REVIEW ARTICLE

KPI-Driven Business Intelligence: A Review of Frameworks and Visualization Tools

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Abstract—Key Performance Indicators (KPIs) serve as measurable metrics that transform complex organizational data into meaningful insights, enabling alignment between operational processes and strategic objectives. Various KPI frameworks, such as the Balanced Scorecard, Performance Prism, and SMART methodology, offer systematic approaches for selecting, designing, and categorizing KPIs to ensure relevance and effectiveness. The distinction between strategic KPIs, which focus on long-term goals, and operational KPIs, which monitor short-term performance, is essential for balanced organizational growth. Business Intelligence (BI) tools, including Tableau, Power BI, and Qlik, facilitate advanced visualization and interactive dashboard creation, improving the accessibility and interpretability of KPI data for stakeholders. This review consolidates pre-2021 research on KPI-driven BI frameworks and visualization techniques, highlighting their role in fostering organizational agility, operational efficiency, and evidence-based decision-making. By integrating robust KPI design principles with modern BI visualization capabilities, organizations can achieve improved performance monitoring, streamlined operations, and a stronger foundation for sustainable competitive advantage. Additionally, the possibilities of BI systems are being increased by new developments in AI-driven analytics and real-time KPI tracking. Emerging AI-driven analytics and real-time KPI tracking enhance BI potential, highlighting the need for continuous innovation in KPI management.

Keywords—*Key Performance Indicators (KPI), Business Intelligence (BI), Balanced Scorecard, Performance Prism, Visualization Tools, Decision-Making.*

I. INTRODUCTION

Many companies have adopted performance measurement tools to remain competitive in today's challenging environment. Organizations are not only confronted with increasingly demanding conditions but also with the ongoing global financial crisis [1]. As a result, measuring performance has become essential for ensuring organizational stability and resilience. While performance has traditionally been assessed through financial indicators, business leaders are now seeking new and innovative performance metrics that can provide a competitive edge and help differentiate them in the market [2].

Any organization must have Key Performance Indicators (KPIs) if it hopes to succeed or remain in operation. They help set and monitor organizational goals. There can be no performance management system based on intangible organizational functions without key performance indicators [3]. Balanced scorecard is the most popular name for this type of system, although there are others. Key performance indicators are heavily used by many other approaches for managing organizations, including Six Sigma, Lean, and variants thereof. While key performance indicators (KPIs) can help organizations avoid common mistakes and risks, they sometimes include too many variables that aren't relevant to the situation, which makes the whole measuring process useless or even harmful [4][5].

There is a lot of evidence in the literature that Businesses may progress by using business intelligence (BI) to make better decisions, which in turn boosts firm performance and BV [6]. Businesses now face intense competition in an ever-changing market, so it's more important than ever for them to make well-informed decisions if they want to stay sustainable and profitable [7][8][9][10]. Consequently, there has been a heightened emphasis on Business Intelligence (BI) due to the fact that all organizations trying to maintain profitability, relevance, and sustainability now require market-related knowledge and strategic information. Business intelligence (BI) helps companies they can transform all their processes and capabilities into knowledge [11]. Then, they can utilize that knowledge to provide the appropriate information at the appropriate time to the appropriate people via the appropriate route [12]. This results in massive volumes of data that may pave the way for the creation of opportunities for the company.

Using visualization tools effectively can be a powerful way to tackle the problems highlighted before [13]. Data, information, and knowledge can be visually represented using visualization to convey experiences, generate insights, make inferences, or develop a complex understanding. For example, by integrating and organizing data, visualization can aid in perception [14][15] and use it to gain a better grasp of massive datasets without resorting to math-heavy statistical approaches. Substituting well-designed visual representations for complex mathematical equations can enhance understanding, memorization, and decision-making through straightforward perceptual interpretations. Visualization adds a human element to data exploration.

Thus, the integration of KPIs, Business Intelligence, and visualization frameworks forms the foundation of modern performance management. This review explores how KPI-driven BI frameworks and visualization tools support organizations in addressing strategic and operational challenges, driving competitive advantage, and ensuring long-term sustainability.

Structure of the Paper

The paper is organized as follows: Section II introduces Business Intelligence (BI). Section III reviews KPI frameworks in business intelligence (BI). Section IV examines visualization tools for KPI-driven BI, covering their role, techniques, and comparative analysis. Section V presents a literature review of major studies, findings, and challenges, while Section VI concludes with important takeaways and suggestions for future research.

