Business Intelligence as a Strategic Support for Decision-Making in Sales Management

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***Abstract* – The objective of this study was to assess the impact of implementing Business Intelligence (BI) on sales management. The dependent variable was sales management, which was assessed through two indicators: Number of sales and average sales. A pre-experimental design was employed, comparing results before and after the BI implementation. The present study employed a quantitative and applied approach. The population and sample sets encompassed all sales transactions within a one-month timeframe. The BI solution was developed using the Kimball methodology, a systematic approach to data integration that has been shown to facilitate efficient implementation processes. MySQL was utilized as the database management system, and Looker Studio (a Google tool) was employed to create the analytical dashboard. The results indicated a 19% increase in sales and a 79.7% increase in average sales. These findings suggest that the utilization of BI tools has the potential to enhance sales management by providing effective decision-support mechanisms.**

***Keywords* – Business intelligence, sales management, decision making, number of sales, average sales.**

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1. Introduction

In recent years, the implementation of Business Intelligence (BI) in various industries has become crucial for improving operational efficiency and optimizing data-driven decision-making [1], [2], [3], [4], [5]. In enterprise environments, BI enables the integration of disparate data sources, transforming information into actionable insights that support competitive advantage. Studies have demonstrated how BI facilitates predictive analytics and personalized visualizations that enhance strategic planning [6]. This approach is especially valuable in the sales sector, where competition requires timely and informed responses to market fluctuations. BI supports this need by identifying patterns and trends in real time.

Recent literature emphasizes the growing reliance on BI in modern business settings, where traditional decision-making based solely on intuition is no longer sufficient. Organizations increasingly depend on data-driven systems to inform decisions at strategic, tactical, and operational levels, enabling greater adaptability in volatile and uncertain environments. The value of BI lies in its ability to process large volumes of data and extract behavioral patterns that enhance sales performance and overall business competitiveness [7]. The bakery industry today faces specific challenges and opportunities that have reshaped how products are manufactured, marketed, and consumed. These transformations are influenced by trends in food, health, technology, globalization, and evolving consumer habits.

A medium-sized enterprise in the bakery sector is currently facing significant challenges in its sales operations due to the lack of reliable and timely information. This enterprise is engaged in the acquisition, production, marketing, and distribution of baked goods. This deficiency has the effect of impairing data management and limiting executive decision-making capacity. The identified issues include uncontrolled production, resulting in product losses, and an absence of strategic planning, attributable to limited data availability.

These concerns underscore the pressing need to adopt digital tools that enhance internal processes and optimize data usage.

The dearth of a dedicated technology department and Business Intelligence infrastructure further exacerbates the problem. The repercussions of this phenomenon encompass inadequate information management, ambiguous business objectives, and recurrent inventory losses. The present study focuses on the improvement of sales management — defined here as the dependent variable — through two key indicators: the number of sales and the average transaction value (average ticket size). The implementation of BI tools is proposed as a strategic solution to address these deficiencies and support sustainable growth.

The research is congruent with the United Nations Sustainable Development Goals (SDGs), particularly those promoting decent work and economic growth, as well as industry, innovation, and infrastructure. The research problem that guided this study is threefold: The present study seeks to investigate the impact of Business Intelligence implementation on sales management within the bakery sector of the company. The present study seeks to investigate the impact of Business Intelligence implementation on decision-making processes, with the ultimate objective of enhancing sales performance within the corporate context. The primary objective of this study is to examine the impact of Business Intelligence on the average ticket size of bakery sales within the company.

The present study is substantiated by technological, theoretical, and social justifications. From a technological standpoint, business intelligence (BI) encompasses the implementation of sophisticated systems that facilitate the expeditious processing of substantial data sets. Theoretically, BI is founded on data analysis and statistical principles, thereby empowering the company to collect, analyze, and present pertinent information in an effective manner. From a social perspective, Business Intelligence (BI) assists organizations in acquiring a more profound understanding of customer behavior and preferences, thereby enhancing customer relationships and decision-making processes.

