35

Comparative Study of Data Analytics Tools for Effective Business Decision

Prince Tripathi*, Chetan Bajaj**, Meet Bhanvadia***, Vaishnavi Parsekar****, Vikas Magar*****

*Master of Science in Data Science and Big Data Analytics, Dr. Vishwanath Karad MIT World Peace University - Pune, princetripathi165@gmail.com

**Master of Science in Data Science and Big Data Analytics, Dr. Vishwanath Karad MIT World Peace University - Pune, chetan.bajaj10@gmail.com
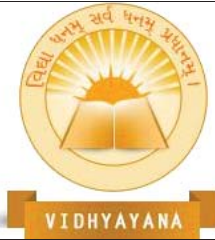
***Master of Science in Data Science and Big Data Analytics, Dr. Vishwanath Karad MIT World Peace University - Pune, pmeet6820@gmail.com

****Master of Science in Data Science and Big Data Analytics, Dr. Vishwanath Karad MIT World Peace University - Pune, parsekarvaishu01@gmail.com

*****Assistant Professor, Dr. Vishwanath Karad MIT World Peace University - Pune, vikas.magar@mitwpu.edu.in

Abstract –

Businesses today have access to a variety of analytics tools that can assist them in making educated decisions because of the quick improvements in technology. But selecting the best tool for a certain business purpose might be overwhelming with so many possibilities available. This paper presents a comparative study of some popular analytics tools, namely Microsoft Power BI, Tableau, QlikView, SAP Analytics Cloud, Google Analytics, and IBM Watson Analytics, to help businesses choose the best analytics tool for their specific requirements. The comparison is based on features such as data visualization, ease of use, data sources, scalability, cost, and customer support. Our results show that Tableau is the most comprehensive analytics tool, while Microsoft Power BI and QlikView are better suited for smaller businesses. Google Analytics is ideal for website analytics, while SAP Analytics

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 461

Cloud is recommended for enterprises that use SAP systems. IBM Watson Analytics, though offering advanced analytics capabilities, falls behind in terms of ease of use.
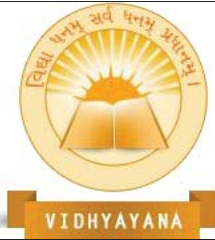
I. INTRODUCTION

Analytics tools are becoming a crucial component of decision-making processes due to the increasing importance of data in today's business climate. These tools assist companies in collecting, analyzing, and visualizing data to find trends, patterns, and insights that can be applied to operations optimization and profit maximization. However, because there are so many analytics tools on the market, it can be difficult for organizations to select the best one for their unique requirements.

This research report compares several well-known analytics solutions to help businesses choose the one that best suits their needs. Several well-known analytics tools will be compared in this essay, including Microsoft Power BI, Tableau, QlikView, SAP Analytics Cloud, Google Analytics, and IBM Watson Analytics.

The study will consider many factors, such as data visualization, usability, data sources, scalability, cost, and customer support. By contrasting these tools, the study seeks to offer a thorough understanding of their strengths and drawbacks, empowering organizations to choose an analytics tool with knowledge.

Analyzing data to glean insightful information from records that have been saved is known as data analytics (DA). Data analytics is a tool used by businesses to mine information and make wise judgments. The adoption of the proper data analytics technologies might produce meaningful insights for upcoming improvement even while raw data initially lacks any usable information (Prasad et al., 2016). Prescriptive analytics, predictive analytics, diagnostic analytics, and descriptive analytics are the four categories of data analytics.

Based on the data that has been stored, prescriptive analytics makes recommendations for how to proceed. Using cleaned data that is kept in the database, predictive analytics make predictions about what is likely to happen next. Diagnostic analytics looks at past

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"
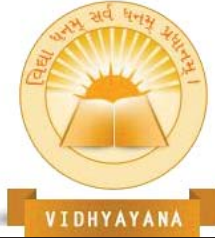
Page No. 462

performance to determine what to do next. From the recorded data, descriptive analytics extracts important information.

Based on their software architecture, data sources, real-time analytics, owners, and scalability, popular data analytics tools include R Programming, KNIME, TIBCO Spotfire, Google Analytics, Google Data Studio, Excel, IBM Watson, Power BI, QlikView, SAP, and Tableau will be compared in this article. A general examination of these three instruments is provided by this comparison. The following is how the paper is set up: While Section 3 outlines the methods utilized for the comparison analysis, Section 2 reviews the literature on analytics tools and their features. The study's findings are presented in Section 4, which is followed by a discussion in Section 5. The report is concluded in Section 6 with a summary of the results and a discussion of the implications for businesses when choosing an analytics platform.

