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Impact of Data Visualization on Strategic Business Decisions: An Empirical Study Using Power BI and Tableau

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Abstract: In the contemporary business environment, organizations increasingly rely on data-driven insights to support strategic decision-making. The exponential growth of business data has intensified the need for effective data visualization techniques that can transform complex datasets into meaningful and actionable insights. Data visualization serves as a critical interface between analytical outputs and managerial cognition, thereby influencing decision accuracy, speed, and confidence.

Despite the widespread adoption of business intelligence tools such as Power BI and Tableau, many organizations struggle to design dashboards that effectively support strategic decision- making. Ineffective visualization design may lead to information overload, misinterpretation of insights, delayed decisions, and suboptimal strategic outcomes. Existing literature largely emphasizes usability, adoption, and technical aspects of visualization tools, while empirical research linking visualization design elements directly to decision quality and decision-making speed stays limited.

The proposed research aims to examine the impact of data visualization design on strategic business decisions, with a specific focus on Power BI and Tableau. The study investigates how visualization design elements—such as chart selection, color schemes, layout structure, interactivity, and dashboard complexity—affect decision quality, decision-making speed, and managerial confidence.

A mixed-method research approach will be adopted using both primary and secondary data. Primary data will be collected from middle and senior-level managers through structured questionnaires and controlled decision-making experiments. Secondary data will include organizational datasets, dashboards, and published industry reports. Statistical tools such as correlation analysis, multiple regression analysis, and analysis of variance will be used to analyze the relationship between visualization design and decision outcomes.

The expected outcome of this research is the development of an empirically validated visualization design framework aimed at improving strategic decision quality and speed. The findings are expected to contribute to academic literature in management and business analytics and offer practical recommendations for organizations using Power BI and Tableau for strategic decision support.

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I. INTRODUCTION

In today's data-driven business environment, organizations generate vast volumes of structured and unstructured data from diverse sources such as enterprise systems, customer interactions, financial transactions, and digital platforms. While data availability has increased significantly, the ability to transform raw data into meaningful insights stays a critical challenge for business leaders. Strategic business decisions such as market expansion, resource allocation, performance optimization, and risk management need prompt, exact, and interpretable information. In this context, data visualization has emerged as a powerful tool that bridges the gap between complex data analytics and effective managerial decision-making.

Data visualization refers to the graphical representation of data and analytical results using charts, dashboards, maps, and interactive reports. Unlike traditional tabular reports, visual analytics enable decision-makers to find patterns, trends, relationships, and anomalies quickly and intuitively. Advanced business intelligence (BI) tools such as Power BI and Tableau have revolutionized how organizations interact with data by offering real-time dashboards, interactive

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filtering, drill-down capabilities, and user-friendly interfaces. These tools empower managers, analysts, and executives to explore data independently, fostering a culture of evidence-based decision-making across organizational levels.

Strategic business decisions are inherently complex and often involve uncertainty, time constraints, and high financial impact. Poor interpretation of data can lead to suboptimal strategies, operational inefficiencies, and competitive disadvantages. Effective data visualization enhances cognitive understanding by reducing information overload and presenting insights in a concise and actionable format. By converting analytical outcomes into visually compelling narratives, visualization tools support faster decision cycles, improved strategic alignment, and enhanced organizational performance.

Despite the growing adoption of BI tools, there is limited empirical research that systematically examines the direct impact of data visualization on strategic business decision quality and effectiveness. Organizations often invest heavily in visualization platforms without clearly understanding how these tools influence managerial belief, confidence, and strategic outcomes. This research addresses this gap by empirically analyzing the role of data visualization in supporting strategic business decisions, with a specific focus on Power BI and Tableau as widely used industry-standard tools.

II. INTRODUCTION, LITERATURE SURVEY & RESEARCH GAP

➢ *Introduction*

In the contemporary business landscape, data has become a strategic asset that significantly influences organizational planning, performance evaluation, and competitive positioning. Rapid advancements in information technology have enabled organizations to collect, store, and process large volumes of data from multiple internal and external sources. However, the mere availability of data does not guarantee effective decision-making. The ability to analyze and interpret complex datasets in a meaningful and prompt manner is essential for strategic business decisions. In this context, data visualization plays a vital role by transforming complex analytical outputs into intuitive visual formats that support managerial understanding and action.

Data visualization involves the use of graphical representations such as charts, graphs, dashboards, and interactive reports to communicate data-driven insights effectively. Modern business intelligence tools, particularly Power BI and Tableau, have enhanced the scope of data visualization by enabling real-time data integration, interactive exploration, and advanced analytical capabilities. These tools allow decision-makers to watch key performance indicators, find emerging trends, and evaluate alternative strategies with greater accuracy and confidence. As a result, data visualization has become an integral part of strategic management and business analytics.

Strategic business decisions are often characterized by uncertainty, time sensitivity, and significant organizational impact. Managers must evaluate multiple variables and scenarios before selecting proper courses of action. Poor data interpretation or reliance on static reports can lead to biased judgments and ineffective strategies. Data visualization reduces cognitive complexity by presenting insights in a clear and concise manner, enabling faster comprehension and improved decision quality. Interactive dashboards further enhance this process by allowing users to drill down into data, compare scenarios, and name root causes of business problems.

Despite the widespread adoption of visualization tools in organizations, there stays a need for systematic analysis of their effectiveness in supporting strategic decision-making. Many studies focus on technical aspects of business intelligence systems, while limited research empirically examines how visualization influences managerial feeling, decision speed, and strategic outcomes. Understanding this relationship is crucial for organizations looking to maximize the value of their investments in analytics and visualization technologies.

Therefore, this study focuses on examining the impact of data visualization on strategic business decisions using Power BI and Tableau as primary analytical tools. By analyzing user experiences and real-world business applications, the research aims to provide insights into how visualization- driven analytics enhance decision accuracy, efficiency, and strategic clarity. This chapter lays the foundation for the later literature review and identification of research gaps, which will further contextualize the study within existing academic and industry research.

➢ *Literature Survey*

Several researchers have examined the role of data visualization and business intelligence systems in enhancing organizational decision-making. Few (2009) emphasized that effective data visualization improves human perception and cognition, enabling decision-makers to find patterns and trends that are often hidden in raw datasets. The study highlighted that well- designed visual representations reduce cognitive load and support faster understanding of complex information.

