

Research Article

Bike Sales Analysis for Understanding Market Trends in Europe via Power BI Dashboard

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ABSTRACT

In the Industry 4.0 era, transforming raw transactional data into strategic insights is vital for maintaining competitiveness. This study leverages Microsoft Power BI to analyze 113,037 bicycle sales records from 2011 to 2016 across Europe using descriptive quantitative methods and interactive dashboards. The analysis reveals that accessories account for the majority of unit sales (77.94%) due to their affordability and repurchase frequency, while high-end bicycles such as Road-150 Red, 62 and Mountain-200 Black, 38 contribute the highest revenue per unit. The adult age group (35–64 years) emerges as the most profitable segment, generating USD 45 million in revenue and USD 18 million in profit. A strong positive correlation ($r = 0.87$) between age and product price underscores the purchasing power of older consumers. Geographically, the United States dominates with 34.68% of customers and USD 15.9 million in revenue, followed by Australia and Canada. Meanwhile, Europe shows promising potential for future growth. The gender distribution is nearly balanced, with both male and female customers favoring accessories—highlighting opportunities for inclusive and gender-neutral marketing. Power BI's visualization tools—bar charts, scatter plots, map views, and forecasting—enable dynamic trend analysis and strategic planning. This study contributes academically by enriching the literature on visual analytics in retail and practically by offering a replicable framework for data-driven decision-making in the bicycle market and other consumer goods industries.

Keywords: Power BI; Sales Analysis; Bicycle Market; Business Intelligence; Consumer Behavior, Data Visualization

1. INTRODUCTION

The rapid development of information technology in the industrial era 4.0 has brought fundamental changes in business data management. Sales data, which was once merely a record of transactions, is now positioned as a strategic asset with the potential to provide deep insights into consumer behavior, market segmentation, and the effectiveness of sales strategies. This transformation compels companies to develop advanced data analysis capabilities in order to make adaptive, accurate, and evidence-based decisions. In this landscape, Business Intelligence (BI) systems have emerged as transformative tools, enabling organizations to process vast amounts of data and convert it into actionable insights that improve decision-making and operational performance through real-time monitoring, predictive analytics, and automated alerts (Putra et al., 2025).

In this context, data visualization plays a central role. As business data grows in volume and complexity, the need for efficient and communicative presentation methods becomes increasingly important. Data visualization provides a strategic bridge between quantitative data and managerial decision-making, allowing users to intuitively identify patterns, trends, and anomalies. In the disciplines of business administration and information technology, data visualization is a crucial topic as it directly relates to operational efficiency and the strengthening of competitive advantage (Jabar et al., 2025). Furthermore, financial and technological development expands the possibilities for adopting cutting-edge tools such as interactive dashboards that support this efficiency (Raihan, 2023, p. 56).

Although data visualization is widely applied in many sectors, its implementation in the bicycle industry in Europe has not received sufficient academic attention. Particularly lacking are studies that utilize interactive platforms like Power BI to analyze sales data within this market. Yet, this approach has the potential to uncover strategic insights from historical data, such as seasonal demand trends, consumer preferences by bicycle type or brand, and sales performance based on location or distribution channel. At present, bicycle sales data is often used only for operational tasks like monthly reporting, stock evaluation, and restocking, without being integrated into more strategic or predictive functions. The current use

remains largely descriptive and insufficient in supporting data-driven decision-making on matters such as market segmentation, dynamic pricing, or promotional targeting.

Therefore, integrating sales data with interactive visualizations represents a significant opportunity to transition from descriptive to analytical and predictive use. However, there remains a gap between the abundance of data and the capacity to process it in real time to support rapid and well-informed decisions. As Rohmah et al. (2025) emphasize, proper planning supported by accurate data can aid in efficient resource allocation and the development of policies aligned with global market dynamics, which is increasingly relevant not only to governments but also to businesses in competitive industries. This research focuses on analyzing bicycle sales data in Europe using Power BI as the primary visualization tool. The objects of study include data categorized by region, product type, and time period. The aim is to explore how interactive visualization can uncover sales patterns, identify growth trends, and detect anomalies that could influence marketing and distribution strategies.

This research contributes in two key aspects. Practically, it provides an interactive dashboard that industry players can use to better understand the dynamics of the bicycle market and create more targeted marketing strategies. Academically, it enriches the literature on the use of business intelligence in sales data analysis, particularly in the underexplored bicycle sector, and demonstrates the practical applicability of Power BI as an adaptive tool in data visualization and strategic decision-making.

LITERATURE STUDY

1. Data Visualization Concept

According to Nancy Organ (2024), data visualization is the art and science of making information visually visible. In her book *Data Visualization for People of All Ages*, Organ explains that data visualization uses shapes, colors, and other visual elements to convey ideas, patterns, and relationships in data. Data visualization aims to facilitate understanding, exploration, and communication of complex information.

From (Geraldine et al., 2025) a similar approach is applied in the context of green purchase intention. They emphasize that "consumers with a positive attitude toward environmentally friendly products are more likely to respond to visualizations that clearly convey environmental values." The concept of data visualization includes:

- a. **Data Presentation:** Transforming raw data into graphs, charts, or other visual forms.
- b. **Proper Visual Selection:** Choosing the type of visualization (such as bar chart, scatter plot, or heatmap) that suits the type of data and the purpose of the analysis.
- c. **Effective Design:** Using design principles such as contrast, hierarchy, and consistency to ensure visualizations are easy to understand.

Data visualization also involves understanding the type of data (numerical, categorical, ordinal) and how best to represent it. For example, numerical data can be displayed using bar or line graphs, while categorical data lends itself to pie charts or heat maps with different colors.