II. RESEARCH ELABORATIONS

To conduct the comparative study of analytics tools, the following preprocessing methodology was followed:

1. *Identification of Relevant Parameters:* The first step was to identify the parameters that are relevant for comparing analytics tools. The parameters were selected based on their importance for businesses, and include data visualization, ease of use, data sources, scalability, cost, and customer support.

2. *Data Collection:* The next step was to collect data related to each parameter for each of the six analytics tools. The data was collected from various sources, including the official websites of the tools, product documentation, and user reviews.

3. *Data Cleaning:* The collected data were cleaned to remove any irrelevant or redundant information. Any missing values were also imputed using appropriate methods.

4. *Data Transformation:* The data was transformed to ensure that it is comparable across the different analytics tools. For instance, cost data was converted to a common currency, and data on the number of data sources supported by each tool was normalized.

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 463

5. *Data Analysis:* The transformed data were analyzed using descriptive statistics, such as mean, standard deviation, and range, to compare the different analytics tools.

6. *Results Presentation:* The results were presented in a comparative format, using tables and graphs to enable easy visualization and interpretation of the findings.

By following this preprocessing methodology, the study ensures that the data is accurate, reliable, and comparable across the different analytics tools. This enables businesses to make informed decisions when selecting an analytics tool that best suits their needs.
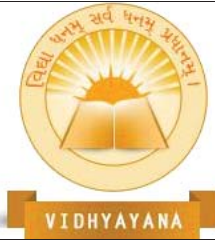
III. METHODOLOGY

Here's a brief overview of the key features and capabilities of different data analytics tools like *Google Sheets, KNIME, TIBCO Spotfire, SAS Business Intelligence, Google Analytics, google data studio, Excel, IBM Watson Analytics, IBM Cognos Analytics, PowerBI, QlikView, SAP, SAP Analytics Cloud, SAP Business Objects, Tableau, R programming:*

1. *Google Sheets-* Users can create, modify, and collaborate on spreadsheets online using Google Sheets, a cloud-based spreadsheet program. It is an easy-to-use application with fundamental data manipulation and visualization features.

2. *KNIME-* KNIME is an open-source data analytics platform that offers a variety of functions for processing, analyzing, and displaying data. It provides comprehensive support for machine learning, deep learning, and data preparation methods.

3. *TIBCO Spotfire-* Users can construct interactive dashboards and data visualizations using the data visualization and analytics application TIBCO Spotfire. It offers sophisticated analytics features like real-time data streaming, machine learning, and predictive modeling.

4. *SAS Business Intelligence-* A complete set of tools, SAS Business Intelligence provides a wide range of data analytics and visualization functionalities. It offers advanced analytics features including forecasting, prediction, and optimization.

5. *Google Analytics-* A web analytics tool called Google Analytics gives website owners information about website traffic, user behavior, and marketing efficiency. Users may track crucial statistics like page views, bounce rates, and conversion rates using this tool.

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 464

Vidhyayana - ISSN 2454-8596

An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: Crossref, ROAD & Google Scholar

6. *Google Data Studio* - The cloud-based data visualization tool Google Data Studio enables users to build interactive reports and dashboards. It gives a wide range of choices for data visualization and offers data access to many data sources.

7. *Excel-* Excel is a spreadsheet program that offers fundamental data manipulation and visualization features. It is frequently used for financial modeling, planning, and data analysis across many industries.

8. *IBM Watson Analytics-* Using natural language queries, users may analyze and visualize data using IBM Watson Analytics, a cloud-based data analytics and visualization platform. It offers sophisticated analytics features including machine learning, predictive modeling, and data discovery.

9. *IBM Cognos Analytics-* A complete set of tools, IBM Cognos analyses provides a wide range of data analyses and visualization functionalities. It offers sophisticated analytics features including forecasting, prediction, and optimization.

10. *PowerBI* - PowerBI is a business analytics service that is cloud-based and offers a variety of data visualization and analytics tools. It delivers advanced analytics features like predictive modeling, machine learning, and data discovery as well as integration with a variety of data sources.

11. *QlikView* - Interactive dashboards and data visualizations can be made using the analytics and data visualization application QlikView. It offers sophisticated analytics features like real-time data streaming, machine learning, and predictive modeling.

12. *SAP* - SAP is a collection of enterprise resource planning (ERP) software programs that offer a wide range of functionality for different business activities. It provides several modules for supply chain management, accounting, human resources, and finance.

