business Intelligence (BI) in retail companies is a complex task that poses various research challenges. One significant challenge is the integration of multiple sources of data, including point-of-sale (POS) systems, customer data, inventory data, and supply chain data, into a unified data warehouse. This requires the

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development of robust data management processes, including data extraction, transformation, and loading. Another challenge is the development of effective analytical models that can extract insights from the vast amounts of data generated by retail operations [6]. These models need to be tailored to the specific needs of the retail industry and must account for factors such as seasonality, consumer trends, and pricing strategies. Finally, there is a need to ensure that the BI system is user-friendly and accessible to non-technical stakeholders, such as store managers and merchandisers, who can use the insights to make informed decisions about pricing, inventory management, and customer engagement strategies [7-8].

In response to the above challenges, this work contributes to the understanding of the successful implementation of BI in the retail industry. We present a detailed case study of a retail company that successfully implemented BI, highlighting the strategies and tools that were used to achieve this. We discuss the benefits of BI implementation, including improved inventory management, better customer targeting, and increased sales revenue. Additionally, we provide insights into the challenges associated with BI implementation in a retail context, such as data quality issues and resistance to change from employees.

The following is a schedule for the rest of this investigation. Section 2 first conducts a literature review. In Section 3, we detail the procedures that guided our study. Section 4 displays the obtained outcomes, and discusses findings learned from our experiments. Section 5 presents the findings.

2. Background

Retail companies face various challenges such as intense competition, changing consumer preferences, and market saturation. These challenges are further compounded by the emergence of e-commerce, which has disrupted traditional retail business models. Retailers must also navigate supply chain disruptions, global economic uncertainties, and shifts in consumer behavior driven by factors such as the COVID-19 pandemic. The study [9] investigated the relationship between business analytics, business process performance, and firm performance. it collected survey data from 161 Turkish manufacturing firms and found that business analytics positively affects firm performance, and this relationship is mediated by business process performance. The study provided evidence that firms can improve their performance by adopting business analytics tools and enhancing their business process performance. The study [10] presented a case study on churn prediction using business analytics in the telecommunications industry. It used a dataset of customer usage patterns and applied various data preprocessing, feature engineering, and machine learning techniques to build predictive models for churn. It compared the performance of several models, including decision trees, random forests, and neural networks, and found that the random forest model performs the best. The study demonstrated the potential of business analytics in predicting customer churn and providing insights for reducing it. The study [11] explored the impact of business analytics and enterprise systems on managerial accounting. It conducted a literature review and found that these technologies can improve managerial accounting by providing timely, accurate, and relevant information for decision-making. It also identified challenges, such as the need for data quality assurance and appropriate training of employees. The study emphasized the importance of integrating business analytics and enterprise systems into managerial accounting practices to enhance organizational performance. The study [12] reviewed the literature on the use of BI and analytics (BI&A) in management accounting research. It is debated that BI&A is a growing field that has contributed to the development of new management accounting practices and concepts, such as performance management and strategic management accounting. It also identified research gaps and opportunities, such as the need for more empirical studies and the exploration of new BI&A technologies, such as artificial intelligence and machine learning. The study provided insights into the status and future direction of BI&A research in the context of management accounting. The study [13] surveyed the relationship between Walmart and local economic development. It collected data from local officials in 500 US counties and found that Walmart's presence in a county can lead to both positive and negative economic impacts. While Walmart could increase employment and reduce food prices, it could also harm small businesses and have negative effects on wages and benefits. The study [14] examined the localization strategies and capability transfer processes in the expansion of Tesco, a UK-based retail giant, into Asian markets. It used a case study approach, drawing on interviews and secondary data, and found that Tesco adopted a multi-scalar localization strategy that involved adapting to local cultural, institutional, and economic contexts at different levels of operation. It also identified capability transfer mechanisms, such as joint

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ventures and partnerships, that enabled Tesco to transfer its retail expertise and knowledge to local partners. The study [15] proposed a segmentation approach for retail stores to improve target marketing through clustering techniques to group stores based on their sales and customer data, and then apply association rule mining to identify customer preferences and purchase patterns for each segment. It also developed a decision tree model to predict customer behavior and recommend marketing strategies for each segment. The study demonstrated the potential of data mining and machine learning techniques in retail store segmentation and target marketing. The paper [16] provided an overview of the history, current state, and future directions of BI. It traced the evolution of BI from decision support systems in the 1960s to the current era of big data and analytics. It discussed the key components of BI, such as data warehousing, OLAP, data mining, and dashboards, and highlights their applications in various domains, including finance, marketing, and supply chain management. The author also identified emerging trends in BI, such as the use of cloud computing and social media analytics, and discussed their potential impact on the field.