2. The Role of Data Visualization in Business

Data visualization is a technique of presenting information in graphical form such as charts, diagrams, or infographics that aims to facilitate understanding, analysis, and data-based decision making. In a business context, data visualization plays a very strategic role, as it allows decision makers to identify patterns, trends, and anomalies that may not be apparent in the raw data. Organ (2024) states that data visualization helps us "see things we might not have noticed before, such as patterns, similarities, and relationships". In business practice, this ability is crucial, especially in situations that require a quick response to changing market conditions or evaluation of operational performance.

Furthermore, data visualization serves as an effective cross-functional communication medium, especially for stakeholders who do not have a technical background. By simplifying the complexity of data into intuitive visual displays, visualization accelerates the analysis process and strengthens collective understanding in the decision-making process. Organ (2024) also emphasizes that data visualization is "a very effective means of conveying data that is important to us to others, as well as for understanding data collected by others".

In addition, argues that the rise of the digital economy and fintech has transformed business behavior to become more data-centric, where decision-making increasingly relies on online data and digital applications. This shift underlines the importance of data visualization tools as enablers of real-time insight delivery and efficient communication across business units. Similarly, Putra et al., (2025) demonstrate the implementation of interactive dashboards using Microsoft Power BI enabled real-time monitoring and improved decision-making in a public organization setting. Their study highlights that visual dashboards allowed stakeholders to respond swiftly to operational issues and track key performance indicators without delay. Moreover, predictive analytics embedded within the visualization system achieved high levels of accuracy, showing the broader potential of data visualization in both descriptive and predictive business functions.

In the digital ecosystem, data visualization is not just a presentation tool but a key element for mapping customer needs

in real-time and adjusting business strategies. (Morande & Tiwari, 2023) stated that “The Digital Ecosystem helps companies understand customer needs, enhance user experience, and retain customer loyalty”. Power BI supports this by enabling fast and accurate analysis for cross-functional decision-making. In line with this, Tirupati et al. (2023) stated that “Power BI’s interactive dashboards, customizable reports, and real-time data updates empower organizations to gain deeper insights and foster data-driven decision-making,” emphasizing the platform’s central role in enabling efficient, collaborative decision-making across departments.

3. Microsoft Power BI

Microsoft Power BI is a cloud-based data analysis service from Microsoft that enables data visualization from various sources for business analysis purposes (Yumni & Widowati, 2021). Power BI began its development in September 2013 and was officially launched on 24 July 2015 (Ningsih et al., 2025). Irawan et al. (2022) stated that Power BI presents interactive graphics that allow interaction between report creators, process owners, and data in an attractive manner.

Power BI enables the creation of dashboards, applications, data analysis, and exploration of information from multiple sources. The platform is cloud-based, integrated with other Microsoft applications, and supports collaboration and data-driven decision-making quickly and accurately (Shoaib & Nandi, 2022).

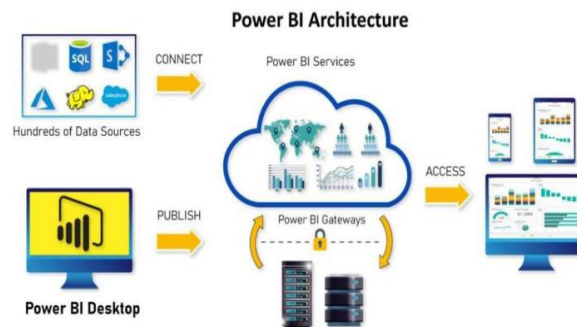


Figure 1. Power BI Structure (Daruvuri et al., 2024)

The Power BI architecture consists of several main components that are integrated with each other (Daruvuri et al., 2024), as follows.

- Power BI Desktop: Application for data import, cleansing, modelling and visualization.
- Power BI Service (Cloud): A place to publish and share reports and access data across devices.
- Power BI Gateway: A link between local data and the cloud so that local data can be automatically updated.
- Power BI Mobile: An application to access dashboards from mobile devices.

Daruvuri et al. (2024) mentioned the main features of Power BI include:

- Deep data analysis with drill-down and drill-through.
- Interactive dashboards that are dynamic and real-time.
- Advanced analytics with Python and R integration.
- Natural Language Query (NLQ) feature for data search with everyday language.

According to Irawan et al. (2022), the advantages of Power BI include:

- Efficient data sharing through a cloud platform for real-time collaboration.
- Real-Time dashboards that allow quick monitoring of data changes.
- Large-scale data processing with high efficiency, without the need for complicated preprocessing.

Power BI offers both ease of use and advanced analytics capabilities, making it a flexible tool for a wide range of needs, from individuals to organisations (Ningsih et al., 2025).

4. Business Intelligence in Power BI

Business Intelligence (BI) is the process and technology for collecting, managing, and analysing data to generate insights to support strategic and operational decisions, including historical and real-time data, both structured and unstructured, including from social media (What Is Power BI? - Microsoft Learn, 2024). A BI analyst is tasked with transforming raw data into meaningful information that can help organisations understand business performance and determine the right next steps. With BI tools, users can dig deeper into the information available. CIO Magazine states that BI does not provide definitive answers to decisions, but rather provides a way to explore data and discover patterns, trends, and factors that influence outcomes. BI allows users to actively analyse data and not just rely on static reports.

In the context of Power BI, BI principles are applied through Microsoft's data analytics platform. Power BI enables integration of data from multiple sources, data processing and analysis, and presentation in the form of interactive

visualizations to aid data-driven decision-making (Sharda et al., 2020). Power BI provides key features such as integration with various data sources (SQL, Excel, APIs, and others), use of DAX and Power Query for advanced analysis and data cleansing, and presentation of interactive visualizations such as charts and KPIs. Users can also collaborate through Power BI Service by sharing reports and dashboards online.

