

## **Business Intelligence Tools – Systematic Review**

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### **Abstract**

*Business intelligence (BI) is a business management term that refers to applications and technologies used to gather, provide access to and analyze data and information about an organization's operations. Business Intelligence is a process of extracting, transforming, managing and analyzing extensive data by making a mathematical model to gain information and knowledge to help make decisions in the complex. Elements of Business Intelligence are Data Warehouse, Data Mining and Decision Support systems. The general objective of this research is to systematically review popularity tools in Business Intelligence.*

**Keywords:** Business Intelligence, Data Warehouse, Data mining, Decision Support System.

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### **I. INTRODUCTION**

Business Intelligence or BI is a computer-based system which is used by organizations for decision making purpose. It consists of huge data warehouse or data marts of business data, from which it performs mining, spotting, digging or analyzing operations to produce appropriate results or reports. BI applications include a wide range of activities for statistical analysis, Data mining, querying and reporting, business performance analysis, benchmarking, Online Analytical Processing (OLAP), Decision Support System (DSS), forecasting and predictive analysis. It provides organizations with meaningful information regarding employees, customers, suppliers and other business associates, which can be used in effective decision making[2,6].

Business Intelligence (BI) is a set of tools supporting the transformation of raw data into useful information which can support decision making. Business Intelligence provides reporting functionality, tools for identifying data clusters, support for data mining techniques, business performance management and predictive analysis.

The aim of Business Intelligence is to support decision making. In fact, BI tools are often called Decision Support Systems (DSS) or fact-based support systems as they provide business users with tools to analyze their data and extract information.

Business Intelligence tools often source the data from data warehouses. The reason is straightforward: a data warehouse already has data from various production systems within an enterprise; the data is cleansed, consolidated, conformed and stored in one location. Because of this BI tool are able to concentrate on analyzing the data.

#### **1.1. Why business intelligence is important**

Overall, the role of business intelligence is to improve an organization's business operations through the use of relevant data. Companies that effectively employ BI tools and techniques can translate their collected data into valuable insights about their business processes and strategies. Such insights can then be used to make better business decisions that increase productivity and revenue, leading to accelerated business growth and higher profits [2].

Without BI, organizations can't readily take advantage of data-driven decision-making. Instead, executives and workers are primarily left to base important business decisions on other factors, such as accumulated knowledge, previous experiences, intuition and gut feelings. While those methods can result in good decisions, they're also fraught with the potential for errors and missteps because of the lack of data underpinning them.

#### **1.2. Benefits of Business Intelligence**

A successful BI program produces a variety of business benefits in an organization. Listed below are some of the benefits of business intelligence implementation:[11]

- i. Single point access to data: By maintaining a data warehouses and data marts, BI can act as an access to point to the data present in this.

- ii. Implementation in all departments: BI can be implemented enterprise wide or it can be local to a single department. If implemented in all departments, organizations will benefit.
- iii. Timely solutions: BI allows users to make ad hoc requests and obtain ad hoc reports as and when needed in order to solve problems.
- iv. Customer or centrally driven: BI can be implemented in two ways: one where reports are generated according to customer demands and second where employees trigger the transactions
- v. Access to external users: By giving access of BI systems to external users like customers who might be interested in analyzing their buying behavior, can find out cost saving opportunities and suppliers can analyse the sales data.
- vi. Improve operational efficiency: By providing real time reports to customers and employees, BI enables quick solutions to problems and easy error detection and correction. Hence improving efficiency.
- vii. Reduction of delays and backlogs: BI systems allow users to design the queries in the system and get reports. Hence human resource can be managed efficiently by reallocating of backlog work to other employees, thus reducing delays.
- viii. Better relationship and deals with customers and suppliers: By analyzing historical data we can review the past performance of the suppliers like on-time delivery, quality, etc. which will help in negotiating with them. Understanding customer buying pattern will allow us to qualify some of the customers to discounts or other offers in order to maintain long term relationship.
- ix. Problem detection: BI systems provide historical, real time and predictive reports. This can be accessed by customers, suppliers and employees. This results in faster detection of problems or errors.
- x. Minimize Wastage: By analyzing the performance of products, customers, projects and marketing strategies, we can allocate resources appropriately and minimize resource wastage.
- xi. Reduced inventory costs: BI systems give the optimum inventory level required at all times, thus reducing cost.
- xii. Leverage investment in ERP: By implementing BI with your existing ERP will allow non-technical users to reap the fruits and get tailor made reports.
- xiii. Better Marketing Analysis: BI systems provide the performance of marketing strategies or campaigns, behavior of customers and existence of new opportunities.
- xiv. Revenue through information: Revenue can be generated by selling information from BI to customers and suppliers.
- xv. Informed and qualified sales force: Sales force will be provided with previous sales figures, information about clients, brands and customers thus empowering them.
- xvi. Understand Customers: BI systems can be used to understand customers and improve customer experience
- xvii. Improved internal communication: BI systems result in improved job satisfaction, knowledgeable work force and better motivation.
- xviii. Understand Customers: BI systems can be used to understand customers and improve customer experience.
- xix. Understand Competitors and Market: BI systems help managers with information on latest trends in the market and the actions taken by competitors.
- xx. Guesswork Avoided: By providing thoroughly analysed decision supporting reports reliance on guess work is minimized.
- xxi. Improved Performance: All these factors result in improved performance of business.