The objective of this study is to determine how the implementation of Business Intelligence improves sales management in a medium-sized bakery enterprise. Specifically, the objective of this study is twofold: first, to assess the impact of BI on decision-making processes, with the aim of enhancing sales within the company; and second, to evaluate the effect of BI on average transaction values in the company's bakery product sales.

2. Methodology

The aim of this research was to evaluate the impact of implementing a business intelligence (BI) solution on sales management within an organization. An applied quantitative methodology was used to objectively measure the effects of a technological intervention based on real data. This methodological approach was chosen in response to the need of generating knowledge aimed at improving business processes through digital tools. Various platforms and technologies, such as Looker Studio, MySQL, and SPSS, were integrated to collect, transform, visualize, and analyze data relevant to strategic decision-making. Details on the instruments, experimental design, study sample, tools used, and analytical approach adopted are provided below.

Looker Studio, formerly Google Data Studio, is a BI platform that facilitates effective decision-making by offering extensive business capabilities for data visualization and analysis.

It facilitates connectivity to over 800 data sources and offers customizable reports, drag-and-drop features, templates, and real-time sharing through application programming interface (API)integration [8].

Sales management constitutes a critical element within marketing strategy, as it ensures that sales efforts are aligned with organizational objectives and performance targets [9].

Business intelligence (BI) is defined as the combination of tools, technology, and processes that transform data into information, enabling this information to return as knowledge, which can then be used to develop a plan. Integration of Business Intelligence (BI) into business strategies is imperative, as it facilitates resource optimization and allows organizations to monitor their strategic goals, ultimately enhancing decision-making [10].

MySQL is an open-source relational database management system that is widely used for efficient data storage and management. The platform's primary characteristics encompass high performance, reliability, scalability, and security, rendering it suitable for both small-scale and enterprise-level applications [11].

Similarly, Business Intelligence (BI) can be conceptualized as the utilization of computer systems to collect and analyze both internal and external data, thereby promoting more efficient and competitive strategies [12].

SPSS (Statistical Package for the Social Sciences) is a statistical analysis platform that enables rapid and accurate computation of descriptive statistics.

The application under discussion facilitates data analysis, particularly in studies that employ surveys and structured records. It also ensures the validity and reliability of measurement instruments used in applied research [13].

The present research follows an applied design, as its objective is to generate new knowledge to address a practical problem in the context of sales management. The study employs a quantitative approach, utilizing authentic, quantifiable data to objectively assess outcomes.

A pre-experimental design was utilized, offering an approximation to the research problem by enabling comparisons between pre- and post-intervention results.

Two types of observations were conducted within the design: the pre-test, which captures the state of the indicators before implementation of the BI solution, and the post-test, which collects data after the intervention to assess any measurable changes.

The before-and-after design proffers a lucid framework for assessing whether the BI tool has precipitated enhancements in strategic decision-making and sales management. By controlling for variability between groups, the pre-experimental design isolates the effects of the BI intervention on the indicators of interest. The framework is illustrated in Figure 1.

Figure 1. Pre-experimental design diagram

The study population consisted of all sales transactions recorded in the company's database during the months of October 2023 and 2024, limited to business days (Monday through Saturday), totaling 26 days of observation.

The number of sales indicators is derived from a sample that encompasses all 26 business days (BD). The sample for the average sales indicator comprises 152 records (Re). The initial 22-day period exhibited a daily transaction frequency of six, while the subsequent 4-day period demonstrated a daily transaction frequency of five. A non-probabilistic, stratified sampling method was employed in this study. The data were grouped into strata by day, and the selection was made to ensure representation of varying transaction levels across the study period. The unit of analysis is the individual transaction, which serves as the basis for both indicators: number of sales and average sale amount.