In addition, Power BI supports real-time analytics, enabling live data monitoring that is essential for businesses that need a quick response to operational or market changes. The benefits of Power BI in business practice include analysing financial statements such as balance sheets and profit and loss, efficiently managing inventory for retail and manufacturing businesses, monitoring the effectiveness of marketing campaigns, and monitoring operational performance through key performance indicators (KPIs).

5. Sales Analysis Theory

Sales analysis involves collecting and evaluating transaction data to guide marketing strategies, with sales volume as a key indicator of demand and strategy effectiveness (Rini et al., 2021). Data mining techniques like the Apriori algorithm help identify frequent item combinations, optimizing product placement and promotions (Dora et al., 2022).

According to Albanjari (2021), there are several main factors that influence sales activities:

- a. Seller Capabilities – Product knowledge, pricing understanding, and communication skills.
- b. Market Conditions – Segmentation, consumer purchasing power, and purchase frequency.
- c. Company Capital – Funding for promotions, distribution, and HR development.
- d. Personal Selling Strategy – Customized presentations and relationship-building.

Strategic Benefits (Dora et al., 2022; Rini et al., 2021):

- a. Promotion & Marketing: Apriori Algorithm reveals buying patterns for targeted discounts or product bundling.
- b. Product Arrangement: Optimizes layout based on purchasing trends.
- c. Long-term Decisions: Historical data guides stock planning and promotions.
- d. Performance Evaluation: Assesses impact of price, promotion, and quality on sales.

Common Analysis Methods:

- a. Sales Trend & Regional Analysis – EDA identifies trends (e.g., property sales decline in specific months) (Lisna & Voutama, 2024).
- b. Product Contribution & Clustering – K-Means highlights top-performing categories (e.g., beverages as flagship products) (Sholekha et al., 2024).
- c. Transaction & Promotion Analysis – Apriori Algorithm uncovers product associations for promotions (Dora et al., 2022).
- d. Product Return Analysis – Evaluates quality and satisfaction (though less discussed in literature).

Sales analysis serves as a tool to refine strategies and enhance competitiveness.

6. Consumer Behavior Theory

Consumer behavior is a branch of marketing that studies how individuals, groups, and organizations make decisions to select, purchase, use, and dispose of products or services, considering not only rational but also emotional, social, cultural, and economic factors (Nassè, 2021). It reflects the dynamic interaction of perceptions, values, social norms, and external influences like media and the environment, forming the basis for market-oriented strategies (Sudirjo et al., 2024). Among key theories, utility theory explains that consumers act rationally to maximize satisfaction, while consumer satisfaction theory focuses on post-purchase evaluations influenced by perceived quality, service, and brand image. Additionally, personality traits and motivation levels—ranging from basic to self-fulfillment needs—shape preferences and behavior, emphasizing the importance of emotionally relevant marketing.

Not all decisions are rational; impulse buying theory highlights spontaneous purchases triggered by emotional cues or external stimuli like visual ads or store atmosphere. Effective strategies must, therefore, balance rational appeals with emotional triggers. The consumer decision-making process generally follows five stages: need recognition, information search, evaluation of alternatives, purchase decision, and post-purchase evaluation. These stages are influenced by internal and external factors, including motivation, perception, personality, culture, reference groups, and situational contexts. Social influence and brand perception are particularly significant in shaping buying behavior.

Understanding these dynamics enables companies to create products that align with consumer preferences, set value-based prices, craft targeted messaging, and improve satisfaction and loyalty through positive experiences. It also supports accurate market segmentation and strategic focus on the most promising consumer groups, making consumer behavior analysis a vital tool for business success in competitive markets (Sudirjo et al., 2024).

In addition, (Rahmawati & Rino, 2025) highlight the role of advertising communication models in influencing consumer behavior, particularly in building loyalty. Through the AIDA model—which stands for Attention, Interest, Desire, and

Action—they argue that emotionally engaging advertising plays a key role in guiding consumers from awareness to loyalty. According to them, “the AIDA advertising model has a significant influence on customer loyalty because it stimulates interest and desire before encouraging action, creating an emotional connection that supports repeat purchasing behavior and brand attachment.” This reinforces the idea that in addition to understanding consumer traits and decision stages, businesses must also strategically craft marketing communications that resonate emotionally to foster long-term customer engagement.

7. Theories of Consumer Behaviour (cont.)

To understand consumer behaviour systematically, various theories have been developed to explain the influencing factors behind purchasing decisions. Utility theory highlights rational consumer choices aimed at maximising benefits, while consumer satisfaction theory focuses on post-purchase evaluations shaped by perceived quality, service, and brand reputation. These theories emphasise the importance of creating value and delivering satisfying experiences. Internal factors such as personality traits (e.g., openness, neuroticism) and motivational hierarchies—from basic needs to self-actualisation also shape preferences and loyalty, requiring marketing strategies to address psychological and emotional dimensions. Moreover, buying behaviour ranges from rational, based on price-benefit analysis, to impulsive, triggered by emotions or external cues like advertising or store ambience. The consumer decision-making process generally involves five stages: need recognition, information search, evaluation of alternatives, purchase decision, and post-purchase evaluation—each influenced by experience, social factors, and context. Consumer behaviour is further affected by internal elements such as motivation and perception, and external factors including culture, family, and technology. Notably, social influence and brand perception are key determinants of purchase decisions. Strategically, understanding consumer behaviour enables businesses to align products with market needs, price effectively, target messages accurately, and foster loyalty through positive experiences. It also enhances market segmentation and helps companies remain competitive in dynamic environments (Sudirjo et al., 2024). According to Solomon (2020), consumer behavior involves much more than just buying products—it reflects deeper psychological, social, and cultural meanings. People often purchase items not only for functional purposes but also to express identity, belonging, or aspiration. Understanding this broader consumption context helps marketers address both rational decision-making and symbolic consumption dimensions.