Davenport and Harris (2007) explored the concept of analytics-driven organizations and argued that firms using business intelligence and analytical tools achieve superior performance and competitive advantage. Their findings suggest that visualization acts as a critical interface between advanced analytics and managerial decision-making, allowing leaders to translate analytical insights into strategic actions.

According to Keim et al. (2010), interactive visual analytics systems enhance exploratory data analysis by allowing users to dynamically filter, drill down, and manipulate data. The authors noted that interactivity in visualization tools significantly improves decision quality by enabling users to test assumptions and evaluate multiple scenarios in real time.

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Tableau Software (2018) and Microsoft Power BI documentation highlight how modern BI tools ease self-service analytics and real-time reporting. These tools democratize data access across organizations, empowering non-technical users to engage in data-driven decision-making. Studies have shown that self-service BI reduces dependency on IT departments and improves organizational agility.

A study by Knaflic (2015) focused on storytelling with data and emphasized the importance of presenting analytical results in a narrative-driven visual format. The research concluded that effective data storytelling enhances managerial engagement, decision confidence, and strategic alignment by making insights more persuasive and actionable.

Recent empirical studies by Popovič et al. (2012) examined the impact of business intelligence system quality on decision-making performance. The findings revealed that high-quality visualization and information presentation positively influence decision speed, accuracy, and user satisfaction. However, the study noted that the effectiveness of visualization depends on user skills and organizational context.

Although existing literature acknowledges the benefits of data visualization and BI tools, most studies are conceptual in nature or focus on system design rather than empirical evaluation. Limited research directly compares widely used visualization platforms such as Power BI and Tableau in the context of strategic business decision-making.

➢ *Research Gap*

The literature review writes down that data visualization is widely recognized as an essential part of modern business intelligence and strategic decision-making. Prior studies have set up the theoretical advantages of visualization in improving data comprehension, reducing cognitive overload, and supporting analytics-driven strategies. However, several research gaps stay unaddressed.

Firstly, there is a lack of empirical studies that directly measure the impact of data visualization on strategic business decision quality, particularly in real-world organizational settings. Many studies focus on technical features or user satisfaction rather than evaluating decision accuracy, speed, and strategic effectiveness.

Secondly, limited comparative research exists between popular visualization tools such as Power BI and Tableau. While both platforms are widely adopted in industry, few studies empirically analyze their effectiveness in supporting strategic decision-making from a managerial perspective.

Thirdly, existing research often overlooks user experience factors such as managerial feeling, confidence, and ease of interpretation when using interactive dashboards. Understanding how decision-makers interact with visual analytics tools is crucial for assessing their true strategic value.

Finally, there is insufficient research focusing on the application of data visualization in emerging economies and academic contexts, particularly within management education and MBA-level decision-making environments.

Addressing these gaps, the present study empirically examines the impact of data visualization on strategic business decisions using Power BI and Tableau. The research aims to offer comparative insights, evaluate decision-making outcomes, and contribute practical recommendations for organizations looking to enhance strategic decision-making through effective data visualization.

➢ *Problem Statement*

In recent years, organizations have increasingly adopted data visualization tools to support strategic business decision-making. Platforms such as Power BI and Tableau enable organizations to analyze large and complex datasets through interactive dashboards and visual analytics. Despite their widespread adoption, many organizations continue to face challenges related to ineffective visualization design, which can lead to misinterpretation of data, delayed decision-making, and reduced decision quality.

Poorly designed visualizations such as inappropriate chart choice, excessive data complexity, lack of clarity, and ineffective use of visual elements—often hinder managers' ability to accurately interpret insights. As a result, strategic decisions may be based on incomplete or misleading information, negatively affecting organizational performance and competitive advantage. This issue is particularly critical in strategic contexts where decisions involve high uncertainty, time constraints, and significant financial implications.

Furthermore, there is limited empirical research that systematically examines how specific data visualization design elements influence the quality and speed of strategic business decisions. Existing studies largely focus on the technical capabilities of business intelligence systems rather than evaluating the effectiveness of visualization design from a managerial decision-making perspective. Comparative analysis of widely used visualization tools such as Power BI and Tableau stays insufficient.

Therefore, the problem addressed in this study is the lack of empirical evidence on how visualization design elements within Power BI and Tableau impact strategic business decision- making outcomes. This research seeks to analyze the relationship between visualization design, decision accuracy, and decision speed, thereby providing insights that can guide organizations in designing more effective dashboards and improving strategic decision quality.

A. Objectives and Scope

➢ *Objectives of the Study*

- *Objective 1*

To analyze the impact of data visualization design on

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strategic decision quality.

This goal focuses on understanding how various data visualization design elements—such as chart types, color schemes, layout structure, interactivity, and data granularity—affect the quality of strategic decisions made by business managers.

✓ *High-Quality Strategic Decisions are Characterized by:*

❖ Accuracy of data interpretation
❖ Logical consistency in decision-making
❖ Alignment with organizational goals
❖ Reduction in decision errors

The study evaluates whether well-designed dashboards help better insight generation, improved pattern recognition, and more informed strategic choices compared to poorly designed or overly complex visualizations. This goal is grounded in Visual Perception Theory and Information Processing Theory, which suggest that human cognition and understanding are significantly influenced by the way information is visually presented.

- *Objective 2*

To examine the influence of data visualization on decision-making speed

This goal aims to assess how data visualization dashboards change the time required by managers to arrive at strategic business decisions. In dynamic and competitive business environments, prompt decision-making is crucial for sustaining competitive advantage.

✓ *Decision-Making Speed is Measured Based on:*

❖ Time taken to understand dashboard content.
❖ Time required to identify key insights and trends.
❖ Time taken to select an appropriate strategic action.

By comparing traditional tabular reports with interactive dashboards developed using Power BI and Tableau, the study examines whether data visualization reduces cognitive effort and accelerates decision-making. This objective is supported by Cognitive Load Theory, which posits that effective visual design reduces mental effort and enhances information processing speed.

- *Objective 3*

To compare the effectiveness of Power BI and Tableau in strategic decision support

This goal involves a comparative evaluation of Power BI and Tableau as business intelligence tools in supporting strategic business decisions.

✓ *The Comparison is Based on the Following Factors:*

❖ Usability and ease of interpretation
❖ Visualization richness and flexibility
❖ Interactivity and drill-down capabilities
❖ User satisfaction and perceived usefulness

By analyzing managerial responses and decision-making performance, the study looks to find which tool more effectively supports strategic decision-making and under what conditions. This goal is linked to the Technology Acceptance Model (TAM), with emphasis on perceived usefulness and perceived ease of use of data visualization tools.