A custom record sheet was developed as well as the primary data collection instrument. The tool was designed for the specific purpose of data collection for the study, and it was used to manually record data related to the dependent variable (sales management) from the company's database. The spreadsheet systematically documented each transaction and aligned it with the predetermined indicators. These data were utilized as the basis for both the pre- and post-test phases of the analysis. The implementation of the BI solution followed the principles of the Kimball methodology. The project commenced with a planning phase, which included meetings with the stakeholder to define objectives, scope, required resources, team roles, and a project timeline. The methodology supported the structured development of data models and ETL (extract, transform, load) processes tailored to the organization's needs. A web-based software platform was developed to support sales registration following the Scrum methodology. Key deliverables were defined in the product backlog, and user stories guided the development. The final deliverable of the study was a web application that integrates Representational State Transfer (REST) services for real-time sales recording. The independent variable in this study is Business Intelligence, and the dependent variable is Sales Management, evaluated using two indicators: Number of sales and average ticket size. A descriptive statistical analysis was conducted to examine the data collected during the pre- and post-intervention periods. The measures of central tendency (mean, median, and mode) were calculated, and the results were summarized using frequency tables and graphical representations. This analytical approach enabled the interpretation of the impact of the BI implementation on sales performance and the effectiveness of strategic decisions within the company.

This section presents the findings obtained from the statistical analysis of the data collected before and after the implementation of the Business Intelligence solution. Two pivotal sales management indicators were appraised: average sales and number of sales. This evaluation was undertaken to ascertain the impact of the technological intervention on the organization's commercial performance.

The analysis is divided into two levels. First, the data are characterized through measures of central tendency (mean), dispersion (standard deviation and variance), and range (minimum and maximum values) via descriptive statistics. This description offers a comprehensive overview of the variations in the indicators during the pre- and post-intervention periods.

Subsequently, an inferential statistical analysis is carried out to establish whether the changes observed between the two periods are statistically significant. To this end, appropriate tests were applied, allowing for a rigorous evaluation of the effectiveness of the BI solution implemented in improving sales management.

3. Results

In this section, descriptive and inferential statistics will be obtained and analysed for the indicators number of sales and average sales.

3.1. Descriptive Analysis

Measurements of the indicators for the number of sales and average sales were carried out. The pre-test (P_test) was conducted, followed by the implementation of the BI solution, and then the post-test (Pt_test) was carried out for each of the indicators mentioned above. The results obtained are presented below (see Table 1).

Indicator 1: Number of Sales (NS)

Table 1. Number of Sales Indicator in Pre-test and Post-test

Descriptive statistics						
NS	BD	Min	Max	Med	Dev	Var
P_test	26	4	10	5.846	1.69	2.855
Pt_test	26	5	13	6.962	1.80	3.238

A descriptive statistical test was performed, using the total number of transactions per day for the month of October. The Number of Sales (NS) indicator showed a mean (Med) of 5.846 for the pre-test and 6.962 for the post-test, which is interpreted as a positive change after the implementation of Business Intelligence (BI), with a 19% increase. This finding suggests that, on average, approximately one additional sale was made per day following the implementation of BI.

The variance deviation (Dev) showed an average of 1.690 for the pre-test, compared to 1.800 in the post-test. This indicates that the pre-test data was slightly more spread out around the mean, suggesting a slight increase in the dispersion of sales performance after the BI solution was implemented. A thorough examination of the standard deviation and variance reveals the presence of inequality or heterogeneity in the impact of BI on sales.

However, the impact of BI on sales was, on average, positive.

In terms of the minimum (Min) and maximum (Max) values, the pre-test recorded a minimum of 4 transactions, while the post-test recorded a minimum of 5 and a maximum of 13 transactions.

This indicates that not only did the minimum number of transactions increase in the post-test, but also the maximum number, reflecting higher sales performance after the implementation of BI.

The data suggests that even on the "worst days," sales were better than before.