8. Bicycle Sales Trends in Europe

In 2024, the European bicycle market saw sales decline by 8.9% (11.7 million units), influenced by the cost-of-living crisis that reduced consumer purchasing power. However, e-bikes remain the dominant segment with sales reaching 5.1 million units in 2023, 50% higher than before the pandemic. The economic crisis also affected the performance of large companies such as Halfords and Brompton. Halfords experienced an 18.3% drop in profit and a 2.8% drop in revenue for its bicycle division, while Brompton experienced a more than 99% drop in profit. However, the second-hand bicycle market showed significant growth. Buycycle recorded an 11-fold increase in sales in France by 2024, reflecting young consumers' interest in sustainability and cost efficiency. The bicycle industry remains optimistic with investments of more than €1.9 billion by 2023 to strengthen local production capacity in countries such as Portugal, Poland, and Germany. These production relocations aim to reduce dependence on global supply chains.

Looking ahead, the market outlook remains positive thanks to government policies that favour sustainable mobility and technological innovation in bicycles. Despite challenges, the e-bike and used bicycle segments are predicted to drive long-term growth in the industry.

9. Data Visualization as a Decision Support Tool in Business Administration

Ramadhani et al. (2024) confirmed the importance of utilising company product data in making business decisions. The accuracy and speed of data processing facilitate access to the necessary information, so that companies can anticipate risks and minimise losses.

Data visualization, according to Khatri & Gupta (2022), helps reduce time wasted when users struggle to access, report and analyse data. Proper visualization allows decision makers to easily recognise patterns or changes in data over time. Consistent and effective data presentation supports quick and accurate analysis, minimises risk, and improves business management efficiency. In business administration decision-making, data visualization plays an important role in identifying trends, patterns, or anomalies that are difficult to detect if the data is only in the form of tables or text. This is crucial for assessing market conditions, financial performance, and operational efficiency precisely and quickly.

(Nisa & Rusdianto, 2024) shows that data visualization plays a crucial role in improving the speed and accuracy of business decision-making through platforms such as Power BI, which can present data in interactive and easy-to-understand formats. Furthermore, (Nafiisa et al., 2022) emphasized that the use of interactive dashboards and dynamic visualizations helps MSME entrepreneurs gain a better understanding of sales trends and consumer behavior, thereby supporting more adaptive and responsive business strategies in response to market changes.

2. RESEARCH METHOD

The research method is a process carried out to obtain data that will be used in further processing and analysis (Sifa, 2024).

1. Type of Research and Research Data

The type of research used is descriptive quantitative with an exploratory approach based on data visualization. This research aims to systematically, factually, and accurately describe the characteristics of bicycle sales data in Europe using statistical analysis techniques and visual representations.

The research data used is secondary data obtained from the Kaggle platform, titled "Bike Sales in Europe" (link: <https://www.kaggle.com/datasets/sadiqshah/bike-sales-in-europe>). The dataset was accessed and downloaded on April 25th, 2025, in CSV format with a file size of 9.7 MB. This dataset contains 18 columns, each with the following data types.

- a) Date - Interval
- b) Day - Numerical
- c) Month - Ordinal
- d) Year - Interval
- e) Customer_Age - Numerical
- f) Age_Group - Categorical
- g) Customer_Gender - Categorical
- h) Country - Categorical
- i) State - Categorical
- j) Product_Category - Categorical
- k) Sub_Category - Categorical
- l) Product - Categorical
- m) Order_Quantity - Numerical
- n) Unit_Cost - Numerical
- o) Unit_Price - Numerical
- p) Profit - Numerical
- q) Cost - Numerical
- r) Revenue - Numerical

The dataset from Kaggle was chosen due to the ease of access, credibility of the source, and completeness of data that supports the research objectives for exploration and visualization of sales patterns.

2. Population and Sample

Quantitative descriptive research with an exploratory approach based on data visualization. The population in this research is the entire dataset, consisting of 113,037 rows record of bicycle sales across multiple countries in Europe. The dataset includes bicycle transaction data covering the sales period from 2011 to 2016.

No sampling was applied, therefore, the entire dataset was used as the population for analysis. The data provides a broad view of consumer behavior and sales performance over time, which aligns with the goals of exploratory data visualization.

3. Research Operational Variables

To ensure clarity of direction and focus of the research, a systematic operational definition of variables is required. The following table presents a description of the research variables along with their definitions, indicators, measurement scales, and theoretical references used as a basis for analysis.

Table 1. Research Operational Variables

No	Research Variables	Variable Definitions	Indicators	Measurement Scale	Sources & Discussion of Previous Research
1	Data Visualization using Power BI (X)	The level of use of Power BI in presenting bicycle sales data visually, interactively and communicatively to facilitate understanding of complex information and support the data-based decision-making process.	<ol style="list-style-type: none"> Type of visualization (bar chart, pie chart, heatmap) Dashboard interactivity Clarity of visual information Speed of pattern understanding 	Ratio	<ul style="list-style-type: none"> -Organ, N. (2024). states that the effectiveness of visualization depends on the selection of graph types and the clarity of visual elements such as color and layout. -Daruvuri et al. (2024). examined the effectiveness of Power BI interactive dashboards in helping users quickly understand data trends and patterns through drill-down and filter features. -Ramadhani et al. (2024). showed that Power BI visualizations accelerate the analysis and decision-making process in a retail business context by emphasizing the clarity and speed of data interpretation.