- *Objective 4*

To develop a visualization design framework for strategic business decisions

Based on empirical findings, this objective aims to propose a structured visualization design framework that organizations can adopt to enhance strategic decision-making.

✓ *The Proposed Framework Will Include:*

❖ Best practices for dashboard layout and visual hierarchy
❖ Appropriate visualization techniques for strategic KPIs
❖ Guidelines for minimizing cognitive load.
❖ Tool-specific recommendations for Power BI and Tableau

This framework looks to bridge the gap between visualization theory and practical business application, offering actionable guidelines for managers, analysts, and organizations.

➢ *Sub-Objectives*

- *Sub-Objective 1*

To assess the cognitive load experienced by managers using different dashboard designs

This sub-aim evaluates the level of mental effort required by managers while interacting with various dashboard designs. Cognitive load is assessed using the following dimensions:

❖ Perceived complexity
❖ Information overload
❖ Ease of understanding
❖ Dashboard navigation effort

The study compares simple, well-structured dashboards with complex, information-dense dashboards to decide how design influences cognitive strain. Lower cognitive load is expected to result in faster comprehension and improved decision accuracy.

- *Sub-Objective 2*

To evaluate managerial confidence and accuracy in decision-making

✓ *This Sub-Goal Examines the Influence of Data Visualization on:*

❖ Managerial confidence in strategic decisions

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- ❖ Accuracy of decision outcomes
- ❖ Reduction in uncertainty and ambiguity

Managerial confidence is measured through self-reported survey responses, while decision accuracy is evaluated using decision-based experimental tasks. The study investigates whether interactive and visually intuitive dashboards enhance trust in data and reduce reliance on intuition or guesswork.

➢ *Scope of the Study*

The scope of the present research clearly defines the boundaries within which the study is conducted, ensuring focus, feasibility, and academic rigor. The study examines the role of data visualization in strategic business decision-making, with specific limitations related to the level of decision-making, respondent profile, visualization tools, industry coverage, and research time limit. By clearly outlining these boundaries, the study supports analytical depth while ensuring relevance to real-world strategic management contexts.

- *Focus on Strategic-Level Business Decisions*

The study is exclusively focused on strategic-level business decisions, which are long-term, high-impact decisions typically made by senior and middle-level management. These decisions include areas such as corporate strategy formulation, market expansion, performance monitoring, resource allocation, and competitive positioning.

Operational and tactical decisions are deliberately excluded from the scope, as they primarily involve short-term execution, routine processes, and day-to-day managerial activities. By concentrating solely on strategic decisions, the study ensures depth of analysis and direct relevance to top management decision-making processes, where effective data visualization plays a critical role in shaping organizational direction.

- *Confined to Selected Industries and Managerial Roles*

The research is limited to selected industries where data-driven decision-making and business intelligence tools are extensively adopted, namely:

- ✓ Manufacturing
- ✓ Retail and E-commerce
- ✓ Banking and Financial Services
- ✓ Information Technology and Services

The respondents are restricted to middle-level and senior-level managers, including department heads, business analysts, strategy managers, and executives who are directly involved in strategic planning, performance evaluation, and policy formulation. This focused respondent selection ensures that participants have the necessary experience, responsibility, and decision-making authority to effectively assess the role of data visualization in strategic business contexts.

- *Visualization Tools Restricted to Power BI and Tableau*

The scope of the study is confined to two widely used business intelligence and data visualization tools:

- ✓ Microsoft Power BI
- ✓ Tableau

These tools are selected due to their strong industry relevance, advanced visualization capabilities, and widespread organizational adoption. Other visualization platforms such as Qlik Sense, Looker, and Excel-based dashboards are excluded to keep consistency, comparability, and analytical depth. The study conducts a comparative evaluation of Power BI and Tableau with respect to usability, visualization design effectiveness, decision support capability, and user feeling in strategic decision-making.

- *Conducted Within the Research Timeframe*

The research is conducted strictly within the approved research time, covering key stages such as:

Literature Review

- ✓ Research design and pilot study.
- ✓ Data collection
- ✓ Data analysis and interpretation
- ✓ Visualization framework development and validation

Due to time constraints, longitudinal studies involving extended observation periods and real- time organizational implementation are beyond the scope of the present research. However, cross-sectional and experimental research approaches are employed to generate dependable, valid, and meaningful insights into the impact of data visualization on strategic business decisions.

III. RESEARCH METHODOLOGY

➢ *Theoretical Framework*

A theoretical framework serves as the foundation of any empirical research by providing a structured lens through which the research problem is examined. It finds relevant theories that explain relationships among key variables and guides the formulation of research goals, hypotheses, and methods. In the present study, the theoretical framework integrates four well- established theories Cognitive Load Theory, Information Processing Theory, Technology Acceptance Model (TAM), and Visual Perception Theory to explain how data visualization design influences strategic business decision quality and decision-making speed.

Strategic business decisions involve high complexity, uncertainty, and long-term organizational impact. Managers must analyze large volumes of data, recognize meaningful patterns, evaluate alternatives, and select right courses of action within limited time limits. Data visualization tools such as Power BI and Tableau play a crucial role in supporting these cognitive processes by transforming complex data into visually interpretable formats. However, the effectiveness of visualization depends not only on technological capabilities but also on how information is designed, perceived, processed, and accepted by users. The selected theories collectively explain these cognitive, perceptual, and

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behavioral dimensions of visualization-driven decision-making.

- *Cognitive Load Theory*

Cognitive Load Theory, developed by John Sweller, explains how human working memory processes information and how instructional or informational design affects learning and decision-making. The theory is based on the premise that working memory has limited capacity, and excessive cognitive load can hinder comprehension, reasoning, and problem-solving.

Cognitive load is generally categorized into three types: intrinsic load, extraneous load, and germane load.

In the context of strategic business decision-making, intrinsic cognitive load arises from the complexity of the decision itself, such as evaluating multiple strategic alternatives or interpreting multifaceted performance indicators. Extraneous cognitive load is caused by poor visualization design, including cluttered dashboards, inappropriate chart choice, excessive use of colors, and lack of visual hierarchy. Germane cognitive load refers to the mental effort devoted to understanding and integrating information meaningfully.