II. FUNDAMENTALS OF BUSINESS INTELLIGENCE (BI)

Business Intelligence (BI), for short, is a popular catchall word for a collection of ideas and practices that aim to enhance company decision-making through the use of fact-based computerized support systems. Some use it similarly to how they use executive information systems or briefing books [16]. One data-driven DSS is a business intelligence system, which primarily aids in querying historical databases and routinely generates summary reports. There are a number of titles that data-driven DSS has experienced throughout time. These consist of retrieval-only DSS and data-oriented DSS, Executive Information Systems, operational data analysis platforms, and Business Intelligence platforms. Management can have a better grasp of the company's state of affairs with the aid of business intelligence (BI), which consists of a collection of skills, methods, and strategies. Business intelligence (BI) solutions allow users to view the past, present, and future. Experts and analysts can enhance their work with easy-to-use tools and get better results, and the current information gap between upper and middle management vanish as a result of BI approach implementation. Managers need high-quality data at all times and from any level.

Definition and Evolution of BI

The complexity of corporate operations has increased due to changes in the company environment, consumer demands, and numerous communication mediums [17]. Growing levels of competition have added another layer of complexity, making it even more difficult for businesses to achieve growth and sustainability. A company's ability to meet these problems depends on its level of knowledge of the market, customer tastes, rivals' moves, suppliers, and internal technological processes. Businesses have been able to store, retrieve, and analyze enormous volumes of information on their business and the industry with the use of BI systems, which have grown in significance over the last decade. This data allows them to make better strategic and tactical decisions, giving them a leg up in their respective industries. Organizational decision-making and workflows can be enhanced with the use of BI instruments and procedures that collect, evaluate, and combine data. In order to increase company performance and respond to changes, organizations can benefit from BI's essential functions. Enterprise resource planning (ERP) systems manage massive volumes of data, both structured and unstructured, and aid in the discovery, cultivation, and realization of new corporate prospects.

Components of BI Systems

Business Intelligence (BI) systems comprise core components such as OLAP for multidimensional data analysis, advanced analytics for predictive insights, performance management tools like dashboards and scorecards, and data warehouses for integrated, cleansed, and query-ready data storage.

- **OLAP (Online Analytical Processing):** It describes the ability for business users to navigate data using complex tools that allow them to slice and dice along dimensions like time or hierarchy. To optimize the company, OLAP is utilized for planning, modeling, analysis, and reporting. It provides summarized, multifaceted perspectives of corporate data [18]. Enterprise intelligence systems that are designed for sophisticated usage data warehouses or data marts, which may be accessed using OLAP techniques and tools.
- **Advanced Analytics:** Predictive analytics, data mining, or forecasting is the process of drawing conclusions or assessing certainty from current information using statistical analysis methods.
- **Corporate Performance Management (Portals, Scorecards, Dashboards):** A number of components can be assembled into a narrative by fitting them into this overarching category. Consider a balanced scorecard that includes financial indicators with other measures, such as those for organizational learning and growth, and presents them in separate portlets.
- **Real-time BI:** Email, message systems, and interactive displays can all receive metrics in real-time.
- **Data Warehouse and data marts:** Business intelligence relies heavily on the data warehouse. Through its integration, it is subject-oriented. By managing the integration, cleaning, aggregation, and querying of numerous business records, the data warehouse makes it easier to physically distribute data.

Role of Key Performance Indicators (KPIs) in BI

KPIs were regarded as the primary mechanism through which business intelligence (BI) systems transformed raw data into actionable information. KPIs were representational forms of measurable information that aligned performance with some strategic or operational goals and allowed decision-makers to track performance progress, assess trends or anomalies, and make decisions based on real-time tactics [19]. In BI tools, KPIs were indeed the cog that connected complicated datasets to decision-makers' cognitive decision-making process by offering an easily interpretable, goal-oriented overview often included in dashboards and scorecards. A further distinction could be made between decision-making at the time and operational KPIs, which aim to support real-time decision-making with their distinctive features, versus strategic KPIs in terms of the depth of performance measurement. The importance of KPIs being tied to context, connecting them to corporate strategy and utilizing reliable and consistent data sources for the actual KPI defined to be trustworthy and valuable.