2	Bicycle Sales Analysis (Y)	A systematic evaluation of bicycle sales transaction data by time, region, and product category, aiming to reveal trends, buying patterns, product contributions, and sales anomalies to support more accurate marketing strategies and business decision-making.	<ol style="list-style-type: none"> 1. Sales volume 2. Sales growth trends 3. Contribution by bicycle type 4. Sales anomalies or deviations 	Ratio	<p>-Rini, A. et al. (2021). emphasized that sales volume is used as a key indicator in assessing the effectiveness of marketing strategies.</p> <p>-Dora et al. (2022). Data Mining for Purchase Pattern Analysis. uses the Apriori algorithm to find purchase patterns in transaction data and devise more efficient product structuring strategies.</p> <p>-Sholekha et al. (2024). applied the K-Means Clustering method to analyze sales data of snack and beverage products, which successfully grouped products based on sales performance and contribution to support stock and marketing strategies.</p>
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4. Data Collection Technique

Data collection in this study was done by downloading datasets available on Kaggle, a platform that provides various data sources. Relevant datasets were retrieved directly from the Kaggle page for further analysis, allowing easy and efficient access to the data needed in the study.

5. Data Processing and Analysis Technique

Datasets obtained from Kaggle were analyzed using Microsoft Power BI. Since Power BI does not have a direct connection to Kaggle, the datasets were first downloaded to local storage in CSV or XLSX format. After that, the data is imported into Power BI Desktop for the analysis process. The analysis process includes the following steps.

a. Data Cleaning and Transformation

Raw data is cleaned of missing or irrelevant values, and transformed to make it suitable for visualization.

b. Data Modeling

The initial data used was in the form of a flat table, where all information was stored in one large table. To facilitate the analysis process, the data was separated into several tables based on categories, and then a relationship between tables was formed using a star schema approach. In the star schema, there is one fact table that contains transaction data, as well as several dimension tables that explain the details of the transaction, such as customer, product, time, and region information. Relationships between tables are formed to facilitate a more structured and efficient process of analyzing and extracting information.

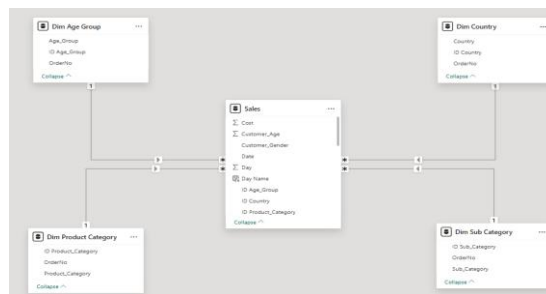


Figure 2. Star Schema

c. Data Visualization

Data is visualized in the form of graphs, tables, and interactive dashboards to informatively depict patterns of bicycle sales in Europe.

d. Descriptive Analysis

Perform simple statistical analysis such as total sales, time trends, and regional distribution to describe the characteristics of the data.

e. Deepening Information

By utilizing features such as drill-down and filtering in Power BI, researchers can dive further into the data to discover findings or trends that are not immediately apparent.

3. RESULTS AND DISCUSSION

3.1 Bike Sales Metrics & Top Products Overview

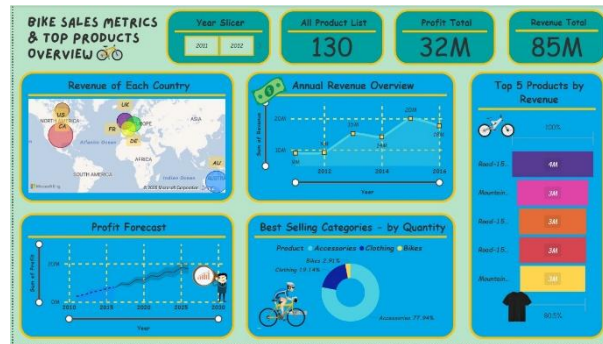


Figure 3. Bike Sales Metrics & Top Products Overview

The “Bike Sales Metrics & Top Products Overview” dashboard presents a concise summary of bicycle sales performance across countries. It displays key figures such as total products (130), total revenue (\$85M), and profit (\$32M). Users can filter data by year for focused analysis.

The annual revenue increased from \$9M in 2011 to a peak of \$20M in 2015, before a slight drop to \$18M in 2016. The profit forecast shows consistent growth toward 2030. The top 5 products by revenue are dominated by variants of Road-150 and Mountain-200, each contributing between \$3M–4M. The sales map highlights the US, Australia, Canada as major markets.

In terms of quantity, Accessories lead significantly with 77.94% of total units sold, followed by Clothing (19.14%) and Bikes (2.91%). Overall, the dashboard provides clear insights for business decision-making.

3.1.1 Global Revenue Distribution by Country (Map View)

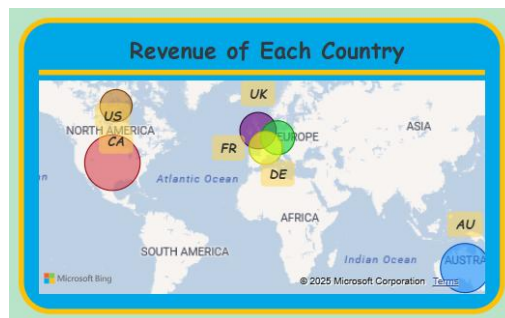


Figure 4. Revenue of Each Country

The map-based visualization highlights the United States and Canada as the top global revenue contributors, reflecting the strength and maturity of the cycling industry in North America. In Europe, the United Kingdom and Germany lead the market, showing strong sales performance despite trailing behind North America. Their growth signals rising interest in cycling products and presents significant expansion opportunities.

This pattern offers strategic insight: while North America dominates in revenue, Europe holds untapped potential especially in countries where cycling culture is on the rise. The UK and Germany could serve as key hubs for broader regional growth, supported by localized marketing, tailored products, and efficient distribution.

Lower-revenue European countries may still offer strong demand and can be targeted through increased brand visibility, partnerships, or entry-level offerings. In summary, North America drives current sales, but Europe presents promising long-term growth prospects for global strategies.