This study primarily focuses on reducing extraneous cognitive load through effective visualization design. Poorly designed dashboards in Power BI or Tableau may overwhelm managers with excessive information, leading to slower comprehension, misinterpretation, and decision errors. Conversely, well-structured dashboards that emphasize clarity, simplicity, and relevance are expected to reduce unnecessary mental effort, allowing managers to focus on strategic reasoning rather than information decoding.

Cognitive Load Theory is used in this research to explain variations in decision-making speed and accuracy when managers interact with different dashboard designs. Cognitive load is operationalized through perceived complexity, information overload, ease of navigation, and mental effort needed to interpret visualizations. The theory supports the hypothesis that dashboards designed to minimize cognitive load results in faster decision-making and improved strategic decision quality.

- *Information Processing Theory*

Information Processing Theory views human cognition as a systematic process involving the acquisition, interpretation, storage, and retrieval of information. According to this theory, decision-making occurs through a sequence of cognitive stages, including attention, perception, encoding, memory, evaluation, and response choice. The efficiency of these stages decides the quality and speed of decisions.

In strategic business contexts, managers must process large volumes of data from multiple sources. Traditional tabular reports often hinder effective information processing due to their linear structure and lack of visual cues. Data visualization enhances information processing by organizing data into meaningful visual patterns that align with human cognitive functioning.

This study applies Information Processing Theory to explain how interactive dashboards support strategic decision-making. Visualizations improve attention by highlighting key performance indicators, trends, and anomalies. They enhance perception by using visual cues such as color, size, and spatial arrangement to be relationships within data. Interactive features such as filtering, drill-down, and dynamic comparisons further support evaluation and reasoning by enabling managers to explore alternative scenarios and confirm assumptions.

By structuring complex information into intuitive visual formats, Power BI and Tableau dashboards ease faster information encoding and retrieval, leading to more logical, consistent, and evidence-based strategic decisions. Information Processing Theory therefore provides a solid foundation for examining how visualization design influences insight generation, analytical reasoning, and strategic choice selection.

- *Technology Acceptance Model (TAM)*

The Technology Acceptance Model (TAM), proposed by Fred Davis, explains user adoption and effective use of information systems. TAM posits that two primary factors decide user acceptance: perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which a user believes that using a system enhances job performance, while perceived ease of use refers to the degree to which a system is perceived as effortless to use.

In the context of this research, TAM is employed to analyze managerial acceptance of Power BI and Tableau as strategic decision-support tools. Even if visualization tools are technically advanced, their effectiveness in supporting strategic decisions depends on whether managers perceive them as useful and easy to use. Complex interfaces, steep learning curves, or unintuitive navigation can reduce user engagement and limit the strategic value of visualization tools.

This study examines perceived usefulness in terms of improved decision accuracy, insight clarity, strategic alignment, and confidence in decision-making. Perceived ease of use is assessed through ease of dashboard navigation, clarity of visual elements, interactivity, and learning effort required to interpret visualizations. TAM helps explain differences in tool effectiveness by linking user feeling with actual decision-making outcomes.

By applying TAM, the study also supports a comparative analysis of Power BI and Tableau. Differences in user interface design, visualization flexibility, and interaction mechanisms may influence managerial preference and effectiveness. TAM therefore provides a behavioral perspective that complements the cognitive and perceptual theories used in this research.

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- *Visual Perception Theory*

Visual Perception Theory explains how humans interpret and make sense of visual stimuli such as shapes, colors, sizes, and spatial arrangements. The theory is grounded in Gestalt principles, which suggest that individuals perceive visual elements as organized patterns rather than isolated components. Principles such as proximity, similarity, continuity, contrast, and visual hierarchy play a crucial role in guiding attention and comprehension.

In data visualization, visual perception principles directly influence how managers interpret dashboards and derive insights. Effective use of color contrast can highlight critical trends or exceptions, while proper alignment and spacing can improve readability and reduce confusion. Poor visual design, on the other hand, may distort perception, mislead interpretation, and result in incorrect strategic conclusions.

This study applies Visual Perception Theory to evaluate how visualization design elements— such as chart selection, color schemes, layout structure, labeling, and visual hierarchy—impact strategic decision quality. Dashboards that align with perceptual principles are expected to enhance pattern recognition, reduce ambiguity, and support faster and more exact insight generation.

Visual Perception Theory is particularly relevant in explaining differences between well- designed and poorly designed dashboards in Power BI and Tableau. The theory supports the argument that visualization effectiveness is not solely dependent on data accuracy but also on how information is visually encoded and perceived by users.

➢ *Sources of Data*

- *Primary Data:*

Surveys and experimental decision-making tasks Primary data for this study are collected directly from respondents through structured surveys and experimental decision-making tasks.

Surveys are used to gather managers' perceptions on dashboard usability, cognitive load, decision speed, and confidence.

Experimental tasks require managers to make strategic decisions using dashboards created in Power BI and Tableau, allowing measurement of decision accuracy and time taken.

- *Secondary Data:*

Organizational datasets, dashboards, industry reports.

Secondary data are obtained from organizational datasets, existing business dashboards, and industry reports.

These data sources provide realistic business scenarios for dashboard design and analysis.

Industry reports support background understanding and benchmarking of visualization practices.