3. Methodology

The methodological design of this study provides retail case study data from the past for 45 establishments in various regions, each of which houses many departments. Throughout the year, the company also hosts a number of sale events at discounted prices. Discounts like these are common in the weeks leading up to the year's four biggest holidays: the Super Bowl, Labor Day, Thanksgiving, and Christmas. The evaluation places five times more emphasis on the weeks that contain these holidays than on the weeks that do not. The data in our case consists of three parts namely stores information, features, and sales information. The store subset consists of Anonymized information about the 45 stores, demonstrating the type and size of the store (See Table 1).

Table 1: Samples of store data in our retail case study.

	Store	Type	Size
0	1	A	151315
1	2	A	202307
2	3	B	37392
3	4	A	205863
4	5	B	34875
5	6	A	202505
6	7	B	70713
7	8	A	155078
8	9	B	125833
9	10	B	126512

In addition, the features subset of data contains additional data related to the store, department, and regional activity for the given dates. This includes the store number, the weekly data, the average temperature per region, the cost of fuel price per region, anonymized data related to promotional markdowns, the consumer price index, the unemployment rate, and variables to determine whether the week is a special holiday week. A sample of retail features is presented in Table 2.

Table 2: Samples of the store feature our retail case study.

Store		Date	Temperature	Fuel_Price	MarkDown1	MarkDown2	MarkDown3	MarkDown4	MarkDown
8180	45	5/24/2013	67.11	3.627	3249.34	481.82	58.48	1183.23	1309.3
8181	45	5/31/2013	65.88	3.646	6474.49	411.38	77.06	9.38	4227.27
8182	45	7/6/2013	70.71	3.633	9977.82	744.29	80	4825.71	3597.34
8183	45	6/14/2013	70.01	3.632	2471.44	517.87	348.54	2612.33	3459.39
8184	45	6/21/2013	70.13	3.626	4989.34	385.31	178.56	2463.42	3117.94
8185	45	6/28/2013	76.05	3.639	4842.29	975.03	3	2449.97	3169.69
8186	45	5/7/2013	77.5	3.614	9090.48	2268.58	582.74	5797.47	1514.93
8187	45	12/7/2013	79.37	3.614	3789.94	1827.31	85.72	744.84	2150.36
8188	45	7/19/2013	82.84	3.737	2961.49	1047.07	204.19	363	1059.46

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8189	45	7/26/2013	76.06	3.804	212.02	851.73	2.06	10.88	1864.57

The sales subsection of the data contains samples between 2010-02-05 and 2012-11-01. Each sample is composed of the store number, the department number, the week, sales for the given department in the given store, and a variable to determine whether the week is a special holiday week. A sample of retail sales is presented in Table 3.

Table 3: Samples of sales data of our retail case study.

	Store	Dept	Date	Weekly_Sales	IsHoliday
0	1	1	5/2/2010	24924.5	FALSE
1	1	1	12/2/2010	46039.49	TRUE
2	1	1	19/02/2010	41595.55	FALSE
3	1	1	26/02/2010	19403.54	FALSE
4	1	1	5/3/2010	21827.9	FALSE
5	1	1	12/3/2010	21043.39	FALSE
6	1	1	19/03/2010	22136.64	FALSE
7	1	1	26/03/2010	26229.21	FALSE
8	1	1	2/4/2010	57258.43	FALSE
9	1	1	9/4/2010	42960.91	FALSE

Investigators can use the case study mentioned above to develop a business intelligence (BI) framework that can forecast annual department sales for each store, model the effects of markdowns during peak sales periods, and recommend courses of action based on the insights gained, giving highest priority to those with the greatest impact on the company.

4. Analysis & Discussions

This section presents an in-depth analysis and discussion of the BI implementation journey of the retail company. Descriptive statistics are a crucial component of implementing BI for a retail company as it helps analyze data to identify insights that can inform business decisions, and descriptive statistics play a key role in this process. Table 1 summarizes the descriptive statistics for the store data in our case study. Consider that our retail company wants to improve its sales performance for a particular store. The company could collect sales data for that store over the past year, including variables such as s Weekly_Sales, units sold, and Fuel pricing. According to the descriptive statistics, we can find that sales for the store were highest during certain weeks and that sales were stronger in certain geographic regions. This implies that we can use descriptive statistics to identify the key drivers of sales performance, such as pricing, promotions, or product features. For example, they might find that sales were higher when the fuel is priced lower or when a specific promotion was run. Based on these insights, the retail company could then develop targeted marketing strategies or adjust its pricing and promotions to improve sales performance for that store.