3.1.2 Annual Revenue Dynamics: Opportunities and Challenges

The annual revenue visualization shows strong growth from 2012 to 2015, followed by a noticeable decline in 2016. This three-year expansion likely reflects successful strategies, timely product launches, and favorable market conditions, aligning well with customer needs. However, the drop in 2016 marks a key turning point that calls for further investigation. Possible causes range from internal issues like strategic missteps or supply chain problems to external factors such as market saturation or changing consumer preferences. The contrast underscores the importance of adaptability and strategic

agility.

A detailed year-over-year analysis, including customer feedback and competitor activity, could help identify root causes and inform future strategies. By learning from both growth and decline, the company can better navigate market shifts and support long-term, sustainable growth.



Figure 5. Annual Revenue Overview

3.1.3 Best-Selling Categories by Quantity: The Dominance of Accessories in Sales Volume



Figure 6. Best Selling Categories by Quantity

Accessories dominate sales at 77.94%, far surpassing bikes (2.91%) and clothing (19.14%), indicating high purchase frequency due to affordability and functionality. According to (Azka et al., 2024), when purchasing power declines due to inflation, consumers shift to cheaper yet useful alternatives. The dominance of accessories reflects a rational response to economic pressure. Thus, accessories are a strategic product. Businesses can leverage this by expanding accessory lines, offering bundles, and creating loyalty programs to boost repeat purchases and customer retention.

3.1.4 Strategic Analysis of Top-Selling Products by Revenue

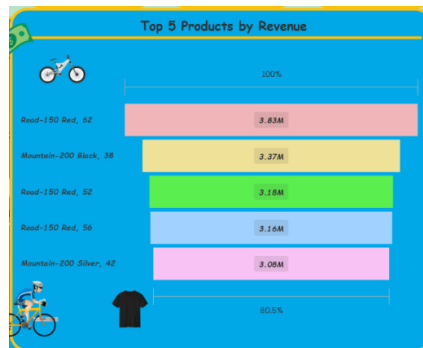


Figure 7. Top 5 Products by Revenue

The top five revenue-generating products are dominated by high-value bicycles, particularly the Road-150 Red, 62 which alone generated nearly USD 3.83 million. Other top contributors include various Road and Mountain bike models, each with around USD 3 million in revenue. Although sold in lower quantities, these bikes drive significant revenue due to their premium pricing.

In contrast, the best-selling products by quantity are low-cost accessories like water bottles and gloves, purchased frequently and in bulk. This contrast reflects two consumer behavior patterns: habitual, high-volume purchases for affordable items, and selective, high-impact purchases for expensive products.

According to utility theory and consumer behavior insights (Sudirjo et al., 2024), this indicates rational decisions in

premium purchases and habitual patterns in low-cost items. Strategically, businesses can bundle accessories with bikes to boost transaction value and promote premium bikes with value-driven messaging. Identifying top bike models by revenue also supports inventory and pricing optimization. Tools like Power BI dashboards enhance visibility into these trends, enabling more effective product planning and promotion (Ramadhani et al., 2024).

3.1.5 Company Profit Growth Projections: Trend Visualization for Long-Term Business Planning

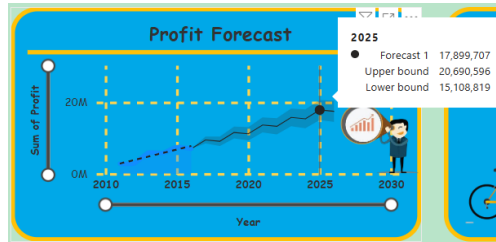


Figure 8. Profit Forecast

One key element in the Bike Sales Metrics & Top Products Overview dashboard is the Profit Forecast chart, which illustrates projected profit growth from 2010 to 2030. While profits were below USD 10 million in 2010, steady growth began in 2015, reaching nearly USD 17.8 million by 2025, highlighting strong, sustainable financial progress. This upward trend reflects effective strategy execution, particularly through high-performing complementary products and targeted marketing. According to Rini et al. (2021), such trends indicate a company’s ability to align offerings with evolving consumer behavior. From a Business Intelligence perspective, the use of Power BI enhances decision-making by making data patterns easily accessible, as supported by Daruvuri et al. (2024).

Moreover, this projection acts as a strategic communication tool, useful for engaging investors, partners, and internal stakeholders. As noted by Organ (2024), clear visual data simplifies complex information for cross-functional understanding vital in proposals and strategic planning. In summary, the profit forecast not only demonstrates financial direction but also the company’s maturity in using data as a strategic asset. Realizing these projections requires continued product quality, innovation, and adaptability to global market trends. This dashboard effectively combines technology and strategic management in the digital era.

3.2 Bike Sales Performance By Customer Segment



Figure 9. Bike Sales Performance by Customer Segment

This dashboard provides a visual summary of bike sales performance by age, gender and country. The Adults age group (35-64 years) is the main contributor to revenue and profit. The United States led sales (34.68%), followed by Australia (21.18%) and Canada (12.54%). Accessories are a favorite product for both men and women. There is a strong positive correlation between age and unit price, where older customers tend to buy more expensive products. Overall, the dashboard supports strategic sales and marketing decision-making based on customer characteristics.

3.2.1 Analysis of Customer Distribution by Gender and the Correlation Between Age and Product Price



Figure 10. Gender Distribution and Correlation of Price vs Age Group

The data illustrates the distribution of customers by gender and shows a significant relationship between the age of customers and the price of the products they choose. It was found that the distribution of customers was relatively balanced between male (58 thousand) and female (55 thousand) with no significant dominance of either group.

In addition, there is a strong positive correlation (0.87) between age and product price, where older customers tend to choose higher-priced products. These findings indicate that the mature segment is a potential target for premium products, so exclusive marketing and product development strategies need to be tailored to the characteristics and purchasing power of this age group in order to increase sales effectiveness and expand the market share of higher-value products.