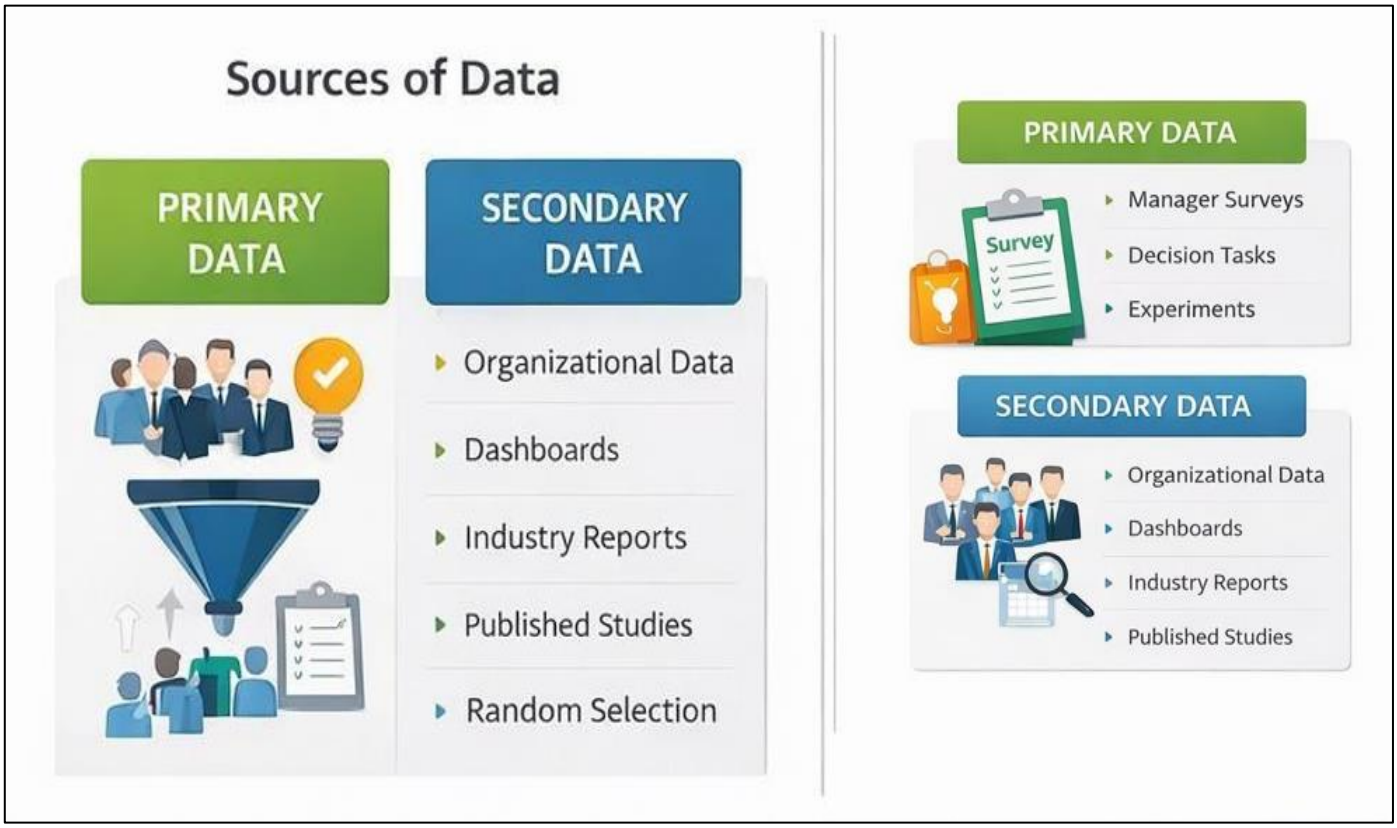

Fig 1 Secondary Data

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➢ *Sampling Technique*

Sampling technique refers to the method used to select a subset of respondents from a larger population to draw valid and reliable conclusions about the entire population. A suitable sampling technique is critical in ensuring that research findings are representative, unbiased, and generalizable. In the present study, stratified random sampling is adopted to select respondents, as it is particularly suitable for studies involving heterogeneous populations with clearly identifiable sub-groups.

➢ *Stratified Random Sampling*

The study employs stratified random sampling to ensure adequate representation of different managerial levels involved in strategic business decision-making. In this technique, the total population is first divided into distinct and non-overlapping sub-groups, known as strata, based on a specific characteristic. In the present research, the population is stratified based on managerial level, namely middle-level managers and senior-level managers.

Stratification is essential in this study because managerial level significantly influences decision- making responsibility, experience, and interaction with data visualization tools. Senior-level managers typically focus on long-term strategic planning, organizational performance, and policy formulation, while middle-level managers take part in translating strategic goals into actionable plans and checking key performance indicators. By creating separate strata for these managerial groups, the study ensures that the perspectives of both strategic and execution- oriented decision-makers are adequately captured.

Once the population is divided into strata, random sampling is applied within each stratum to select respondents. This random selection minimizes researcher bias and ensures that every individual within a stratum has an equal chance of being included in the sample. As a result, stratified random sampling improves the precision of estimates and enhances the internal validity of the study compared to simple random sampling.

➢ *Choice of Respondents*

The respondents for the study consist of middle-level and senior-level managers who are actively involved in strategic business decision-making and extensively use data visualization tools such as Power BI and Tableau for performance analysis, reporting, and planning. These respondents include department heads, business analysts, strategy managers, functional managers, and senior executives who rely on dashboards and visual analytics to support strategic evaluations and decisions.

Restricting the sample to experienced managerial professionals ensures that participants have the necessary domain knowledge and decision-making responsibility to evaluate the effectiveness of data visualization tools. This targeted respondent selection enhances the relevance, credibility, and practical applicability of the research findings.

➢ *Sample Size Determination*

The sample size for the study is found using statistical adequacy methods to ensure sufficient power for meaningful data analysis and hypothesis testing. An adequate sample size is essential to reduce sampling error, increase confidence in results, and support generalization of findings to the larger population.

Techniques such as power analysis and standard sample size determination formulas are employed to estimate the minimum number of respondents needed. Power analysis helps find the sample size needed to detect statistically significant relationships between visualization design, decision quality, and decision-making speed at a desired confidence level. Factors such as expected size, significance level, and statistical power are considered while deciding the final sample size.

Additionally, the study accounts for practical considerations such as respondent availability, response rate, and data completeness. By balancing statistical requirements with practical feasibility, the final sample size ensures accuracy, reliability, and robustness of the research outcomes.

➢ *Justification of the Sampling Technique*

The choice of stratified random sampling is justified due to its ability to manage population diversity and improve representativeness. Since managerial roles differ significantly in terms of decision authority, experience, and interaction with visualization tools, stratification based on managerial level provides a more correct reflection of the population structure. This approach reduces sampling bias, improves precision, and strengthens the external validity of the study.

Overall, the sampling technique adopted in this research ensures that the data collected is dependable, representative, and suitable for examining the impact of data visualization on strategic business decision-making using Power BI and Tableau.

➢ *Statistical Tools*

Statistical tools play a critical role in analyzing collected data and transforming raw responses into meaningful insights. The selection of proper statistical techniques ensures accuracy, reliability, and validity of research findings. In the present study, a combination of descriptive and inferential statistical tools is employed to examine the impact of data visualization design and business intelligence tools on strategic decision quality and decision-making speed. The statistical analysis supports hypothesis testing, group comparison, and evaluation of relationships among key research variables.