Table 4: Summary statistics for the store's data in our case study.

	Weekly_Sales	*Temperature*	*Fuel_Price*	*CPI*	*Unemployment*
count	143	143	143	143	143
mean	46.6014	60.66378	3.358607	171.5784	7.999151
std	5.399713	15.17279	0.429401	3.100148	0.483853
min	39	30.48089	2.672067	167.5465	6.953711
25%	44	47.72022	2.885367	168.4081	7.508333
50%	46	61.05111	3.488644	171.3862	8.150133
75%	47	74.69733	3.726133	174.7246	8.428578
max	80	82.17644	3.997778	176.6526	8.619311

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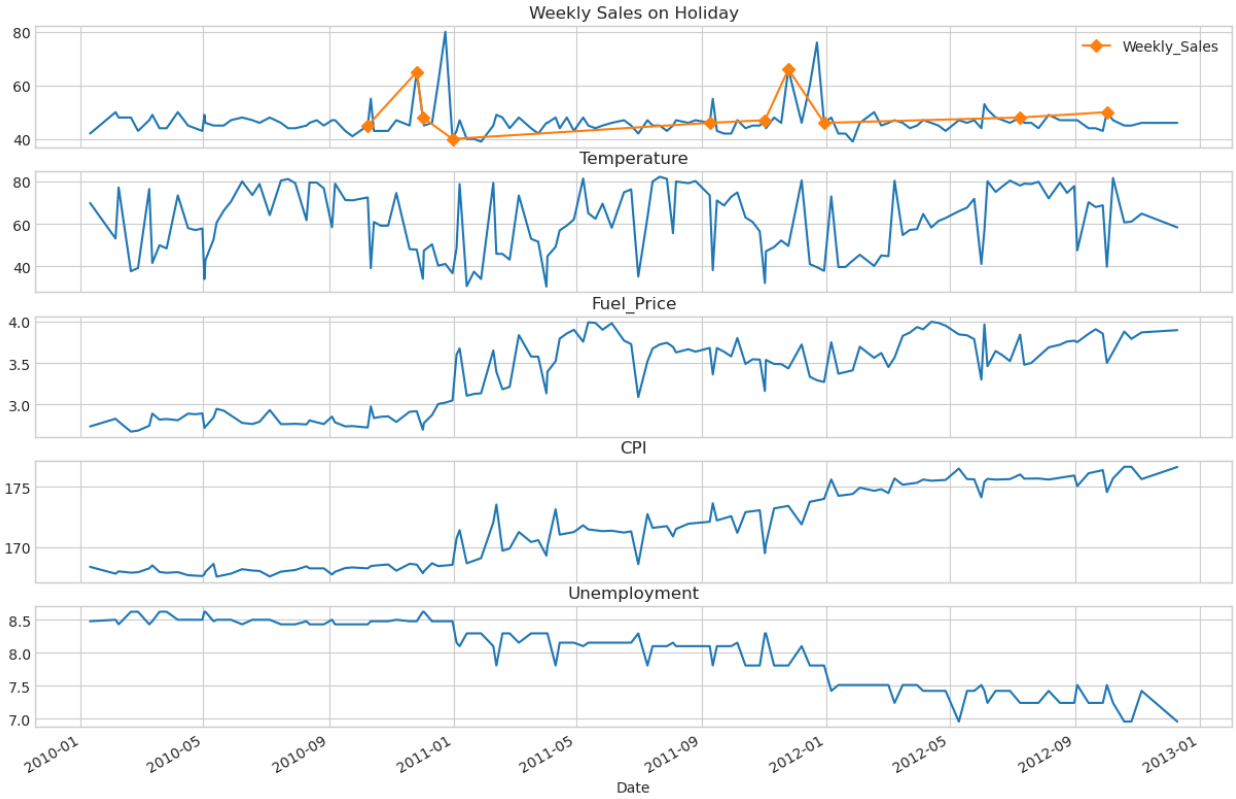

Figure 1: Visualization of attributes stores in our retail case study.