### 1.3. HOW THE BI PROCESS WORKS

Although business intelligence is utilized in different ways and for different purposes by individual companies, the process is fairly uniform throughout all industries and typically explains as follows:



Figure 1:BI works process steps

## II. BI methods

Much more than a specific “thing,” business intelligence is an umbrella term that covers the processes and methods of collecting, storing, and analyzing data from business operations or activities to optimize performance. All of these things come together to create a comprehensive view of a business to help people make better, actionable decisions. Over the past few years, business intelligence has evolved to include more processes and activities to help improve performance. These processes include [14, 15]

**Table 1: BI Methods with Description.**

Method	Description
Data mining	Using databases, statistics, and machine learning (ML) to uncover trends in large datasets
Reporting	Sharing data analysis to stakeholders so they can draw conclusions and make decisions
Performance metrics and benchmarking	Comparing current performance data to historical data to track performance against goals, typically using customized dashboards
Descriptive analytics	Using preliminary data analysis to find out what happened
Querying	Asking the data-specific questions, BI pulling the answers from the data sets
Statistical analysis	Taking the results from descriptive analytics and further exploring the data using statistics such as how this trend happened and why
Data visualization:	Turning data analysis into visual representations such as charts, graphs, and histograms to more easily consume data
Visual analysis	Exploring data through visual storytelling to communicate insights on the fly and stay in the flow of analysis
Data preparation:	Compiling multiple data sources, identifying the dimensions and measurements, and preparing it for data analysis

### 2.1 Applications of Business Intelligence

**Retailing:** Business Intelligence can be used to forecast the demand and analyse its fluctuations over time. This will help in optimizing the size of inventory in order to meet the customer demands. It will also help the companies to better understand the consumer behavior in order to direct their marketing campaigns. It will also help in enhancing relationship with suppliers.

**Banking:** BI will help the banks and financial institutions in identifying the customer base. This will help them in planning their marketing strategies. It will also help the banks in deducing performance metrics and benchmarks in order to measure the business performance. It can also help in knowledge management or learning management. It will help in management of large amount of data.

**FMCG:** BI will provide predictive analysis to forecast demand and understand consumer behavior. Optimization of manufacturing processes and procurement functions will lead to better relationship with suppliers. Standardization will ease the load of transaction recording and multiple source reports.

**Automobile:** BI can help in optimization of production, research, HR, distribution, marketing and finance functions by providing effective decision-making tools. In short Business Intelligence has enterprise-wide applications in all departments.

**Distribution and Logistics:** BI will enhance communication with business partners which will lead to efficient and coordinated operations. BI will provide intelligent reports to optimize the whole operations of the enterprise.

**Airways:** BI will remove hindrances in the ticket management system. BI can be used to analyses the consumer behavior pattern and predict future behavior patterns in order to increase operations efficiency by improving flight management and improve sales revenue. Consumer demands can be satisfied efficiently.

**Manufacturing:** BI will enhance communications with suppliers and standardize all the transactions occurring with them hence increasing efficiency. BI will forecast the demand for product which will optimize inventory, production and procurement size. BI implemented in HR department will help in understanding the employee needs and difficulties and for their performance appraisal.

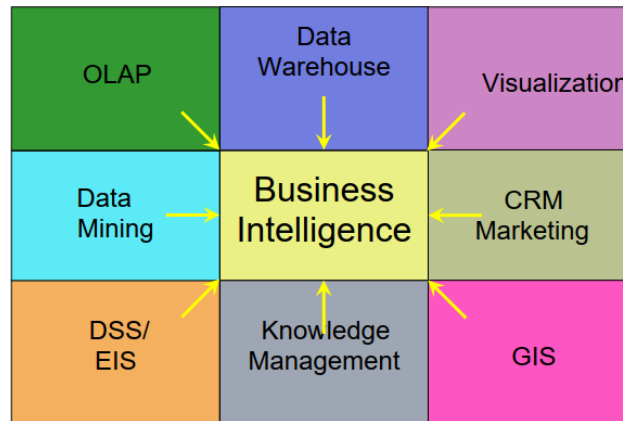
**Hospitality:** BI will help Hospitality companies to respond quickly to problematic situations. It will help them in handling problems in an efficient and timely manner. It will also give them an edge over their competitors by notifying them of new market opportunities and help them in taking advantage of it.

**Pharmaceutical:** BI will help these companies in understanding the customer behavior pattern. It will help them in research and development. It will enhance communication with suppliers and distributors.

**Services:** BI will help in people management. This is important as in services industries employees are a critical part of business success. Business Intelligence will also help in performance management of business

through benchmarking and to enhance relationship with business associates. It will also help in managing huge amount of data within the company. It will also help in training the employees and in knowledge management [17 – 26].

Business intelligence is a natural outgrowth of a series of previous systems designed to support decision making. The emergence of the data warehouse as a repository, the advances in data cleansing that lead to a single truth, the greater capabilities of hardware and software, and the boom of Internet technologies that provided the prevalent user interface all combine to create a richer business intelligence environment than was available previously. BI pulls information from many other systems. Figure 2 depicts some of the information systems that are used by BI.



**Figure 2: BI Relation to Other Information Systems.**

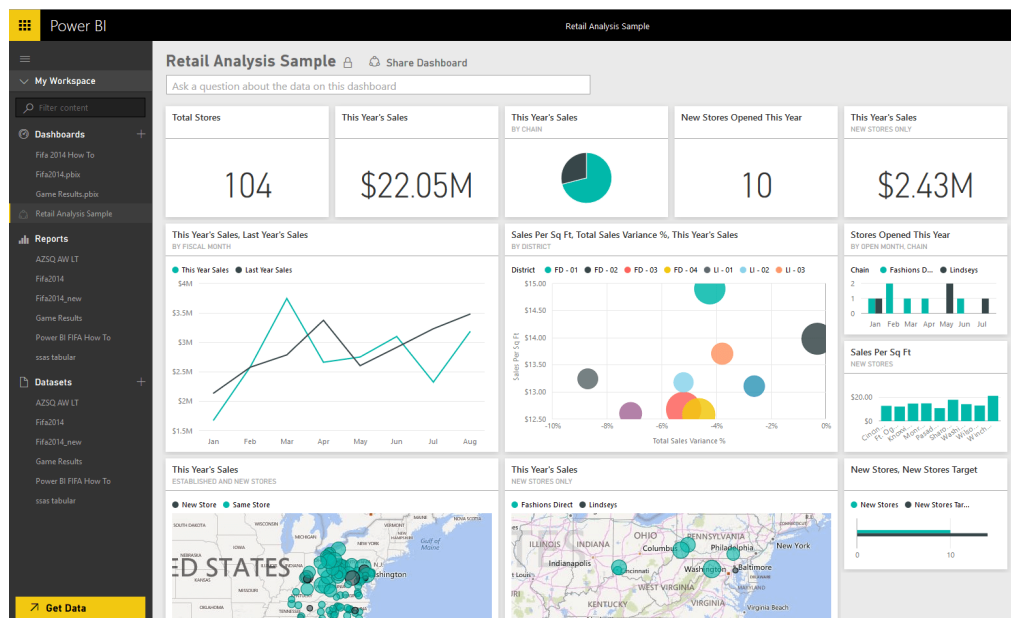
where: OLAP = on-line data processing, CRM=customer relationship management, DSS= decision support systems, GIS = geographic information systems

### III. POPULAR BUSINESS INTELLIGENCE SOFTWARE TOOLS

Business intelligence tools (BI tools) are types of software used to collect, organize, visualize and analyze data accumulated through business operations to highlight trends and patterns to allow for actionable data-based decision-making [7].