➢ *Descriptive Statistics*

Descriptive statistics are used to summarize and describe the basic characteristics of the respondents and the key variables involved in the study. This technique provides an overview of demographic and professional attributes such as managerial level, years of experience, industry type, and frequency of use of data visualization tools. Measures such as mean, median, standard deviation, frequency, and percentage

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are employed to present the distribution and central tendencies of variables related to visualization design, perceived usefulness, cognitive load, decision quality, and decision-making speed.

Descriptive analysis helps in understanding overall response patterns and finding preliminary trends in the data. It also helps in detecting missing values, outliers, and data inconsistencies prior to conducting advanced statistical analyses. By summarizing respondent characteristics and key constructs, descriptive statistics set up a foundation for later inferential analysis.

➢ *Correlation Analysis*

Correlation analysis is used to examine the strength and direction of relationships between data visualization factors and strategic decision outcomes. Pearson's correlation coefficient is applied to assess the association between variables such as visualization clarity, interactivity, cognitive load, decision quality, and decision-making speed.

This analysis helps find whether improvements in visualization design are associated with better decision outcomes. For example, a negative correlation between cognitive load and decision quality would write down that higher mental effort leads to poorer decisions. Correlation analysis also aids in finding multicollinearity issues among independent variables before performing regression analysis. While correlation does not imply causation, it offers valuable insights into the interrelationships among key study variables.

➢ *Multiple Regression Analysis*

Multiple regression analysis is employed to examine the combined and individual impact of multiple independent variables on dependent variables. In this study, regression models are used to assess how visualization design elements (such as layout clarity, chart effectiveness, color usage, and interactivity) and visualization tools (Power BI and Tableau) influence strategic decision quality and decision-making speed.

Regression coefficients show the size and direction of influence of each independent variable, while the coefficient of determination (R^2) explains the proportion of variance in decision outcomes explained by visualization factors. This analysis enables the study to find the most significant predictors of effective strategic decision-making and supports hypothesis testing related to visualization effectiveness.

➢ *Analysis of Variance (ANOVA)*

Analysis of Variance (ANOVA) is applied to compare mean differences in decision performance across separate groups. In this research, ANOVA is used to examine variations in decision quality and decision-making speed across managerial levels (middle-level vs senior- level managers), industry types, and visualization tools (Power BI vs Tableau).

ANOVA helps find whether observed differences in performance are statistically significant or due to random variation. By finding group-level differences, the analysis provides insights into how managerial role and tool choice influence strategic decision outcomes. Where necessary, post-hoc tests are conducted to find specific group differences.

➢ *Decision Time and Accuracy Analysis*

Decision time and accuracy analysis is used to directly evaluate managerial performance while interacting with visualization dashboards. Decision time is measured by recording the time taken by managers to interpret dashboards, name key insights, and select right strategic actions.

Decision accuracy is assessed by comparing managerial decisions with predefined best or benchmark solutions in experimental or scenario-based tasks.

- Tools Used: Power BI, Tableau, Python, SQ

Fig 2 Statistical Tools

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➢ *Schematic Flow*

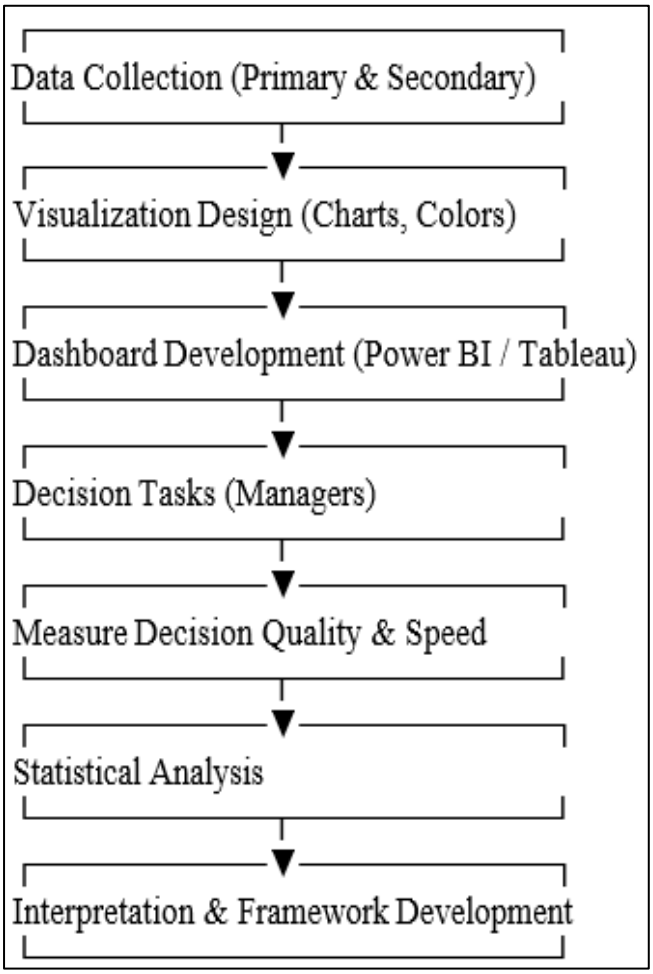

Fig 3 Schematic Flow

IV. EVALUATION CRITERIA

Evaluation criteria define the standards used to assess the effectiveness of data visualization dashboards in supporting strategic business decision-making. In the present study, multiple evaluation criteria are employed to capture both objective performance outcomes and subjective managerial feelings. These criteria enable a comprehensive assessment of how data visualization design and visualization tools influence strategic decision quality, decision-making speed, and user experience. The selected evaluation measures are aligned with the research goals, theoretical framework, and statistical analysis techniques used in the study.

➢ *Decision Accuracy*

Decision accuracy refers to the extent to which strategic decisions made by managers are correct, effective, and aligned with best or benchmark outcomes. In this study, decision accuracy is measured by comparing managerial decisions derived from dashboard insights with predefined correct or expert-validated solutions in scenario-based or experimental tasks. Higher accuracy shows that the dashboard effectively supports insight interpretation, pattern recognition, and evidence-based strategic reasoning.

Decision accuracy is a critical indicator of strategic decision quality, as inaccurate interpretations can lead to flawed strategies, financial losses, and competitive disadvantages. This criterion is strongly linked to Information Processing Theory and Visual Perception Theory, which suggest that well-designed visualizations enhance comprehension and reduce misinterpretation of complex information.

➢ *Decision Consistency*

Decision consistency assesses the stability and uniformity of decisions made by managers across similar or repeated strategic scenarios. Consistent decisions show that dashboards present information in a clear and unambiguous manner, enabling managers to apply similar reasoning when faced with comparable data conditions.