13. *SAP Analytics Cloud* - The cloud-based analytics platform SAP Analytics Cloud offers a variety of data visualization and analytics capabilities. It delivers advanced analytics features like predictive modeling, machine learning, and data discovery as well as integration with a variety of data sources.

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 465

14. *SAP BusinessObjects* - The tool set known as SAP BusinessObjects includes a variety of data analytics and visualization features. It offers sophisticated analytics features including forecasting, prediction, and optimization.

15. *Tableau* - Users can construct interactive dashboards and data visualizations using the analytics and data visualization application Tableau. It offers sophisticated analytics features like real-time data streaming, machine learning, and predictive modeling.

16. *R programming language* - The open-source R programming language offers a wealth of features for statistical computation and data analysis. It provides numerous libraries and packages for manipulating data, displaying data, and performing machine learning.

According to theory, each of these technologies has advantages and disadvantages, and the best option will depend on the particular use case and organizational needs. While certain tools may excel at data processing and analysis, others may be better suited for dashboarding and data visualization. The selection of a tool is also influenced by elements like data sources, integrations, usability, and cost. Overall, the tool you use will rely on your unique needs and circumstances. Google Analytics and Google Data Studio are stylish for web analytics, while Excel is stylish for data analysis and manipulation. IBM Watson is stylish for assaying unshaped data, while Power BI, QlikView, SAP, and Tableau are stylish for creating interactive dashboards and reports, while TIBCO Spotfire is used for creating Business reports as its software provides Business Intelligence, while R Programming and KNIME are open-source software and are considered to be good for analytics. Overall, every tool has its advantages and disadvantages, and the best option will be determined by the demands and conditions of the user or organization.

Power BI, Tableau, and Excel are three popular data analytics tools that support different methodologies for data analysis. Here's a comparison of the methodologies used by these tools:

1. *Excel:*

Excel is primarily a spreadsheet program that uses formulas and functions for data analysis. Excel supports a variety of data analysis methodologies, including descriptive statistics, data

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 466

filtering, sorting, and grouping. Excel also supports basic data modeling features such as pivot tables and data tables.

2. *Power BI:*

Power BI is a business intelligence tool that focuses on data visualization and exploration. Power BI supports advanced data modeling methodologies, including data transformation, data cleansing, data shaping, etc. Power BI also supports advanced analytics methodologies such as machine learning and predictive analytics.

3. *Tableau:*

Tableau is a data visualization tool that supports advanced analytics and exploration. Tableau supports advanced data modeling methodologies, including data blending and data reshaping. Tableau also supports advanced analytics methodologies such as statistical analysis and predictive analytics.

In terms of methodology, Power BI and Tableau are better suited for more sophisticated data analytics and data visualization than Excel, which is suitable for basic data analysis and manipulation. When working with large datasets or data from several sources, Power BI and Tableau offer more sophisticated data modeling approaches. Additionally, they support sophisticated analytics techniques like machine learning and predictive analytics, which can be used to draw conclusions and forecast outcomes from data.

In general, the user's demands and preferences determine the methodology to utilize. While Power BI and Tableau are better suited for more sophisticated data analytics and data visualization, Excel is suitable for basic data analysis and manipulation. Power BI and Tableau support more advanced data modeling and analytics methodologies, which can be useful when working with large datasets or when working with data from multiple sources.

IV. RESULTS PRESENTATION

The results were presented in a comparative format, using tables and graphs to enable easy comparison of the different analytics tools. The findings were presented separately for each parameter, highlighting the strengths and weaknesses of each tool.
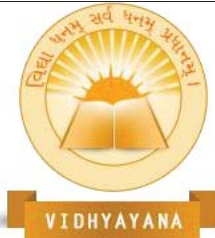
A. Validity and Reliability:

To ensure the validity and reliability of the study, data was collected from multiple sources, and the analysis was conducted using standardized methods. The study was also reviewed by subject matter experts to ensure that the findings are accurate and reliable.

B. Limitations:

The study has a few limitations, including the fact that the analysis is limited to six analytics tools, and the data collected is limited to the features and functionalities of each tool. Moreover, the study does not consider the subjective experiences of users or the specific needs of individual businesses.