III. KPI FRAMEWORKS IN BUSINESS INTELLIGENCE

KPI frameworks in Business Intelligence were introduced to effectively identify, classify, and measure performance indicators in relation to the business strategy. Key performance indicators (KPIs) are often grouped into four types in the Balanced Scorecard: learning and development, internal processes, customers, and finances. This allows for a more well-rounded assessment of an organization's performance [20]. The Performance Prism, developed in the KPI space, is a model that classifies performance indicators based on stakeholder satisfaction, strategies, processes, capabilities, and stakeholder contributions. A popular paradigm for KPI selection is SMART stands for "Specific,

Measurable, Achievable, Relevant, and Time-bound." There was also the use of Goal-Question-Metric (GQM) methodologies or Key Result Areas (KRA) models to ensure that organizational objectives aligned with operational objectives in choosing KPIs.

KPI frameworks were championed to align with BI platforms to enable seamless integration of real-time tracking, automation reports, and visual dashboards for stakeholders to understand the gap between strategy and action. Figure 1 shows a KPI-driven Business Intelligence process where collected data informs strategic goals like revenue growth and operational metrics like CSAT, NPS, and churn rate. Analysis and reporting produce dashboards and reports, enabling organizations to monitor performance and make data-driven decisions.
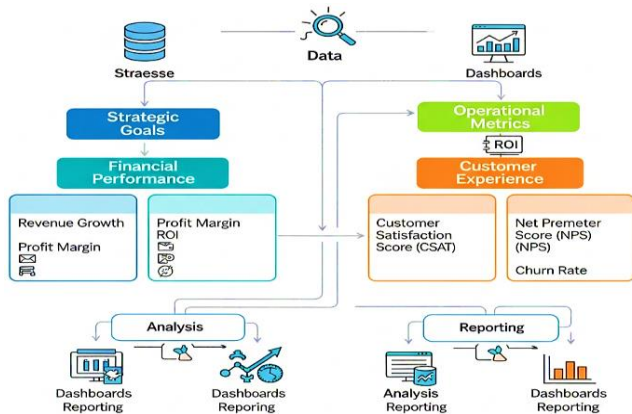

Fig. 1. KPI Frameworks in Business Intelligence

Existing KPI Frameworks

Key performance indicators are measurements that certain companies use to monitor their progress and effectiveness in achieving their strategic goals. Because of the correlation between company culture and productivity, it's crucial to think about corporate culture alongside company strategy. The execution of the plan is affected by each individual characteristic, and a strong corporate culture is the engine that drives performance. Popa stresses that four primary considerations are necessary for the development of KPIs. The project's success or failure is dependent on the following three components of the key performance indicators (KPIs): (1) control and observation of the activities and people, (2) acquiring the essential information to improve the activities (3) supporting the reports for the stakeholders (4) making sure activities are in line with the objectives [21].

These metrics should include both quantitative and qualitative components so that they can be controlled and measured. Key performance indicators (KPIs) should be customized to each organization because of their unique characteristics, goals, and circumstances; nonetheless, a generic framework can serve as a helpful reference. that the most important quality of a key performance indicator is its actionability, which allows for the correction of any adverse tendencies.

KPI Selection and Design Methodologies

Business Intelligence (BI) systems are used to follow a structured paradigm that aligns with the organization's goals and strategies when choosing and designing Key Performance Indicators (KPIs). Researchers even acknowledged the SMART criterion as a baseline for developing key performance indicators (KPIs). Balanced Scorecard approaches were also most commonly used to relate KPIs through internal processes, learning, customers, and finances. The Goal-Question-Metric (GQM) and the Analytic Hierarchy Process (AHP) are two excellent methods for classifying KPI models according to their significance to the business [22]. Very little design for KPIs earlier on BI focused extensively on domain experts, engaged stakeholders collaboratively in workshops and most frequently on archival data examining (both lagged and leading) for the establishment of meaning and capacity to achieve the level of measurement.

KPI Categorisation: Strategic vs. Operational

The differentiation of strategic KPIs from operational KPIs was a key aspect of Business Intelligence research and practice. Strategic KPIs were meant to assess long-term organizational goals that were typically aligned to a mission statement or competitive position. Strategic KPIs tended to be broad in nature, longer in scope, and for guiding decision-making at a higher level, with the involvement of high-level management [23]. On the other hand, operational KPIs are oriented toward the present and future, signaling short-term, process-oriented metrics that measure activities that occur on a daily basis or efficiency of a process.

The effective BI systems required evidence of a hierarchical connection between operational and strategic KPIs, such that measurable improvements at the operational level were linked to progress toward a strategic goal. Exhibiting this hierarchy was made possible with the development of dashboards that combined, at varying degrees, both types of KPI data from all levels of an organization. Dashboards typically present a set of options that are linked to a hierarchy consisting of levels that include executives and frontline managers. In this capacity the dashboard is often utilized for a layered approach with an organization, where data is shared across the organization while measuring strategic and operational outcomes.