3.2.2 Analysis of Revenue and Profit Contribution by Consumer Age Group

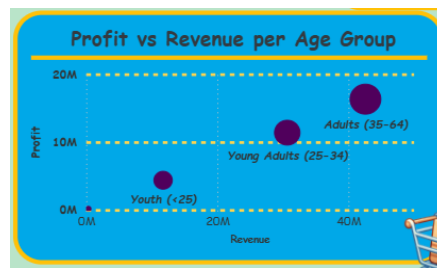


Figure 11. Profit vs Revenue per Age Group

The "Profit vs Revenue per Age Group" chart shows a clear trend of increasing contributions to company revenue and profit based on consumer age groups. The Youth group (<25 years) contributes the least, with revenue around 15 million and profit approximately 5 million, reflecting their limited purchasing power.

In contrast, the Young Adults (25–34 years) group shows a significant increase, generating about 30 million in revenue and 12 million in profit, indicating growing financial stability.

The Adults (35–64 years) group contributes the most, with revenue reaching 45 million and profit around 18 million. This suggests that older consumers possess stronger purchasing power and represent the most potential market segment for the company. Overall, the chart highlights that as consumer age increases, so does their contribution to the company’s profitability.

3.2.3 Sales Distribution Trends by Country: U.S. Dominance and Growth Potential in Europe

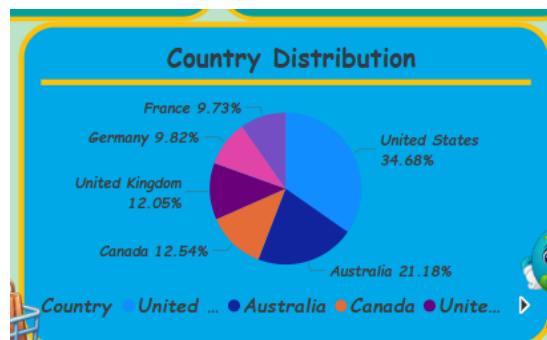


Figure 12. Country Distribution

The “Country Distribution” chart depicts each country's contribution in the form of a pie chart, representing the percentage of customers or sales volume. The United States took the top spot as the largest contributor with a significant share of 34.68%, highlighting its central role in the company's business strategy. Australia came in second with a contribution of 21.18%, followed by Canada at 12.54%.

Meanwhile, European countries made smaller contributions such as the United Kingdom 12.05%, Germany 9.82%, and France 9.73%. This distribution indicates potential opportunities to expand market penetration in Europe and other countries with relatively smaller contributions, aiming to increase diversification and global sales growth. Overall, the chart confirms that the United States is the company's main market with the greatest influence, which is the focal point for future marketing strategies and product development.

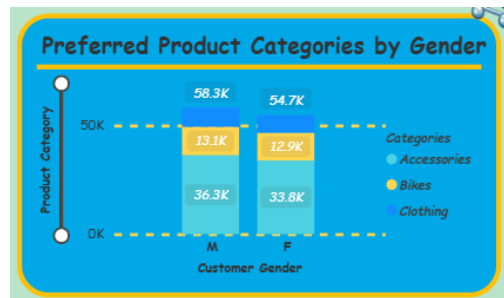


Figure 13. Preferred Product Categories by Gender

3.2.4 Comparison of Product Purchase Preferences Between Male and Female Customers

There are three main product categories analyzed: Accessories, Bikes, and Clothing, with preferences differentiated by customer gender.

Male customers, with a total of 58,300 thousand purchases, mostly chose the Accessories category with 36,300 thousand units. The second most popular category was Bikes with 13,100 thousand units, followed by clothing in third place with around 8,900 thousand units. Similarly, female customers, with a total of 54,700 thousand purchases, showed a comparable preference: Accessories are also their favorite product with 33,800 thousand units, followed by Bikes with 12,900 thousand units, and clothing with 8,000 thousand units.

From this data, it is clear that the accessories category dominates purchase preferences in both gender groups, indicating that accessories products are a key focus in sales strategies. Bicycles took a significant second place, reflecting the strong interest in this category among customers. Although clothing made the smallest contribution, it remains an important part of the product offering to complement customer needs. This information can be a valuable reference to guide targeted marketing efforts and product development based on gender specific preferences.

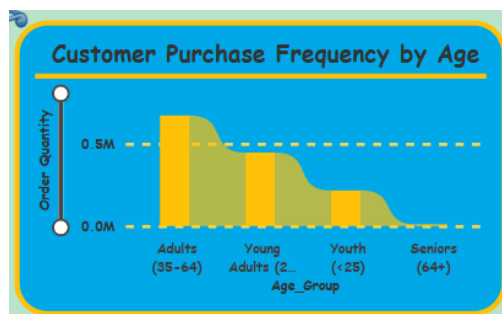


Figure 14. Customer Purchase Frequency by Age

3.2.5 Product Purchase Trends Based on Customer Age Segmentation

This chart shows the purchase frequency based on age groups, divided into four categories: Adults (35–64), Young Adults (25–34), Youth (<25), and Seniors (64+).

The chart indicates that the Adults group (35–64) has the highest purchase frequency with over 0.5 million orders,

making them the main contributors to total purchases. The Young Adults group (25–34) ranks second, with a purchase frequency lower than that of Adults. Next, the Youth group (<25) shows an even lower purchase frequency, while the Seniors group (64+) records the lowest purchase frequency.

The key insight from this data is that the adult age group (35–64) is the most active segment in terms of purchase volume, whereas seniors contribute the least. This information is crucial for focusing marketing strategies and product development according to the characteristics and needs of each age group.