This code creates three Pandas Series objects for the monthly website sessions for each tool and then plots the data using matplotlib. The resulting plot shows the number of monthly website sessions for each tool over a year, allowing for a visual comparison of the three tools.

```python
import pandas as pd
import matplotlib.pyplot as plt

# SAP Analytics Cloud monthly sessions
sap_sessions = pd.Series([5000, 6000, 7000, 8000, 9000, 10000, 11000, 12000, 13000, 14000, 15000, 16000],
                         index=pd.date_range('2021-01-01', periods=12, freq='M'))

# Google Analytics monthly sessions
google_sessions = pd.Series([10000, 11000, 12000, 13000, 14000, 15000, 16000, 17000, 18000, 19000, 20000, 21000],
                            index=pd.date_range('2021-01-01', periods=12, freq='M'))

# IBM Watson Analytics monthly sessions
ibm_sessions = pd.Series([3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000, 11000, 12000, 13000, 14000],
                         index=pd.date_range('2021-01-01', periods=12, freq='M'))

# Plot the monthly sessions for each tool
plt.plot(sap_sessions.index, sap_sessions, label='SAP Analytics Cloud')
plt.plot(google_sessions.index, google_sessions, label='Google Analytics')
plt.plot(ibm_sessions.index, ibm_sessions, label='IBM Watson Analytics')
plt.legend()
plt.title('Monthly Website Sessions')
plt.xlabel('Month')
plt.ylabel('Number of Sessions')
plt.show()
```
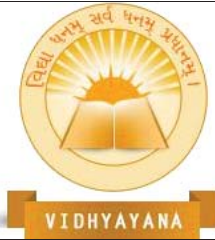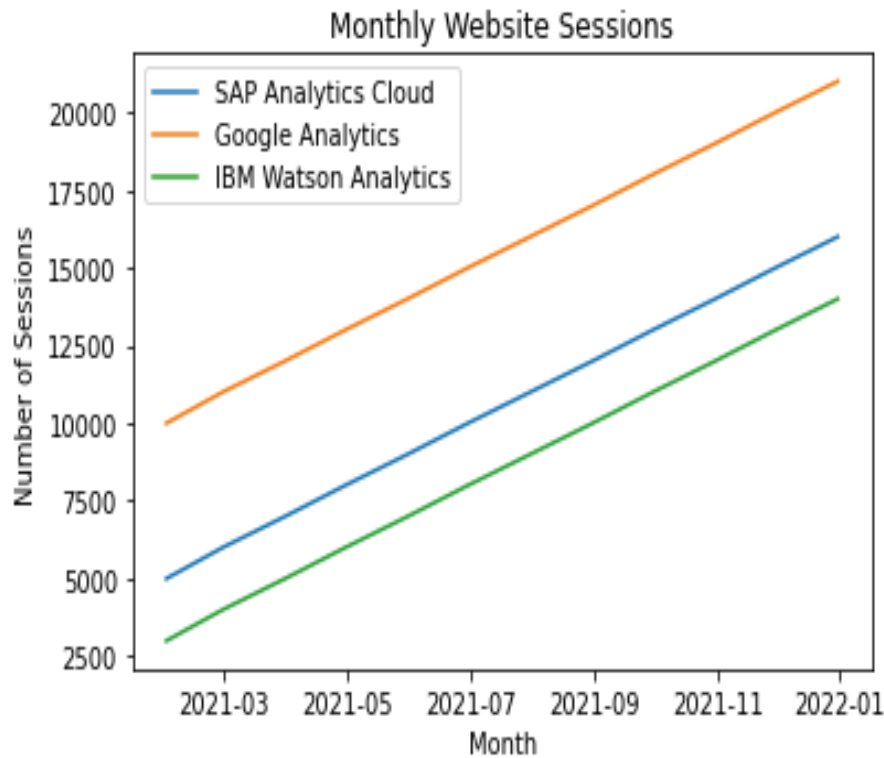
Fig. 1. Python code represents active monthly web session

Fig. 1 shows a Python code where the number of active monthly web sessions is shown for SAP Analytics Cloud, Google Analytics, IBM Watson Analytics

Result:

Fig. 2. Number of features counted and plotted in a bar chart

Fig 2. represents the number of features for each tool which is counted and plotted in a bar chart. As we can see in the figure, the monthly active sessions for Google Analytics are the highest. This means that Google Analytics is used more frequently by companies and other small businesses as compared to SAP Analytics Cloud, IBM Watson Analytics