IV. VISUALIZATION TOOLS FOR KPI-DRIVEN BI

The complement of industry-standard Business Intelligence (BI) visualization tools lies in their ability to effectively display and analyze KPIs, though these tools differ in terms of interactivity, customization, and integration [24]. Tableau is widely regarded as an industry-standard tool, valued for its drag-and-drop functionality, diverse visualization options, and strong connectivity with multiple data sources, making it especially effective for exploratory KPI analysis. Microsoft Power BI's cost and smooth integration with the Microsoft technology stack have contributed to its increasing appeal, and versatile dashboard-building capabilities suitable for both strategic and operational KPIs [25]. QlikView and Qlik Sense leverage associative data models, enabling users to dynamically explore relationships among KPIs across varied datasets. Similarly, IBM Cognos Analytics is recognized for organizational-level reporting and governance, features particularly essential in regulated industries.
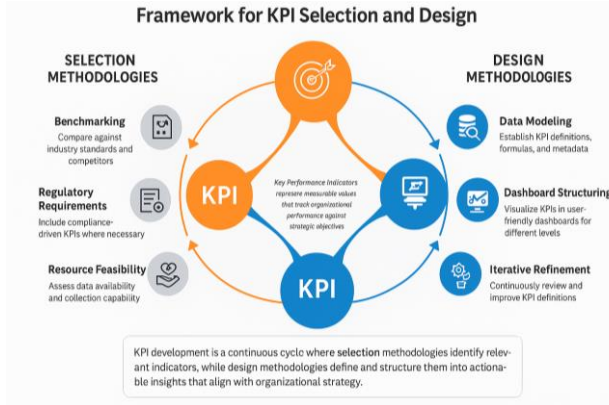
Fig. 2. Framework for KPI Selection and Design

Figure 2 demonstrates that KPI development is an ongoing process that integrates selective methodologies (identification, and prioritization of KPIs) and design methodologies (structure and definition of KPIs) and these methodologies interplanar business strategy with measure the performance effects.

Role of Visualization in BI

The phrase "business" in "business data visualization" and "business intelligence" encompasses more than just economic pursuits. It encompasses a wide range of tasks performed by both individuals and organizations to ensure the smooth operation of a system [26]. This can encompass a wide range of fields, such as business, academia, athletics, the arts, politics, and many more. All parts of the business, whether human or organizational, are reflected in the data produced and recorded in these processes and activities, which are subsequently analyzed and reported at different levels. A primary objective of business intelligence is to enable users to get meaningful insights from massive data sets. What distinguishes business data or information from other forms of data is:

- **Abstract:** The majority of company data pertains to intangible processes and activities. There are no actual things, models, or phenomena described by the data, and it is not utilized in any way to generate such things.
- **Quantitative:** Quantitative data is the main focus of business data, while qualitative data also provides valuable insights and is highly valuable in the field of artificial intelligence.
- **Structured or semi-structured:** Metadata is typically well-defined and most data is structured using common properties.
- **Multidimensional:** Multiple levels of analysis and viewpoints are possible for any given set of facts or metrics. The field of business analysis is one where this frequently occurs.
- **Atomic:** Transactions are the lifeblood of most businesses, and each record of raw data is a discrete, observable, and interpretable atomic unit.

Comparison of BI Visualization Tools

Data visualization technologies have become essential parts of business intelligence strategy by 2019. As seen in Table I, cloud-based business intelligence tool use increased at a phenomenal rate in 2019, according to Gartner [27]. These technologies have become increasingly popular due to their

scalability and cost-effectiveness (as illustrated in Figure 3). Because of their lack of enterprise-wide penetration, this category is mostly associated with smaller organizations and developers that like open-source tools due to their flexibility [28]. Critics have panned commercial-dominated tableau's visual storytelling features and praised Power BI's tight interaction with Microsoft's ecosystem.