Overall, this descriptive analysis shows a clear comparison between the pre-test and post-test results, illustrating the improvement in sales performance after the BI solution was implemented (see Table 2).

Indicator 2: Average Sales (AS)

Table 2. Average sales indicator in pre-test and post-test

Descriptive statistics						
AS	Re	Min	Max	Med	Dev	Var
P_test	152	119	2115.47	1625.26	363.937	132450.270
Pt_test	152	554	3473.15	2919.22	506.872	256919.97

A descriptive statistical test was performed using the average sales per day for the month. The analysis shows that in the pre-test, the average sales were 1,625.26, while in the post-test it increased to 2,919.22, representing a positive change after the implementation of the business intelligence solution, with a notable increase in sales performance.

The standard deviation in the pre-test was 363.94, compared to 506.87 in the post-test, indicating that the post-test data shows a higher dispersion relative to the mean. The variance also increased from 132,450.37 in the pre-test to 256,919.20 in the post-test, reflecting that the data is more variable in the period after the implementation.

In terms of extreme values, the minimum in the pre-test was 119, while in the post-test it increased to 554. The sales floor exhibited a marked increase, rising from a minimum of 119 to 554, suggesting that BI contributed to the reduction of days with particularly low sales.

The maximum in the pre-test was 2,115.47, while in the post-test it increased to 3,473.15. These results indicate that both the minimum and maximum values in the average sales increased in the post-test, suggesting better performance and stability in sales after the implementation of the BI solution. This analysis provides a clear view of the positive impact that the implementation had on sales performance, although not all days benefited equally.

3.2. Descriptive Analysis

Normality tests were performed using the SPSS tool, with Shapiro-Wilk for the number of sales indicator and Kolmogorov-Smirnov for the Average Sales indicator.

This phase is crucial as it helped determine the distribution type and which test was applied for interpreting the results.

The following results were obtained:

Table 3 shows the results of the normality test, giving a Significance level (Sig) of .011 in the pre-test, which was interpreted as a normal distribution. However, the post-test gives a Sig. of <.001, resulting in a non-normal distribution. This indicated that the type of test to be performed would be the non-parametric test because the distribution results are the same both are non-normal.

Indicator 1: Number of Sales

Table 3. Normality test number of sales

Normality tests			
	Shapiro wilk		
	Statistic	gl	Sig
NumberSales_pretest	.892	26	.011
NumberSales_postest	.835	26	<.001

Indicator 2: Average Sales

Table 4. Normality test average sales

Normality tests			
	Shapiro wilk		
	Statistic	gl	Sig
AverageSales_pretest	.188	152	<.001
AverageSales_postest	.162	152	<.001

Table 4 shows the results of the normality test, giving a Sig. of <.001 in the pre-test, which is interpreted as a non-normal distribution. Similarly, the post-test gives a Sig. of <.001, resulting in a non-normal distribution. This indicated that the type of test to be performed would be the non-parametric test, as both results show a non-normal distribution.

3.3. Hypothesis Testing

H1: The implementation of a BI tool improves the number of sales at company.

NVa: Number of sales before using the BI implementation

NVd: Number of sales after the BI implementation

H2: The implementation of a BI tool improves the average sales at company.

Pva: Average sales before using the BI implementation.

PVd: Average sales after using the BI implementation

Research Hypothesis 1

Alternative Hypothesis Ha: The implementation of a BI tool improves the number of sales at company.

$$HA = NVd > Nva$$

Null Hypothesis H0: The implementation of a BI tool does not improve the number of sales at company.

$$H0 = NVd \leq Nva$$

Research Hypothesis 2

Alternative Hypothesis Ha: The implementation of a BI tool improves the average sales at company.

$$HA = PVd > Pva$$

Null Hypothesis H0: The implementation of a BI tool does not improve the average sales at company.

$$H0 = PVd \leq Pva$$

Using the Mann-Whitney U test for both indicators.