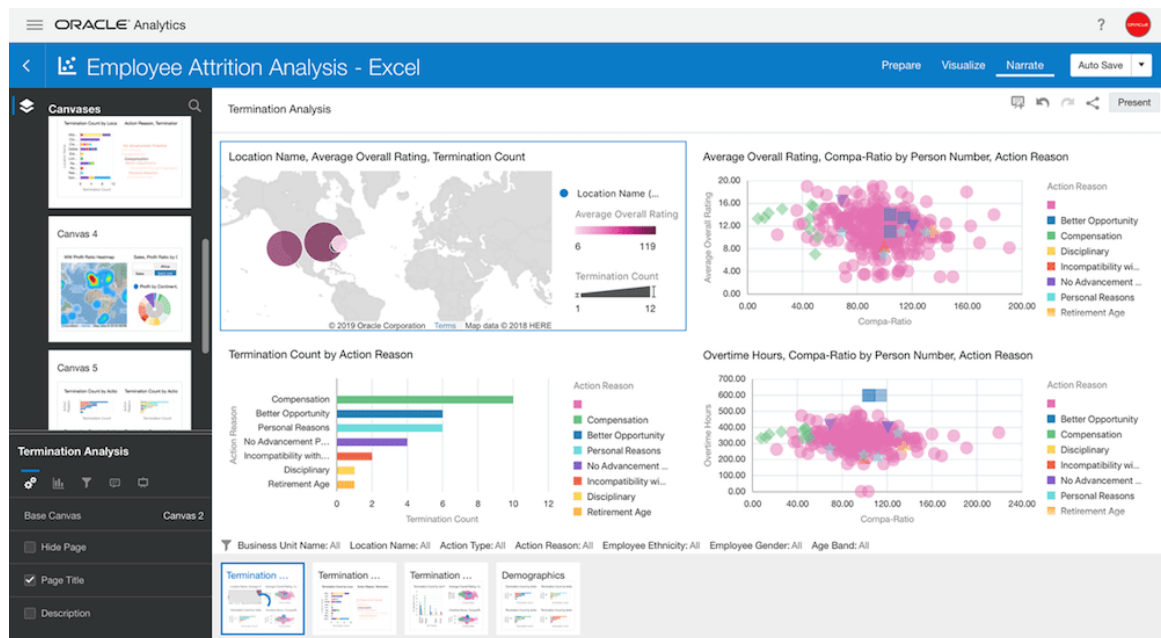
#### 3.1. POWER BI

Microsoft Power BI is an analytics tool that assists in reporting, data mining and data visualization to provide business insights. Through Power BI's simple interface, businesses can connect to a variety of data sources and create their own dashboards and reports.



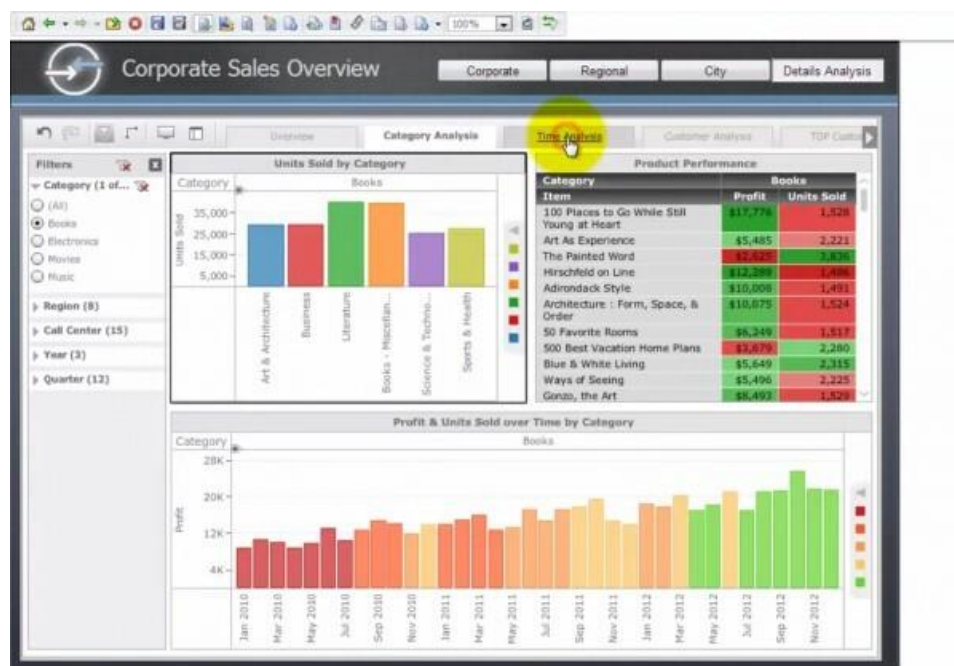
### 3.2. Oracle Analytics Cloud

Oracle Analytics Cloud is an AI-powered solution that provides robust reporting and analytics features to businesses of all sizes. It offers a strong selection of reporting and analytics features from the convenience of the cloud. It prepares and analyzes data for trends, then turns that data into an intuitive visualization for users to explore and share. This helps users get a deeper understanding of a range of business questions as well as make accurate predictions and forecasts.