TABLE I. MARKET SHARE OF MAJOR DATA VISUALIZATION TOOLS IN 2019

Tool	Market Share (%)	Primary Use Base
Tableau	22.3	Enterprises, Analysts
Power BI	19.8	SMEs, Microsoft, Ecosystem Users
Qlik view	14.7	Enterprises, Data Analysts
Google Data Studio	10.4	Freelancers, Small Businesses
D3.js	8.6	Developers, Technical Users

Key data visualization tools' 2019 market shares are shown in Figure 3. Tableau led the market with 22.3%, followed by Power BI at 19.8%, QlikView at 14.7%, Google Data Studio at 10.4%, and D3.js at 8.6%, highlighting Tableau and Power BI as the most widely used visualization platforms that year.
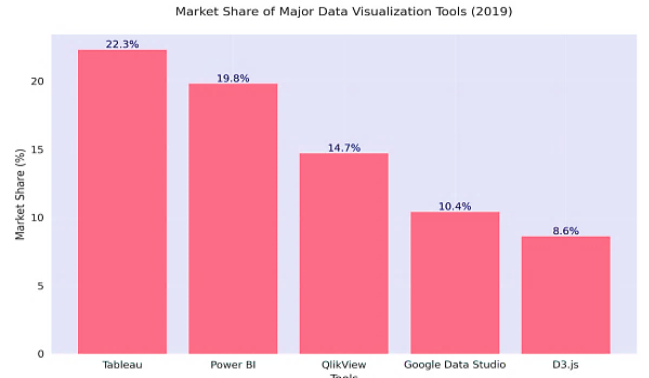

Fig. 3. Comparative Analysis of Data Visualization Tools

Common Visualization Techniques for KPIs

In Business Intelligence platforms, visualization methods for KPIs were created to help decision makers with clarity, interactivity, and approximate speed in making judgments. The dashboards were perhaps the most common way of visualizing KPIs [29]. They framed and clustered multiple KPIs within a single joined interface and allowed users to interact and drill down into the KPIs in order to monitor activity over time. Bar and column charts are the most prevalent way to compare categorical data, while line and area charts show the changes of multiple KPIs over time [30]. Gauge charts and speedometer-like visuals were well adapted to showing whether progressing towards a target, while some critics indicated that they occupied a lot of space with not much data density. Heat maps and color-coded scorecards were convenient ways to compare performance between units or time periods, possibly more fitting in the performance management side of the research.

V. LITERATURE REVIEW

This literature Summary examines diverse KPI-driven Business Intelligence applications, detailing methodologies, findings, challenges, and future directions across domains including contact centers, churn prediction, education, manufacturing, and recommender systems, highlighting

technological integration, process optimization, and performance measurement advancements.

Plaza and Pawlik (2021) Optimization of some Key Performance Indicators (KPIs) is impacted by the rate of development of Contact Centre technologies. Key performance indicators (KPIs) have been thoroughly examined in relation to the successive industry-wide technology deployments of Social media, WebRTC, chat, IVR, visual IVR, multichannel, omnichannel, and bots. Important metrics for customer service that the authors chose include: Occupancy Rate, Service Level, Customer satisfaction, average handling time, average waiting time, cost per contact, and first call resolution [31].

Villazón et al. (2020) promote and advise that project-based companies use lean concepts and processes to establish KPIs that meet their operational and organizational needs. The research attempts to discover and categorize key performance indicators (KPIs) through a qualitative approach. Its foundation is a systematic literature review (SLR) of project management, performance metrics, and project success. The R&D and innovation project-based organization was examined using surveys, internal studies, a quality manual, and a benchmarking process. Therefore, the study's conclusions are extremely pertinent to project-based organizations, particularly those that are unclear about the best ways to create a set of key performance indicators (KPIs) [32].

Moscoso-Zea et al. (2019) A hybrid information infrastructure for knowledge management and business intelligence is created by merging an educational data warehouse (EDW) with an enterprise architecture (EA) repository. This study builds on prior work by conducting experiments on the proposed infrastructure using a variety of techniques and approaches from OLAP, EA analytics, learning analytics, and educational data mining. The goal is to create explicit knowledge by analyzing academic processes and educational data [33].

Khan et al. (2018) offer guidance on how to apply the methodology in order to find processes and then map them using simulation tools. Enhancing the data-driven basis for process reengineering, it now includes process verification. This research analyses a production line process using the WITNESS Horizon 21 simulation tool to ascertain how effectively data-driven process reengineering and process verification operate to effect change [34].

Chen et al. (2017) The smart factory's hierarchical architecture was first proposed, and then the layers of physical resources, networks, and data applications were studied in relation to the key technologies. They also went over some of the main issues and potential solutions related to incorporating vital integrating new technologies into the production process, such as the IoT, big data, and the cloud. Lastly, the smart factory's core technologies were tested on a candy packing line, demonstrating a considerable improvement in the equipment's overall efficacy [35].