In this study, decision consistency is evaluated by analyzing variations in managerial responses across multiple scenarios with similar data patterns. Lower variation in decision outcomes reflects higher consistency and reliability of visualization support. This criterion is particularly important for strategic planning, where consistent interpretation of performance indicators and trends is essential for keeping strategic alignment across time and managerial roles.

➢ *Time Taken for Decision-Making*

Time taken for decision-making measures the speed at which managers interpret dashboards, find key insights, and arrive at strategic decisions. This criterion is evaluated by recording the duration between dashboard exposure and final decision choice during experimental or task- based exercises.

Faster decision-making shows effective visualization design that reduces cognitive effort and accelerates information processing. This criterion is grounded in Cognitive Load Theory, which states that reducing unnecessary mental effort enables quicker comprehension and response.

Time efficiency is especially critical in dynamic business environments where delayed decisions can result in missed opportunities or increased risk.

➢ *Managerial Confidence Level*

Managerial confidence captures the degree of confidence managers have in their strategic decisions after interacting with data visualization dashboards. Confidence is measured using self- reported survey items, typically on a Likert scale, assessing trust in dashboard insights, clarity of information, and perceived reliability of decisions.

Higher confidence levels suggest that dashboards effectively support decision-making by reducing uncertainty and ambiguity. This criterion is strongly associated with the Technology Acceptance Model (TAM), as confidence influences perceived usefulness and continued use of visualization tools. Confident decision-makers are more likely to rely on data-driven insights rather than intuition or guesswork.

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➢ *Dashboard Usability Score*

Dashboard usability score evaluates the overall user experience of Power BI and Tableau dashboards, focusing on ease of use, clarity of visual elements, navigation simplicity, and interaction effectiveness. Usability is assessed through standardized usability scales and survey responses covering layout clarity, chart readability, interactivity, and ease of learning.

High usability scores show that dashboards are intuitive, visually clear, and supportive of strategic analysis. This criterion is essential for comparing Power BI and Tableau, as differences in interface design and visualization flexibility may influence user preference and decision performance. Dashboard usability is linked to Visual Perception Theory and TAM, highlighting the role of design and ease of use in effective decision support.

➢ *Overall Evaluation Approach*

The combination of decision accuracy, decision consistency, decision speed, managerial confidence, and dashboard usability provides a multidimensional evaluation of data visualization effectiveness. By integrating objective performance measures with subjective user feelings, the study achieves a balanced and comprehensive assessment of how Power BI and Tableau dashboards influence strategic business decision-making.

➢ *Gantt Chart (Research Timeline Explanation)*

The Gantt chart presents the overall research timeline and outlines the sequence of activities conducted during the three-year research period. The study is systematically planned and executed in separate phases to ensure smooth progress and prompt completion.

- *Year 1*

Focus on the foundational stage of the research. During this period, the research problem is found and clearly defined. An extensive literature review is conducted to understand existing studies, theories, and research gaps related to data visualization and strategic decision-making. Based on the insights gained from literature, a conceptual framework is developed to guide research goals and methods.

- *Year 2*

Is dedicated to the empirical phase of research. This stage involves designing research methods, including sampling, data collection instruments, and statistical techniques. Data is then collected from selected respondents using surveys and experimental tasks. After data collection, statistical analysis is conducted to test hypotheses and examine relationships between visualization design, decision quality, and decision-making speed.

- *Year 3*

This is the final phase of the research. During this stage, the proposed model and findings are confirmed to ensure reliability and accuracy. The thesis is then systematically written, incorporating results, discussion, conclusions, and recommendations. Finally, the research work is given, followed by thesis evaluation and viva voce examination.

V. CONCLUSIONS

This research examined the impact of data visualization on strategic business decision-making, with a specific focus on the role of visualization design and the effectiveness of Power BI and Tableau as decision-support tools. In an era where organizations increasingly rely on data for strategic planning, the ability to transform complex datasets into clear and actionable insights has become essential. The study highlights that data visualization is not merely a presentation tool but a critical enabler of effective strategic decision-making.

The findings write down that well-designed data visualization dashboards significantly improve strategic decision quality by enhancing accuracy, consistency, and alignment with organizational goals. Visualization design elements such as right chart selection, clear layout structure, effective use of color, and interactive features were found to play a vital role in reducing misinterpretation and decision errors. Dashboards that adhered to visual perception and cognitive principles enabled managers to recognize patterns and trends more efficiently, leading to more informed strategic choices.

The study also concludes that data visualization positively influences decision-making speed. Interactive dashboards developed using Power BI and Tableau helped managers quickly interpret key performance indicators and find critical insights compared to traditional tabular reports. By reducing cognitive load and simplifying information processing, visualization tools enable faster strategic responses, which is crucial in dynamic and competitive business environments.

Comparative analysis of Power BI and Tableau revealed that both tools effectively support strategic decision-making, though differences were seen in usability, flexibility, and user preference. While Power BI was appreciated for its integration and ease of use, Tableau was recognized for its advanced visualization capabilities and analytical flexibility. Managerial confidence in decision-making increased when dashboards were perceived as easy to use, dependable, and visually clear, reinforcing the importance of user acceptance in visualization effectiveness.

Overall, the study emphasizes that the success of data visualization in strategic decision-making depends not only on technological sophistication but also on thoughtful design and user-centered implementation. The proposed visualization design framework offers practical guidelines for organizations to improve dashboard effectiveness and decision outcomes. The research contributes to both academic literature and managerial practice by providing empirical evidence on how data visualization enhances strategic decision quality and speed. Future research may extend this study by exploring added industries, visualization tools, and longitudinal decision outcomes.

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DECLARATION

I, Bogala Uma Naga Mahesh Reddy, hereby solemnly declare that the research proposal entitled “Impact of Data Visualization on Strategic Business Decisions: An Empirical Study Using Power BI and Tableau” is an original and independent work prepared by me for the purpose of admission to the Doctor of Philosophy (Ph.D.) programme in Management (Business Analytics) at SRM UNIVERSITY AP.

I further declare that this research proposal has been prepared exclusively for academic and research purposes and has not been given, either in part or in full, to any other university or institution for the award of any degree, diploma, fellowship, or any other academic qualification. All sources of information used in the preparation of this proposal, including journal articles, books, reports, and other scholarly materials, have been duly acknowledged and referenced as per standard academic practices.