### 3.3. MicroStrategy

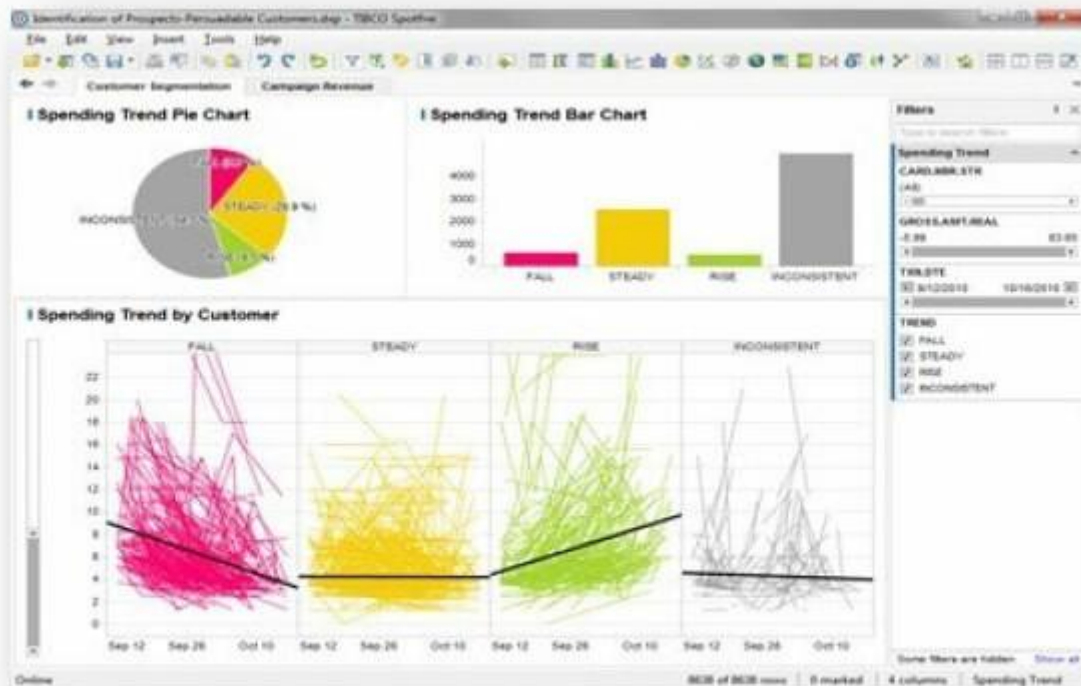
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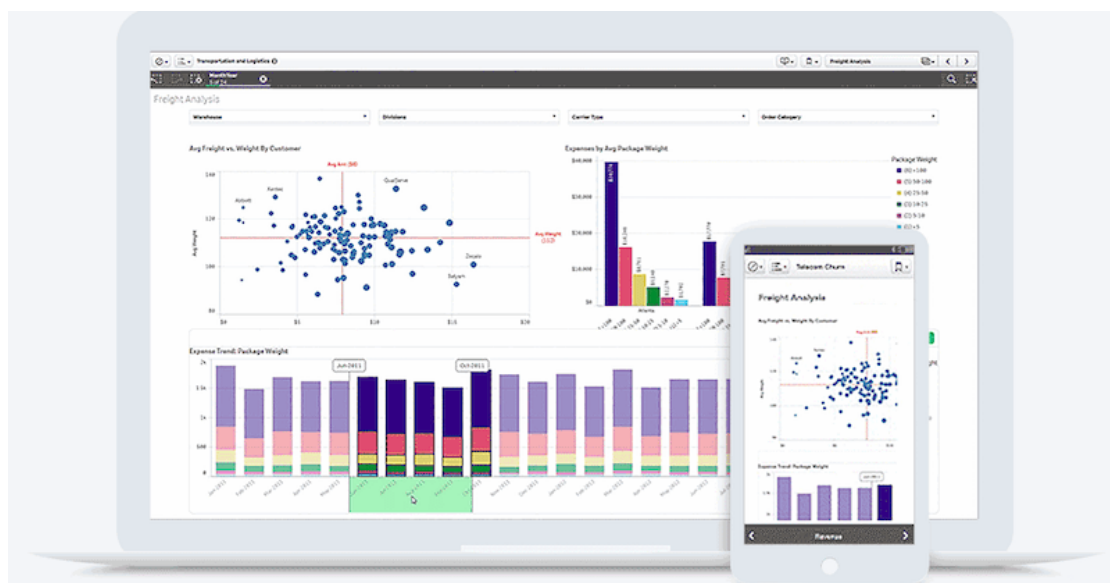
### 3.4. TIBCO Spotfire

TIBCO Spotfire is a complete business intelligence and data discovery platform that can perform various functions, including in-depth analysis and robust visual reporting, all powered by artificial intelligence. It offers data streaming technology, which can support insights with AI, big data integration, integration with the Internet of things (IoT) and more.