Venkatrama (2017) an approach to tackle this by investigating a fresh way of incorporating BI principles into RS for smartly handling user modifications and complex business situations. Provide a business intelligence (BI) platform that employs a hybrid RS methodology to boost RS performance. Business intelligence recommender systems (BIRS) are able to enhance their learning, user profile, and predictive models by utilizing data mining techniques from BI. This allow it to provide users with more useful personalized recommendations [36].

Table II summarizes key studies on KPI-driven Business Intelligence, describing their methods, key discoveries, difficulties encountered, areas of concentration, and suggested future paths, highlighting diverse applications across industries and technological contexts.

TABLE II. Literature Summary of a Study on KPI-Driven Business Intelligence

Author	Study On	Approach	Key Findings	Challenges	Future Directions
Plaza et al. (2021)	Impact of Contact Centre technologies on KPI optimization	KPI measurement for social media, omnichannel, multichannel, chat, WebRTC, visual IVR, IVR, and bot usage	Key performance indicators (KPIs) that were monitored in connection with technology adoption were service level, cost per contact, customer happiness, average hold time, first call resolution, abandon rate, average waiting time, and occupancy rate.	Integration complexity across multiple channels; measuring qualitative aspects like satisfaction accurately	Develop unified KPI measurement frameworks for evolving omnichannel environments
Villazón et al. (2020)	Lean concepts for key performance indicator identification in project-based businesses	An organization's approach to research and development (R&D) and invention (IP) through the use of a qualitative strategy grounded in a Systematic Literature Review (SLR) (quality manual analysis, benchmarking, internal studies, surveys)	Provides a methodical approach to determining which key performance indicators (KPIs) are most relevant to a certain business and its operations; stresses the significance of coordinating KPIs with various stakeholders' conceptions of project success	Lack of clarity in KPI formulation; diverse stakeholder needs	Broader industry validation; standardised frameworks for KPI design
Moscoso-Zea et al. (2019)	Information and knowledge management (BI&A) hybrid infrastructure for educational institutions	Developed infrastructure combining EDW and EA repository with OLAP and learning analytics	Educational decision-making was aided by the ability to see and analyse organizational components.	Integrating heterogeneous data sources; scalability	Expand to cross-domain applications; enhance predictive analytics capabilities

Khan et al. (2018)	Verification and reengineering of data-driven processes	Used WITNESS Horizon 21 simulation for process mapping and verification	Improved efficiency and accuracy in process change implementation	Simulation limitations; resource-intensive setup	Develop automated BI-driven simulation frameworks for faster optimization
Chen et al. (2017)	Smart factory architecture and KPI improvements	Proposed hierarchical architecture and validated with candy packing line case study	Significantly improved Overall Equipment Effectiveness through IoT, big data, and cloud integration	Integration costs; cybersecurity risks	Broaden application to multi-line factories; incorporate AI-driven KPI monitoring
Venkatrama et al. (2017)	BI-based recommender system (BIRS) framework	Hybrid methodology combining OLAP tools, BI metrics, and data mining techniques	Enhanced RS learning, user profiling, and prediction accuracy for e-commerce	Handling large, diverse data; adapting to dynamic user behaviour	Extend BIRS to multi-domain personalization; integrate real-time BI insights

VI. CONCLUSION AND FUTURE WORK

KPIs are central to Business Intelligence (BI), acting as measurable metrics that convert complex data into actionable insights. They help organizations align performance tracking with strategic goals, improve decision-making, and monitor operational efficiency. Structured frameworks such as the Balanced Scorecard, Performance Prism, and SMART methodology provide effective approaches for KPI design. Visualization tools like Tableau, Power BI, and Qlik enhance interpretability by offering interactive, real-time dashboards that enable stakeholders to identify trends and take timely actions. Differentiating between strategic and operational KPIs is crucial for balancing long-term vision with immediate process optimization. Literature suggests that KPI-driven BI systems strengthen organizational agility and competitive advantage by integrating analytics, visualization, and strategic planning. However, research is often constrained by the absence of longitudinal data and insufficient exploration of industry-specific contexts, limiting the applicability of proposed models.

Future research should focus on integrating AI-driven analytics with KPI monitoring to support predictive and prescriptive decision-making. Developing dynamic KPI models that adapt to evolving market conditions is essential. Cross-domain studies could examine KPI relevance in emerging sectors such as green energy, smart cities, and digital healthcare. Moreover, immersive visualization techniques, including AR and VR, may enhance engagement, comprehension, and real-time organizational performance management.

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