Indicator 1: Number of Sales

Table 5. Mann-Whitney U test results for sales number indicator

N	26
Mann-whitney U	220,500
W	571,500
Z	-2,189
Sig	0,029

In Table 5, the calculation of the Mann-Whitney U test calculation for the sales number indicator is shown. The U value = 220.5 represents the test statistic. Additionally, the Z value = -2.189 is shown, which was calculated based on the average ranks and sums of the two groups (before and after implementation). With a 5% significance level, the result shows a p-value = 0.029, which is lower than the specified significance level of 0.05. This finding provides sufficient evidence to dismiss the null hypothesis and affirm that a significant difference exists. Thus, providing statistical evidence to support the alternative hypothesis. Based on these results, it can be stated that the implementation of BI has significantly improved the number of sales in company, as it had a statistically significant impact.

Table 6. Mann-Whitney U test results for average sales indicator

N	152
Mann-whitney U	9198,000
W	20826,000
Z	3,072
Sig	0,002

In Table 6, it is shown the calculation of the Mann-Whitney U test for the average sales indicator, where the U value = 9198.000 represents the test statistic.

Additionally, the Z value = -3.072 is shown, which was calculated based on the average ranks and sums of the two groups (before and after the implementation). At a 5% significance level, the p-value is 0.002, which is lower than the threshold of 0.05. This indicates that there is enough evidence to reject the null hypothesis, allowing to conclude that a significant difference exists. Thus, providing statistical evidence to support the alternative hypothesis. Based on these results, it can be stated that the implementation of BI has significantly improved the average sales in company, as it had a significant statistical impact.

4. Discussion

The objective of this research was to analyze the contribution of Business Intelligence (BI) tools to the enhancement of sales management in a medium-sized enterprise operating within the bakery sector. To this end, a dashboard was developed and delivered to the management team, incorporating key performance indicators meticulously selected to monitor critical aspects of the sales process. Additionally, indicators deemed essential for facilitating real-time strategic decision-making were incorporated. The results obtained during the study confirmed that the implementation of these tools not only facilitated the visualization of relevant data but also significantly enhanced sales management. This positive outcome demonstrates that BI can serve as a fundamental pillar in optimizing commercial operations. Building on these findings, a comparative analysis is proposed to evaluate the key indicators—specifically, the number of sales and the average transaction value—in relation to other studies addressing similar variables within the context of BI implementation. This comparison will facilitate the identification of both similarities and differences in reported impacts, thereby contributing to a more comprehensive understanding of best practices in the application of BI tools. Furthermore, these findings are juxtaposed with extant literature documenting the effects of BI adoption in improving analogous processes across various organizations. Such comparisons offer a more expansive perspective on the transformative potential of BI in different business contexts. The outcomes observed in this study reflect a notable positive impact following the implementation of the Business Intelligence system. Specifically, the number of sales increased from 5,846 in the pre-test to 6,962 in the post-test, representing a 19% increase. This growth underscores the pivotal role of BI in empowering organizations to process and finalize a higher volume of transactions.

The advancement can be attributed to several factors, including the enhanced data-driven decision-making, the identification of purchasing trends, and the optimized sales strategies that result from this increased capacity.

A comparative analysis of the pre- and post-implementation phases reveals the efficacy of dashboards in enhancing sales performance. This assertion aligns with the principles outlined in [14], which stipulates that dashboards should possess a user-friendly, dynamic, intuitive, and interactive interface that displays high-value information, thereby generating novel insights and fostering the emergence of new business opportunities that salespeople can leverage to improve their performance with customer [15], [16], [17] and improve their competitiveness to gain their competitive advantage [18].