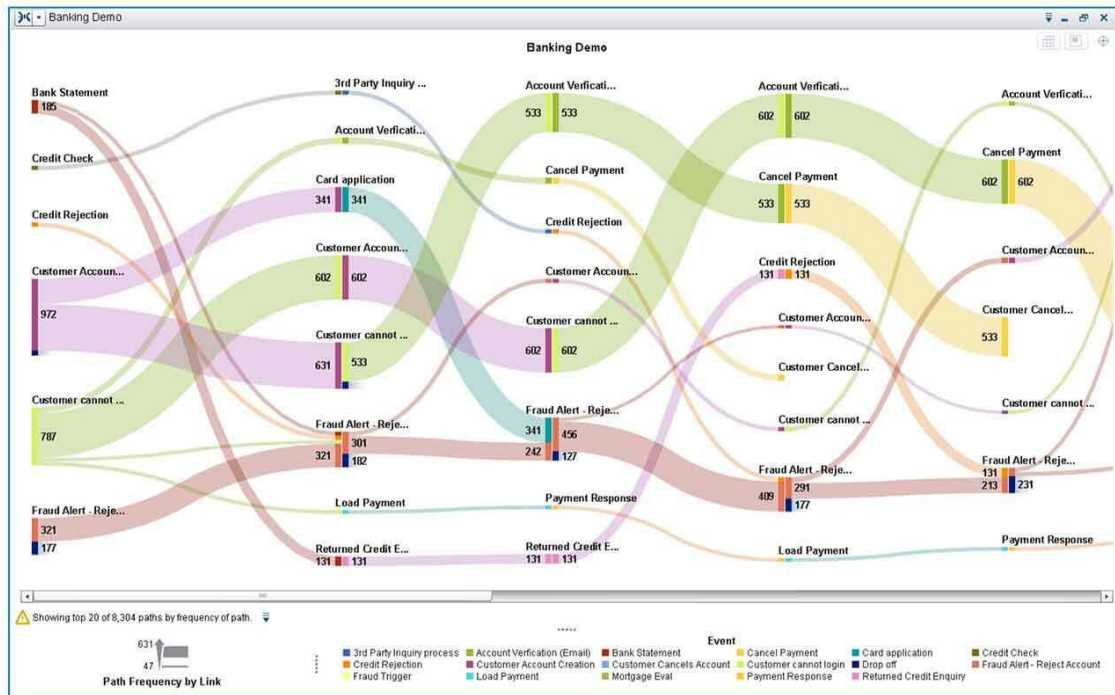
### 3.5. Qlik Q

Qlik Sense is a self-service data analytics software that enhances human intuition with the power of artificial intelligence to enable better data-driven business decisions. It allows organizations to explore their data and create intuitive and compelling visualizations from data insights with drag-and-drop simplicity. As the next-generation advancement of QlikView, released in 2014, it expands analytical possibilities to support the entire insights life cycle and helps businesses modernize their approach to intelligence. It has two editions: Business and Enterprise, offered on a per account annual subscription. Enterprises can choose between a hosted SaaS public cloud or multi-cloud, on-premise or private cloud deployment.



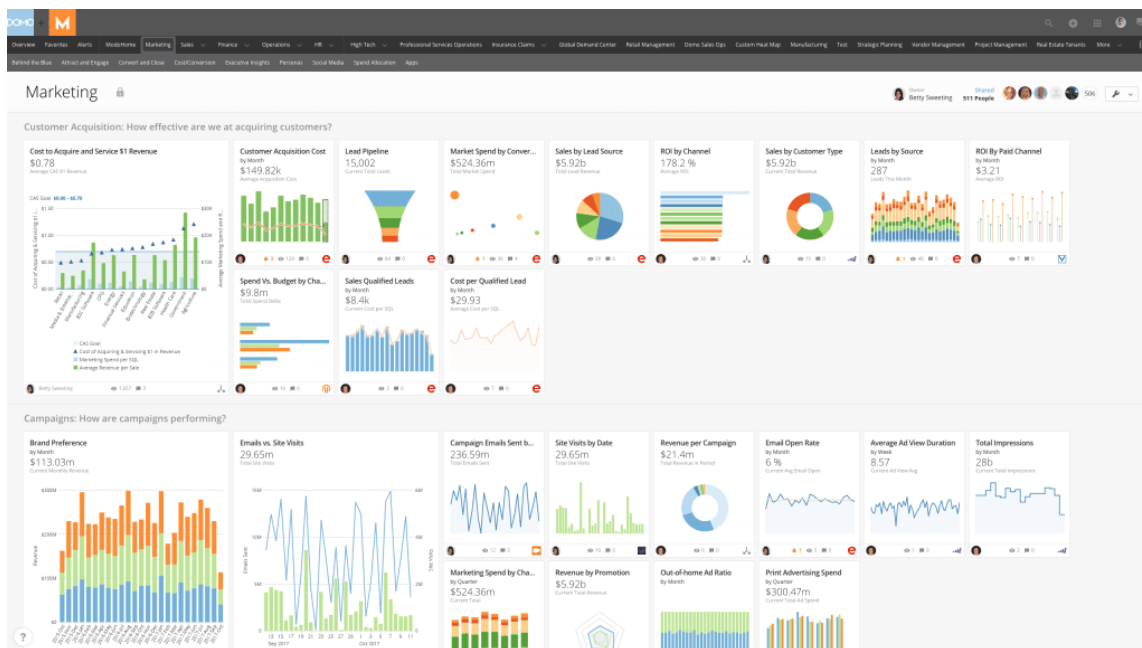
### 3.6. SAS Visual Analytics

SAS Visual Analytics offers fast answers to complex questions drawn from datasets of all sizes. It provides guided exploration, interactive dashboards, smart visualizations and self-service analytics to users of all technical skill levels, promoting data literacy and visibility. Its versatile, scalable design helps users make better business decisions based on data transparency. Built on a cohesive in-memory architecture, it promotes intelligent action driven by insight.



### 3.7. Domo

Domo is a cloud-based business management suite that accelerates digital transformation for businesses of all sizes. It performs both micro and macro-level analysis to provide teams with in-depth insight into their business metrics as well as solve problems smarter and faster. It presents these analyses in interactive visualizations to make patterns obvious to users, facilitating the discovery of actionable insights. Through shared key performance indicators, users can overcome team silos and work together across departments.



### 3.8. Dundas BI

Dundas BI is a browser-based analytics platform built to embed from the ground up. The vendor provides single and multi-tenant deployments with access to shared, reusable content. HTML5 enables customizable visualizations and user-friendly dashboards to build reports with interactivity options to drill down into data on demand. It allows secure write-backs to the database, capturing input through custom forms, stored procedures and REST APIs. It gives businesses complete control over the data stored on their IT infrastructure.