I also affirm that I shall strictly adhere to the rules, regulations, and ethical guidelines prescribed by SRM UNIVERSITY AP and the University Grants Commission (UGC) during my doctoral research. I understand that any form of plagiarism, data manipulation, or violation of academic integrity may result in the rejection of my candidature or cancellation of registration at any stage of the Ph.D. program.

Signature of the Research Scholar

Bogala Uma Naga Mahesh Reddy

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SAMPLE EXCEL DATA

	A	B	C	D	E	F	G	H	I	J	K
1	Manager ID	Manager Level	Industry	Tool Used	Dashboard Clarity Score	Interactivity Score	Cognitive Load Score	Decision Accuracy	Decision Time Minutes	Managerial Confidence	Usability Score
2	1	Senior	Banking	Power BI	4.5	4.2	2.1	90	12	4.6	4.5
3	2	Middle	IT Services	Tableau	4.7	4.6	1.9	92	10	4.8	4.7
4	3	Senior	Manufacturing	Power BI	4.2	4	2.5	85	15	4.2	4.3
5	4	Middle	Retail	Tableau	4.6	4.5	2	91	11	4.7	4.6
6	5	Senior	IT Services	Power BI	4.3	4.1	2.3	88	13	4.4	4.4
7	6	Middle	Banking	Tableau	4.8	4.7	1.8	94	9	4.9	4.8
8	7	Senior	Retail	Power BI	4.1	3.9	2.6	84	16	4.1	4.2
9	8	Middle	Manufacturing	Tableau	4.6	4.4	2.1	90	11	4.6	4.5
10	9	Senior	Banking	Power BI	4.4	4.3	2.2	89	14	4.5	4.5
11	10	Middle	IT Services	Tableau	4.7	4.6	1.9	93	10	4.8	4.7

SAMPLE DASHBOARD

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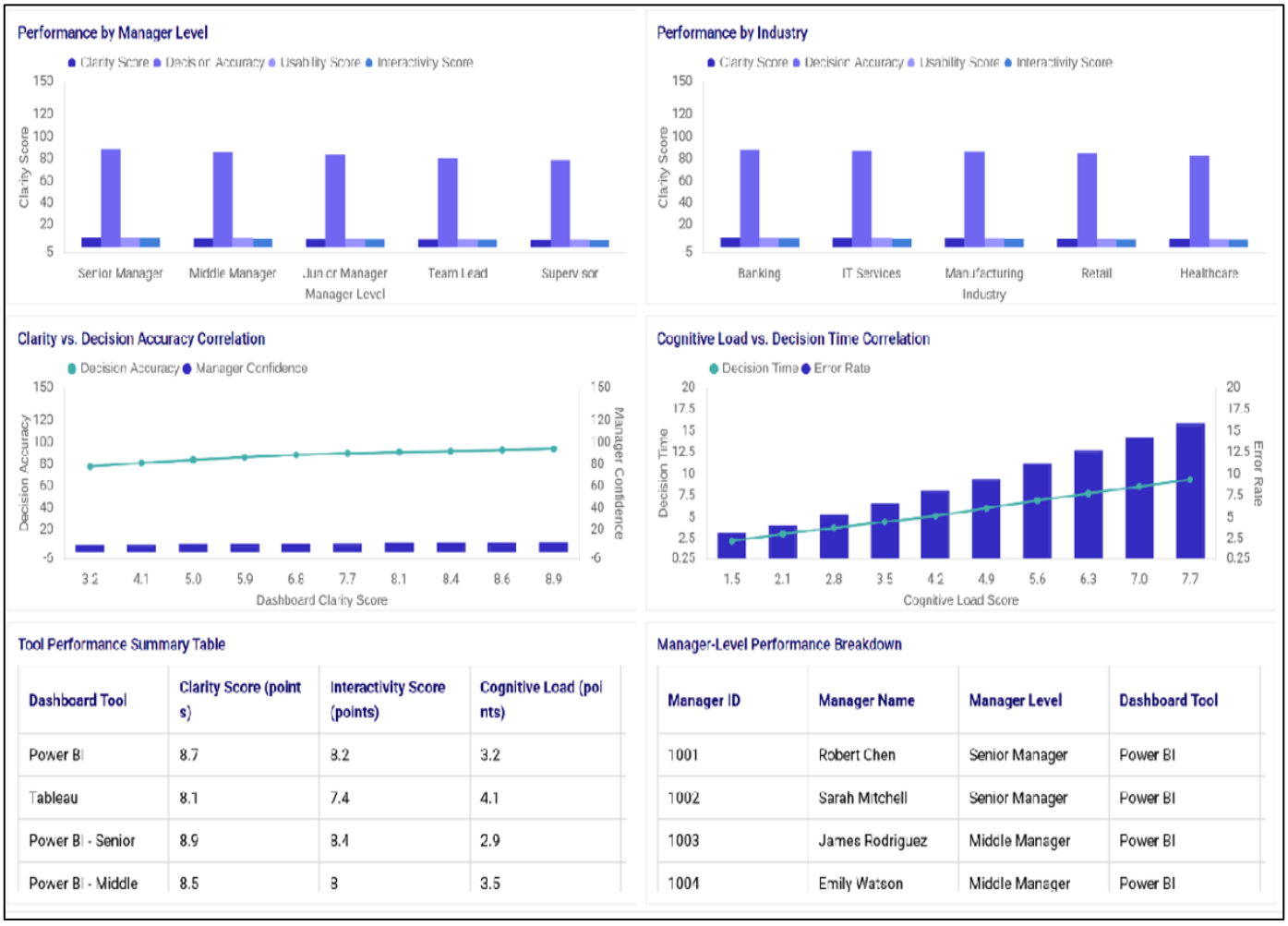

Tool Performance Summary Table

Dashboard Tool	Clarity Score (points)	Interactivity Score (points)	Cognitive Load (points)
Power BI	8.7	8.2	3.2
Tableau	8.1	7.4	4.1
Power BI - Senior	8.9	8.4	2.9
Power BI - Middle	8.5	8	3.5

Manager-Level Performance Breakdown

Manager ID	Manager Name	Manager Level	Dashboard Tool
1001	Robert Chen	Senior Manager	Power BI
1002	Sarah Mitchell	Senior Manager	Power BI
1003	James Rodriguez	Middle Manager	Power BI
1004	Emily Watson	Middle Manager	Power BI