The average transaction value indicator exhibited a more pronounced improvement, increasing from 1,625.26 in the pre-test to 2,919.22 in the post-test—an increase of 79.7%. This substantial modification not only substantiates the efficacy of the implemented system but also elucidates how state-of-the-art data analytics enabled the formulation of strategies aimed at optimizing the value of each sale. In this sense, the BI solution contributed not only to an increase in volume but also to a qualitative enhancement in sales performance and overall profitability. A relevant comparison can be made with the study [18] which concluded that the implementation of BI tools significantly improved sales management, particularly in strategic decision-making. The aforementioned study reported a 180.07% increase in performance, thereby underscoring the positive operational impact of BI adoption. Furthermore, the research highlighted additional pivotal benefits, including effective data consolidation, accelerated information processing, and the provision of real-time insights to decision-makers. These findings are consistent with those of the present study and reinforce the assertion that the adoption of business intelligence (BI) supports process optimization and improves commercial results [19]. In both studies, centralized visualization of key indicators through dashboards facilitated quicker and more effective adaptation to changing business environments, resulting in enhanced organizational performance. This finding underscores the critical role of business intelligence (BI) in transforming data into actionable value, thereby maximizing outcomes and enhancing competitiveness across various sectors. A related study demonstrated that the integration of BI with strategic decision-making mechanisms can yield substantial competitive advantages. The findings of the aforementioned study demonstrate that the implementation of business intelligence (BI) has been shown to enhance the acquisition and accuracy of pertinent data, consequently leading to superior information visualization and optimized sales processes [20].

These observations are in alignment with the research findings presented herein, wherein the implementation of a BI solution has been shown to consolidate critical information into a dynamic dashboard, thereby enabling faster and more informed decisions by management.

This integration of data enhanced the quality of strategic responses and contributed to the improvements observed in sales indicators following implementation. The referenced study also highlighted the importance of data accuracy and accessibility in successful commercial management according to the findings that were confirmed in this research. These results suggest that Business Intelligence (BI) is not merely a visualization tool, but rather an integrated strategic approach to achieving sustainable improvements in business performance. The observed increases in both the number of sales and the average transaction value provide robust evidence that the implementation of Business Intelligence tools had a positive impact on this enterprise. These enhancements are indicative of an improved capacity for customer acquisition, more efficient processes, and overall optimization of sales operations. Consequently, it can be posited that BI enables more effective decision-making by furnishing real-time, precise, and accessible information through dynamic dashboards customized to managerial needs.

5. Conclusion

The findings of this study indicated that the implementation of Business Intelligence (BI) led to a substantial enhancement in sales management, primarily through the optimization of decision-making processes. The Business Intelligence (BI) solution enabled the analysis of pivotal indicators, namely the number of sales and the mean transaction value. With respect to the number of sales indicator, the mean prior to implementation was 5,846 transactions. Following the implementation of the new system, the number of transactions increased to 6,962, indicating a 19% growth. This outcome suggests a positive influence of the BI solution on overall sales performance, as demonstrated by the enhancement in both the minimum and maximum daily sales values following the implementation of the solution. A thorough descriptive statistical analysis of the average sales indicator revealed a considerable increase in the mean value, from 1,625.26 prior to implementation to 2,919.22 post-implementation, corresponding to a 79.7% improvement. This increase indicates enhanced daily average revenue and validates the positive impact of the BI solution. Furthermore, substantial enhancements were detected in the minimum and maximum values, underscoring improved stability and overall performance in sales outcomes.

Future research should explore several avenues to further validate and expand upon these findings. First, longitudinal studies that examine BI impact over extended periods would help determine the sustainability of performance gains.

Secondly, comparative analyses across various industries and organizational sizes have the potential to elucidate how context influences the effectiveness of BI. Thirdly, the integration of qualitative methodologies, such as interviews with managers or staff, has the potential to yield more profound insights into user adoption, system usability, and organizational culture as factors influencing BI success. Subsequent studies could examine the incorporation of artificial intelligence (AI) or machine learning (ML) models into BI systems, which might facilitate predictive sales analytics and automated decision-support systems. These directions would not only enrich the theoretical understanding of BI in organizational contexts but also offer practical guidance for enhancing its implementation in real-world scenarios.

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