### 3.9. Sisense

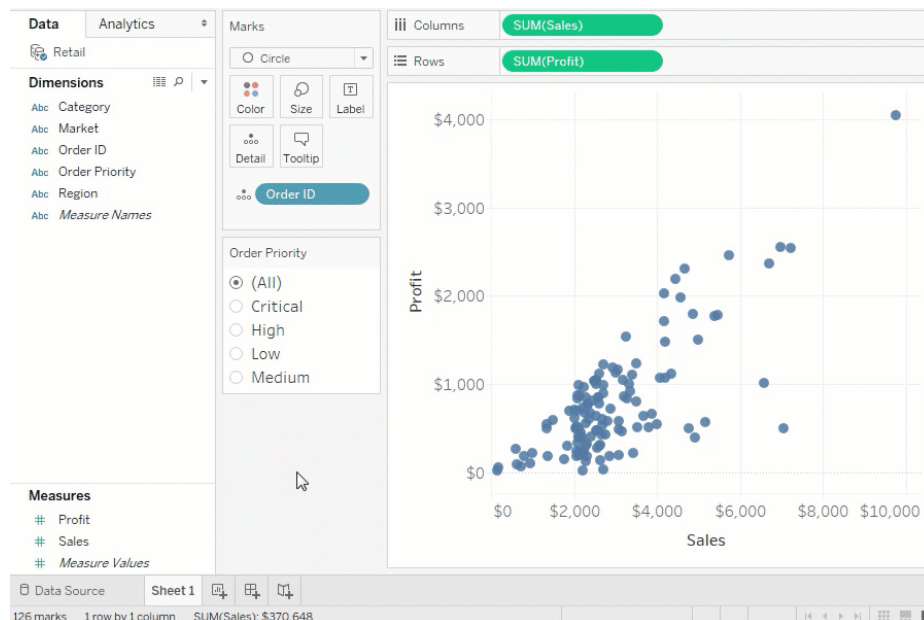
Sisense is an end-to-end data analytics platform that makes data discovery and analytics accessible to customers and employees alike via an embeddable, scalable architecture. With a back-end powered by in-chip technology, it allows analysts to blend large datasets from a variety of sources into a single cohesive database for the entire company. On the front-end, users of all technical skill levels can craft visualizations, reports and dashboards to explore and share insights that drive businesses forward. Its AI-driven, cloud-native analytics offering, Fusion, embeds into business workspaces and empowers teams to view key metrics and data insights where they work. Designed for companies of all sizes, it can be deployed on-premises, as a private cloud-hosted SaaS, as a fully managed SaaS or via a hybrid strategy. It is available via annual subscription pricing and offered in three packages: its main offering BI Analytics Teams, its embedded analytics component Product Teams and code-driven cloud analytics through Cloud Data Teams.





### 3.10. Tableau

Tableau is a data visualization and analytics solution that assists enterprises in making data-driven business decisions. It blends information from a wide range of sources to deliver actionable, real-time insights. It allows exploration of data via intuitive means such as drag-and-drop filtering and natural language queries, irrespective of skill levels. With ample customization and security options, it offers control over data visualization, enabling creation of dashboards and stories that effectively convey business narratives. It can be purchased as part of the Tableau Creator package, which includes the desktop version, Prep and a Creator license of the server or online version.



## IV. ANALYSIS OF BUSINESS INTELLIGENCE SOFTWARE TOOLS

We analyzed ten popular business intelligence software tools with the following criteria [7]

### 4.1. Dashboarding and Data Visualization

- Advanced Visualizations using Python and R:** The solution supports creating advanced and sophisticated visualizations by using libraries and packages of Python and R programming
- Animations:** The solution enables data to be presented as an animation, mainly to show changes across multiple groups or time periods.

- c. **Auto-charting:** The solution guides the users by suggesting the best suitable visualization for the graphical representation of the selected data.
- d. **Auto-refresh:** The solution offers an automatic refresh of charts and visualizations in a dashboard at regular intervals.
- e. **Dashboard Rebranding:** The solution allows changing the formatting settings (font, logo, color, etc.) of a dashboard to align it with the organization's brand.
- f. **Dashboards:** The solution allows creating dashboards that provide a single-screen snapshot view of various KPIs, business analytics metrics, and critical data points, placed in the form of panels.
- g. **Embed Dashboards and Visualizations in Webpages:** The solution allows dashboards and visualizations to be embedded into other webpages.
- h. **Interactive Data Visualizations:** The solution provides charts, graphs, and visualizations with interactions such as scaling, linking, tooltip, mouse, and touch events.
- i. **Visualizations with Drill-down and Drill-up:** The solution provides drill-down and drill-up capabilities to explore multidimensional and hierarchical data, directly from visualizations

Dashboarding and Data Visualization	Popular BI Software Tools									
	Power BI	ORACLE	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
Advanced Visualizations using Python and R	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Animations	✓	✓✓✓	✓✓✓✓	✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓
Auto-charting	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Auto-refresh	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Dashboard Rebranding	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓
Dashboards	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Embed Dashboards and Visualizations in Webpages	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Interactive Data Visualizations	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Visualizations with Drill-down and Drill-up	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓

#### 4.2. Platform Functions

- a. **Collaboration and Information Sharing:** The solution allows users to interact and share visualizations and reports via team messaging and collaboration platforms, emails, discussion
- b. **Decentralized Analytics Environment:** The solution offers a decentralized analytics environment, which is a system of storing and managing business intelligence, or data,
- c. **Globalization Support:** The solution supports internationalization and localization customizations such as language, fonts, font-sizes, symbols, reading direction,
- d. **Projects or Workspaces:** The solution enables creating projects or workspaces which contain collections of dashboards, visualizations, reports, etc.
- e. **Write to Transactional Applications:** The solution can write to transactional applications.

Platform Functions	Popular BI Software Tools									
	Power BI	ORACLE	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
Collaboration and Information Sharing	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Decentralized Analytics Environment	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Globalization Support	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Projects or Workspaces	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Write to Transactional Applications	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓

#### 4.3. Reporting

- a. **Ad-hoc Reporting:** The solution offers an intuitive platform for non-technical users to create and distribute reports on the fly, without any assistance from the IT team.
- b. **Auto-schedule Reports:** The solution facilitates the automatic delivery of reports at recurring time schedules.
- c. **Built-in Alerts:** The solution comes with a built-in alerting component to distribute certain reports only when a specific pre-set condition within the data is met.
- d. **Canned/Managed Reporting:** The solution allows technical users to design and template complex reports to be used by the entire organization or a specific user group.
- e. **Conditional Formatting:** The solution supports the conditional formatting of reports to highlight cells with a particular color or font when a specific pre-set condition is met.
- f. **Interactive Reporting:** The solution offers interactive reporting and enables end-users to interact with different report views dynamically.
- g. **Reports Exporting:** The solution allows exporting of reports in various formats such as HTML, Excel, CSV, or PDF files.