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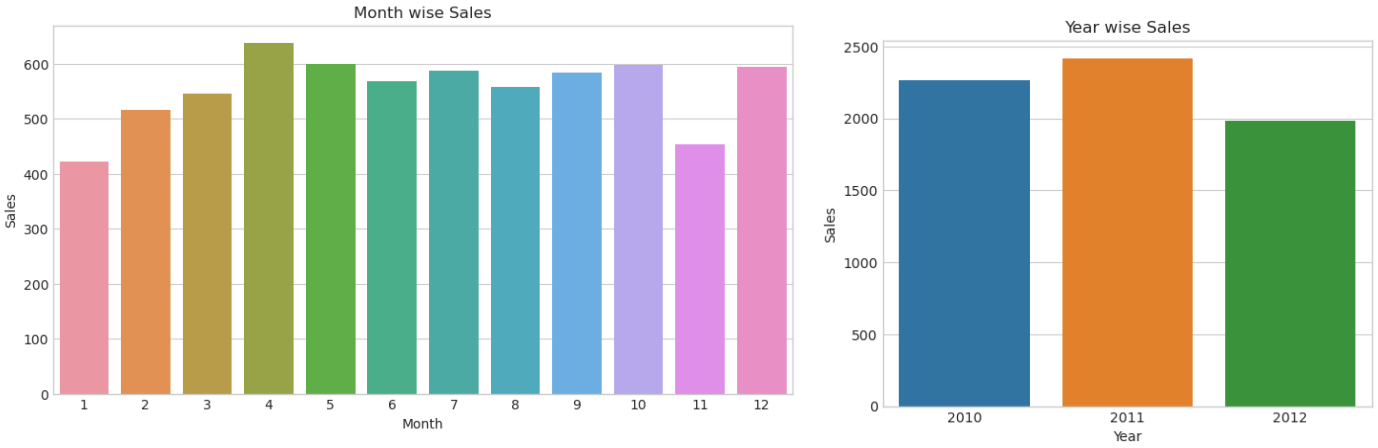

Figure 2: Visualization of sales of retail at monthly basis (left) and yearly basis (right).

Visualization of attributes of stores is an important component of implementing BI for a retail company. By