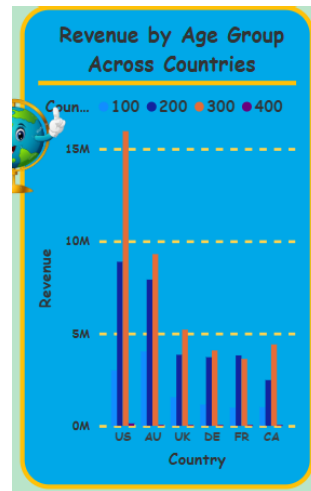


Figure 15. Revenue by Age Group Across Countries

3.2.6 Revenue Analysis by Age Group Across Countries

This chart displays revenue by age group across various countries, including the US, Australia (AU), United Kingdom (UK), Germany (DE), France (FR), and Canada (CA). The colors represent the revenue amounts, with darker shades indicating higher revenue levels.

Among these countries, the US clearly stands out with the highest revenue, generating approximately \$15.958.904 million, which significantly surpasses the figures of all other markets. Australia and the United Kingdom follow as the next largest contributors, but their revenue figures remain considerably lower than that of the US. Meanwhile, Germany, France, and Canada exhibit relatively similar revenue levels, each contributing around 5 million.

The key insight from this data is the dominant role of the US market across all age groups, emphasizing its critical importance in the company's overall revenue generation. This dominance suggests that business strategies, marketing efforts, and product development should prioritize the American market to maximize growth and profitability. Additionally, the noticeable gap between the US and other countries points to potential opportunities for expanding presence and increasing revenue in markets like Australia, the UK, and key European countries. Understanding these regional differences allows the company to tailor its approach effectively, targeting specific age groups and countries for optimized performance.

4. CONCLUSION

This study demonstrates that utilizing Power BI as an interactive visualization tool effectively provides in-depth insights into bicycle sales trends across Europe and consumer behavior across demographics and regions. By analyzing 113,037 transaction records from 2011 to 2016, Power BI enabled the discovery of strategic findings through dynamic and intuitive visual formats, in line with Organ's (2024) assertion that data visualization bridges the gap between complex quantitative information and fast, intuitive decision-making.

Overall, accessory products such as water bottles and gloves emerged as the top-selling category by volume (77.94%), although they contributed less to total revenue. This finding supports consumer behavior theory (Sudirjo et al., 2024), which suggests that repetitive purchases of low-value products are often driven by habit and functional needs. Conversely, premium bicycles like the Road-150 Red, 62 and Mountain-200 Black, 38 which made up only 2.91% of sales volume, contributed the highest revenue per unit (USD 3–3.8 million), reflecting rational, value-driven purchasing behavior consistent with utility theory.

Demographically, consumers aged 35–64 were identified as the most economically significant segment, contributing approximately USD 45 million in revenue and USD 18 million in profit. A strong positive correlation ($r = 0.87$) was observed

between customer age and product price, as visualized through scatter plots, confirming that older consumers tend to purchase higher-value items. This group also recorded the highest purchase frequency (>500,000 transactions), reinforcing the importance of developing exclusive and value-focused strategies for this segment.

Geographically, the United States stood out as the leading market, contributing 34.68% of customers and USD 15.9 million in revenue dominated by adult consumers and premium products. Australia and Canada followed, while the United Kingdom, Germany, and France showed promising potential for expansion if supported by locally tailored marketing. This aligns with Business Intelligence theory (Sharda et al., 2020), which emphasizes that integrating spatial, demographic, and sales data enables timely and evidence-based strategic decisions.

From a gender perspective, the relatively balanced distribution 58,300 male and 54,700 female customers with similar preference for accessories, highlights the opportunity for gender-neutral marketing and universally designed product offerings. Although the clothing category contributed the least in unit sales, it remains relevant for bundling and cross-selling strategies.

Power BI's visual features including bar charts, pie charts, map views, and scatter plots enabled the detection of seasonal patterns, sales anomalies, and performance trends across regions in real time. A key highlight was the profit forecast dashboard, which projected consistent profit growth from 2015 to USD 17.8 million by 2025. This supports Ramadhani et al. (2024), who found that Power BI facilitates trend analysis and strategic communication through effective visual representation.

Based on these findings, this study offers several strategic recommendations for the bicycle industry and other retail sectors:

1. Expand accessory lines with high purchase frequency and bundling potential;
2. Target adult consumers with exclusive products that reflect value and comfort;
3. Maintain market leadership in the U.S. through quality and customer experience strategies;
4. Enhance market penetration in Europe particularly the UK, Germany, and France through localized marketing and competitive pricing;
5. Implement gender-neutral marketing based on actual consumer data rather than demographic assumptions.

In conclusion, Power BI proves to be more than a visualization tool it is a Business Intelligence platform capable of transforming large datasets into actionable, strategic insights. Academically, this research contributes to the growing body of literature on interactive visualization in data-driven decision-making. Practically, it demonstrates how analytical technology can be effectively adopted by industries to enhance efficiency, precision in strategy, and long-term business sustainability.

ACKNOWLEDGEMENTS

The authors would like to express their highest appreciation to Politeknik Negeri Bandung, especially to the Business Administration Study Program and Informatics Engineering Study Program, for their academic support, facilities, and inspiring learning environment during the process of conducting this research. Such support is an important foundation in the successful preparation of this data visualization project.

The authors would also like to acknowledge the Kaggle platform for providing the "Bike Sales in Europe" dataset as the main data source for visual analysis and processing using Power BI. The availability of complete and credible data from the platform was very helpful in producing relevant and accurate findings.

Deep gratitude is also extended to the lecturer, peers, and all those who have provided constructive suggestions, scientific input, and motivation during the process of preparing this report. Collaboration and support from various parties have enriched the quality of analysis and delivery of the results of this research.

Finally, the authors hope that the results of this research can make a real contribution, both in the development of literature in the field of data visualization and business intelligence, as well as an applicable reference in strategic decision making in the bicycle industry and other data-based business sectors.

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