- h. **Reports Versioning:** The solution offers a versioning system for reports and allows viewing past versions of a report.
- i. **Text-based Natural Language Reports:** The solution enables easy processing, querying, and generation of data reports and visualizations through text-based natural

Reporting Functions	Popular BI Software Tools									
	Power BI	ORACLE	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
Ad-hoc Reporting	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Auto-schedule Reports	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Built-in Alerts	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Canned/Managed Reporting	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Conditional Formatting	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Interactive Reporting	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Reports Exporting	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Reports Versioning	x	x	x	✓✓	✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Text-based Natural Language Reports	✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓	x	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓

#### 4.4. Availability & Scalability

- a. **Dynamic Scaling:** The solution should be able to automatically scale the resources to accommodate varying throughput at different times of the day.
- b. **Fault Tolerance:** The solution is built with fault tolerance architecture and capabilities to recover from any single point of failure automatically.
- c. **High Availability:** The system provides for high availability through means such as redundant backup servers, cloud nodes, or other methods.
- d. **Scalability:** The solution should be horizontally and vertically scalable.

Availability & Scalability	Popular BI Software Tools									
	Power BI	ORACLE	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
Dynamic Scaling	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Fault Tolerance	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
High Availability	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Scalability	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓

#### 4.5. Data Sources Connectivity

- a. **Accounting Platforms:** The solution connects to popular accounting platforms like Intuit Quickbooks, FreshBooks, Sage, etc.
- b. **Big Data Ecosystem:** The solution connects to various tools and platforms related to Big Data ecosystem like Apache Hive, Apache Spark SQL, Cloudera Hive, Cloudera Impala, Databricks Cloud, Hortonworks, MapR Drill, Pivotal HAWQ, Google BigQuery, Presto, Neo4J, etc.
- c. **CRM Platforms:** The solution connects to popular CRM platforms like Salesforce, HubSpot, Insightly, FreshSales, etc.
- d. **Cloud Files Storage Systems:** The solution connects to popular cloud storage and synchronization systems like Google Drive, OneDrive, Dropbox, etc.
- e. **Customer Success Platforms:** The solution connects to popular customer success platforms like Freshdesk, Intercom, Zendesk, etc.
- f. **Data Integration Tools:** The solution integrates with popular data integration tools like Informatica, etc.
- g. **E-Commerce:** The solution connects to popular e-commerce platforms like Shopify, Magento, Big Commerce, etc.
- h. **ERP Platforms:** The solution connects to popular ERP systems from SAP, Oracle, etc.
- i. **Enterprise BI Platforms:** The solution connects to popular enterprise BI platforms like SAP HANA, SAP BW, IBM Cognos, Oracle Analytics Server (OBIEE), etc.
- j. **Enterprise Messaging Platforms:** The solution connects to popular enterprise messaging platforms like Slack, etc.
- k. **JDBC, ODBC and Parameterized Connections:** The solution connects to popular enterprise messaging platforms like Slack, etc.
- l. **Marketing Platforms:** The solution connects to popular marketing platforms like Marketo, Pardot, Eloqua, MailChimp, Survey Monkey, Unbounce, Google Adwords, etc.
- m. **NoSQL Databases:** The solution connects to NoSQL databases such as MongoDB, Cassandra, Apache HBase, Couchbase, etc.
- n. **Payment Processing Platforms:** The solution connects to popular payment processing platforms like PayPal, Square, Stripe, etc.

- o. Project Management Platforms: The solution connects to popular project management platforms like Jira, Asana, Trello, etc
- p. Relational Databases: The solution connects to relational databases such as Oracle, SQL Server, MySQL, PostgreSQL, Sybase ASE, IBM DB2, etc.
- q. SEO and Web Analytics Platforms: The solution connects to popular SEO and web analytics platforms like Google Analytics, Adobe Analytics, Heap Analytics, Ahrefs, etc.
- r. SFTP/FTP Support: The solution connects to stored data via SFTP or FTP
- s. Social Media Platforms: The solution connects to popular social media platforms like Twitter, Facebook, etc. and gathers data for further analysis.
- t. Standard Files: The solution enables creating datasets from files like Excel, CSV, XML, JSON, PDF, etc.
- u. Statistical Files: The solution connects to SAS (\*.sas7bdat), SPSS (\*.sav), and R (\*.rdata, \*.rda) data files.

Data Sources Connectivity	Popular BI Software Tools									
	Power BI	ORACLE	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
Accounting Platforms	✓✓✓	✓✓	✓✓✓	✓✓✓✓	✓✓✓	✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓
Big Data Ecosystem	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓
CRM Platforms	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Cloud Files Storage Systems	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Customer Success Platforms	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓
Data Integration Tools	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓✓✓	×	×	✓✓✓✓
E-Commerce	✓✓	✓✓	✓✓✓✓	✓✓✓✓	×	✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓
ERP Platforms	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓	×	✓✓✓✓	✓✓
Enterprise BI Platforms	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓	✓✓✓
Enterprise Messaging Platforms	✓✓✓✓	×	✓✓	✓✓✓✓	✓✓✓	×	✓✓	✓✓✓✓	✓✓✓	✓✓
JDBC, ODBC and Parameterized Connections	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Marketing Platforms	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
NoSQL Databases	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Payment Processing Platforms	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	×	✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓
Project Management Platforms	✓✓✓	✓✓✓	✓✓	✓✓✓✓	✓✓✓	✓✓	✓✓✓✓	✓✓	✓✓✓✓	✓✓
Relational Databases	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
SEO and Web Analytics Platforms	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓
SFTP/FTP Support	✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓
Social Media Platforms	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Standard Files	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Statistical Files	✓✓✓	✓✓✓	✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓

#### 4.6. Deployment Options

- a. SaaS Option: The solution is available as a fully hosted, Software as a Service (SaaS) offering.
- b. Self-Hosted Option: The solution can be installed on the client's on-premise or cloud infrastructure.