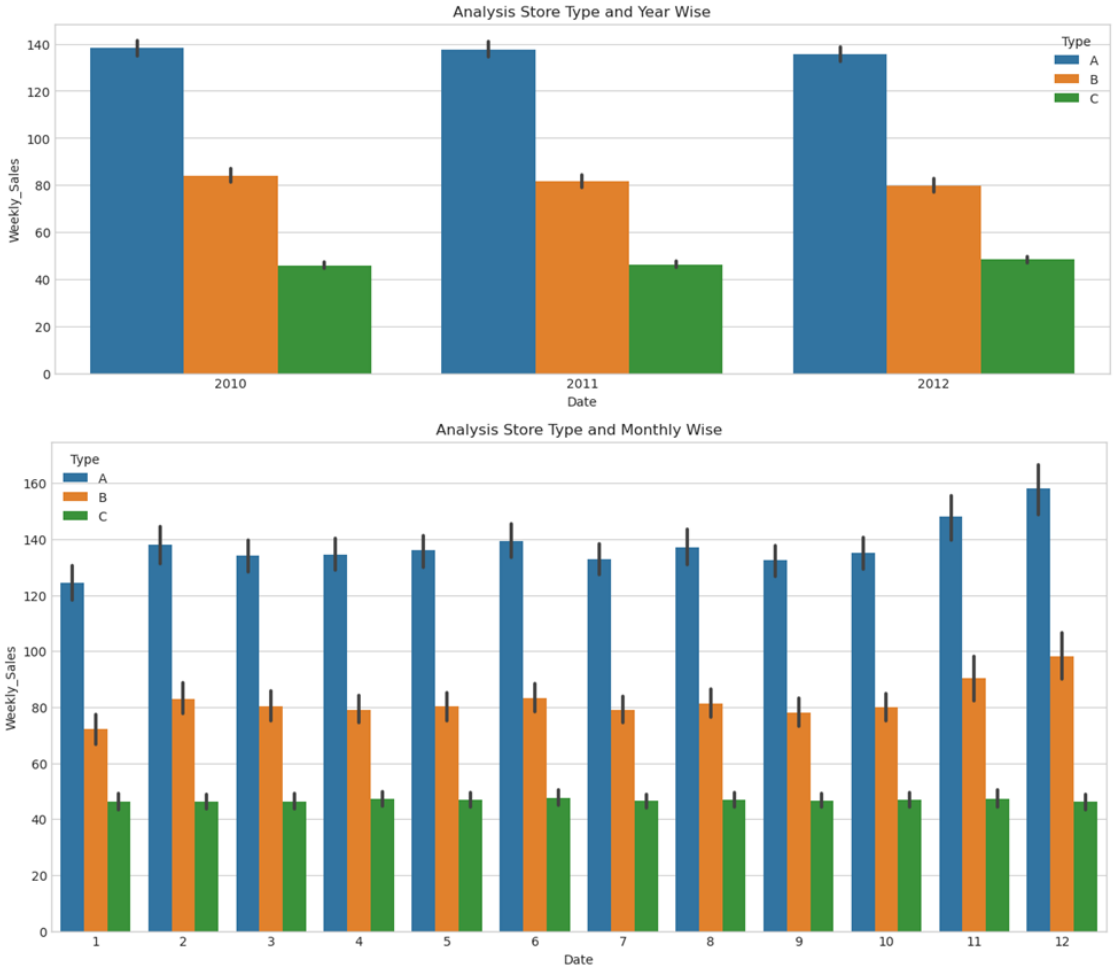

Figure 3: Visualization of sales of different type of stores in our retail at monthly basis (bottom) and yearly basis upper).

visualizing store attributes such as Temperature, CPI, and sales, retail companies can identify trends and patterns in-store performance, as shown in Figure 1. This visualization can also be used to compare the performance of different

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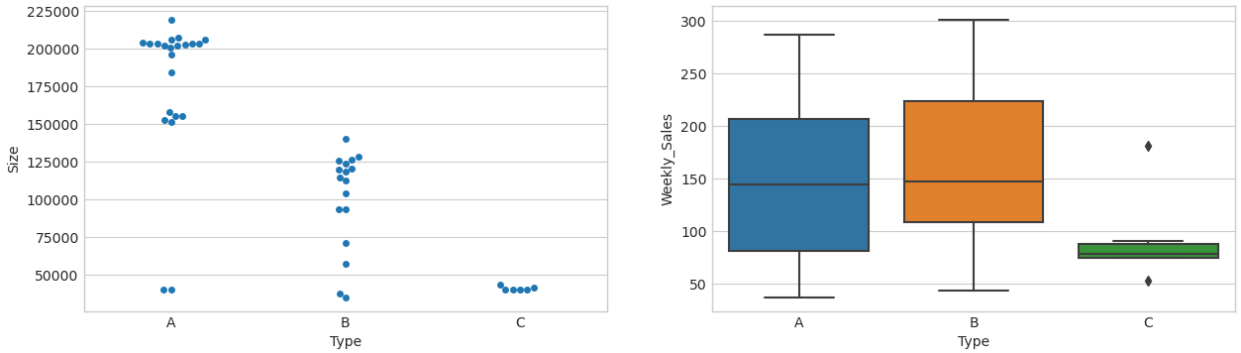

Figure 4: visualizing distributional store-wise analysis using swarm plot (left) and box plot(right).

Figure 5: Visualization of correlation heatmap for our case study.

stores across a variety of attributes. For example, we can compare the sales performance of stores in different time scales (as shown in Figure 2), or the performance of stores with different store types (See Figure 3). To get more insights into our retail in a store-wise manner, Figure 4 shows the distribution of sales and size information according to store type. Finally, visualization of retail can help communicate insights from data analysis to key stakeholders, such as executives, store managers, and marketing teams. By presenting data concisely, visualization can help ensure that everyone involved in decision-making has a shared understanding of the data and its implications.

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In the context of our retail company, a correlation map is displayed in Figure 5 to analyze the relationships between different variables, such as Weekly_Sales, Temperature, Fuel_Price, and CPI. The output of the map can help identify the key drivers of sales performance, such as pricing, promotions, or product attributes. Analyzing the correlations between Weekly_Sales, Temperature, Fuel_Price, and CPI provide insights into which factors are most closely associated with sales performance and adjust their strategies accordingly.

5. Conclusion

This research explores the implementation of BI in a retail company and can provide valuable insights that can inform business decisions and improve overall performance. This case study has highlighted some key ways in which BI can be implemented in a retail company, including the use of descriptive statistics to analyze customer behavior and identify trends and patterns, as well as the visualization of store attributes to communicate insights and drive improvement. Through the implementation of BI, the retail company in this case study was able to gain a deeper understanding of customer behavior, optimize inventory management, and improve sales performance for specific product lines. By continuing to collect and analyze data using BI tools, the company can continue to identify opportunities for improvement and make data-driven decisions to improve overall performance. While implementing BI requires a significant investment of time and resources, the benefits can be significant. As retail companies face increasing competition and changing consumer preferences, the ability to make data-driven decisions can be a key differentiator in achieving long-term success.

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