Deployment Option	Popular BI Software Tools									
	Power BI	ORACLE	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
SaaS Option	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Self-Hosted Option	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓

#### 4.7. Extensibility

- a. API Extensibility: The solution supports API integration using REST or other methods to provide programmatic access for managing data sources, workbooks, content, users, sites, etc. and for building custom integration with other solutions.
- b. IDE Support: The solution supports API integration using REST or other methods to provide programmatic access for managing data sources, workbooks, content, users, sites, etc. and for building custom integration with other solutions.

Extensibility	Popular BI Software Tools									
	Power BI	ORACLE	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
API Extensibility	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
IDE Support	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓

#### 4.8. OS Support

- a. Linux: The solution's components such as its analytics engine/server, data visualization tools, etc. can be installed on Linux operating systems.
- b. Mac OS: The solution's components such as its analytics engine/server, data visualization tools, etc. can be installed on Mac OS operating systems.
- c. Windows: The solution's components such as its analytics engine/server, data visualization tools, etc. can be installed on Microsoft Windows operating systems.

OS Support	Popular BI Software Tools									
	Power BI	ORACLE BI	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	sisense	tableau
Linux	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Mac OS	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✗	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Windows	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓

#### 4.9. Security

- Application Activity Tracking: The solution maintains a record of administrative and user actions and generates a report on such activities.
- Authentication Protocols and Systems: The solution supports or integrates with authentication protocols and systems such as SAML, OpenID, Kerberos, LDAP, Active Directory, etc. to access existing corporate user directory.
- Column Level Security: The system enables applying column-level security policies and defining which table columns are revealed to any given user, user groups, or user roles.
- Encryption: The solution provides encryption capabilities for stored data to ensure that data-at-rest is protected and in-transit information is secure.
- Object-level Security: The system enables applying object-level security policies and defining which visualizations, reports, dashboards, worksheets, and other objects are revealed to any given user, user groups, or user roles.
- Row-Level Security (RLS) and User Filtering: The system enables applying object-level security policies and defining which visualizations, reports, dashboards, worksheets, and other objects are revealed to any given user, user groups, or user roles.
- Single Sign-on and Trusted Authentication: The solution allows configuring SSO to provide automatic access to the users without prompting them to log in separately if they have already authenticated themselves into the corporate authentication system.

Security	Popular BI Software Tools									
	Power BI	ORACLE BI	MicroStrategy	TIBCO Spotfire	Qlik	SAS	DOMO	Dundas BI	sisense	tableau
Application Activity Tracking	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓✓✓✓
Authentication Protocols and Systems	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Column Level Security	✓✓✓	✓✓✓✓	✓✓✓✓	✓	✓✓✓✓	✗	✓✓✓	✓✓✓✓	✗	✗
Encryption	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Object-level Security	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Row-Level Security (RLS) and User Filtering	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓
Single Sign-on and Trusted Authentication	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓✓✓

#### 4.10. Vendor Qualification Requirements

- Free Trial: Does the solution offer a free trial?
- Open Source: Is the software available as an open-source, free to use license?
- Implementation Services: Does the vendor offer software implementation services, including solution evaluation and installation, to minimize the on-premise expertise required to implement the solution?
- Maintenance Contracts: Does the vendor offer software implementation services, including solution evaluation and installation, to minimize the on-premise expertise required to implement the solution?
- On-premise Maintenance: Does the vendor provide on-premise maintenance support?
- Price Capping: Can the implementation costs be capped and based on a fixed scope?
- Certifications: Does the vendor offer testing and certification programs to certify professionals who have achieved specific qualifications in using, configuring, or customizing the product?
- Free Live Training: Does the vendor provide free live training?
- In-Product Help and Suggestions: Does the vendor offer in-product help and suggestions within the application to help the user to get started with using the product?
- Training Material: Does the vendor offer training material to help in configuring and using various features and functionalities of the product?
- 24x7 Technical Support: Does the vendor offer 24x7 technical support?
- Chat and Instant Message: Does the vendor offer help desk support via instant messaging or live chat?
- Forum/Community Support: Does the product have an active community support forum for the user community to interact and provide assistance to one another?
- Penalties: Does the vendor accept penalties if the SLA terms are violated?
- Phone and Email: Does the vendor offer help desk support via telephone and email?
- formal service level agreement (SLA): Is a formal service level agreement (SLA) published or available for review?
- Financial Stability: Is the vendor financially stable, as evidenced by a Dun & Bradstreet or similar report?
- Public Entity: Is the vendor a public company?



- s. References: Is the vendor able to provide customer references?
- t. Vendor Financials: Are the vendor's financial statements such as P&L statement, balance sheet, cash flow statements, etc. available for review?

Vendor Qualification Requirements	Popular BI Software Tools									
	Power BI	ORACLE	Microsoft	TIBCO	Qlik	SAS	DOMO	Dundas BI	Sisense	Tableau
Free Trial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Open Source	No	No	No	No	No	No	No	No	No	No
Implementation Services	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maintenance Contracts	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
On-premise Maintenance	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Price Capping	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Certifications	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Free Live Training	No	Yes	No	No	No	Yes	Yes	No	Yes	No
In-Product Help and Suggestions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Training Material	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24x7 Technical Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
No Chat and Instant Message	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No
Forum/Community Support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Penalties	Yes	No	Yes	Yes	Yes	No	No	Yes	No	No
Phone and Email	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
formal service level agreement (SLA)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Financial Stability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Public Entity	Yes	Yes	Yes	No	No	Yes	Yes	No	No	Yes
References	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vendor Financials	Yes	Yes	Yes	No	No	Yes	Yes	No	No	Yes

- ✓✓✓✓----- Fully Supported Out of the Box / Yes
- ✓✓✓----- Moderately Supported Out of the Box / Supported with Workarounds
- ✓✓----- Supported with Additional Modules / Supported with Partner Integrations /
- ✓-----Supported with Custom Development
- ✗----- Not Supported / No

## V. CONCLUSION

This paper discussed Business Intelligence tools as a more suitable choice for business data analytics. This paper elaborated on why BI tools are more popular in this real business world era, and their benefits such as Timely solutions, Single point access to data, better relationship, Improved Performance, and deals with customers and suppliers. This study has also specially analyzed how BI tools related to other systems, and BI methods. Finally, we analyzed ten popular BI software tools with different criteria, which will help current and future researchers choose good BI tools for their research.

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