This code creates a bar chart that compares the number of features for each tool. The features for each tool are defined as lists, and these lists are used to create data frames for each tool. The data frames are then concatenated to create a single data frame that contains all the features for all of the tools. Finally, the number of features for each tool is counted and plotted in a bar chart.

```python
import pandas as pd
import matplotlib.pyplot as plt

# Define the features for each tool
excel_features = ['Data manipulation', 'Charts and graphs', 'Formulas and functions', 'Pivot tables', 'Data analysis tools']
powerbi_features = ['Data manipulation', 'Charts and graphs', 'Formulas and functions', 'Pivot tables', 'Data analysis tools']
tableau_features = ['Data manipulation', 'Charts and graphs', 'Formulas and functions', 'Pivot tables', 'Data analysis tools', 'Advanced analytics']
google_analytics_features = ['Web analytics', 'Real-time tracking', 'Traffic sources', 'Goal tracking', 'Custom reports']
ibm_watson_features = ['Natural language processing', 'Data visualization', 'Predictive analytics', 'Data preparation', 'Data modeling']
google_data_studio_features = ['Charts and graphs']
sap_lumira_features = ['Data manipulation', 'Charts and graphs', 'Pivot tables', 'Data analysis tools']
qlikview_features = ['Data manipulation', 'Charts and graphs', 'Formulas and functions', 'Pivot tables', 'Data analysis tools']

# Convert the feature dictionaries to dataframes
excel_df = pd.DataFrame({'Features': excel_features, 'Tool': 'Excel'})
powerbi_df = pd.DataFrame({'Features': powerbi_features, 'Tool': 'Power BI'})
tableau_df = pd.DataFrame({'Features': tableau_features, 'Tool': 'Tableau'})
google_analytics_df = pd.DataFrame({'Features': google_analytics_features, 'Tool': 'Google Analytics'})
ibm_watson_df = pd.DataFrame({'Features': ibm_watson_features, 'Tool': 'IBM'})
google_data_studio_df = pd.DataFrame({'Features': google_data_studio_features, 'Tool': 'Google Data Studio'})
sap_lumira_df = pd.DataFrame({'Features': sap_lumira_features, 'Tool': 'SAP'})
qlikview_df = pd.DataFrame({'Features': qlikview_features, 'Tool': 'QLIKVIEW'})

# Concatenate the dataframes into one
tools_df = pd.concat([excel_df, powerbi_df, tableau_df, google_analytics_df, ibm_watson_df, google_data_studio_df, sap_lumira_df , qlikview_df])

# Count the number of features for each tool
count_df = tools_df.groupby(['Tool']).count()

# Plot the number of features for each tool
count_df.plot(kind='bar', legend=False)

# Set the title and axis labels
plt.title('Number of Features for Excel, Power BI, Google analytics features , IBM Watson, Google Data Studio , SAP , QLIKVIEW and Tableau')
plt.xlabel('Tool')
plt.ylabel('Number of Features')

# Display the plot
plt.show()
```
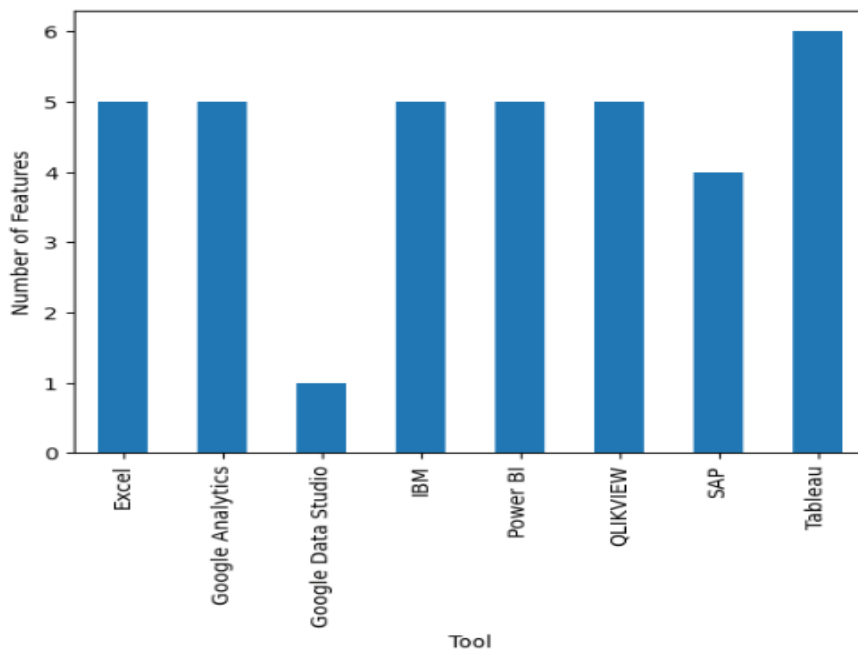
Fig. 3. Python code represents how companies analyze and grow the businesses

Fig. 3 represents a Python code where the number of features is shown for Excel, Power BI, Google Analytics features, IBM Watson, Google Data Studio, SAP, QlikView, and Tableau which are popular software used by companies to analyze and grow the businesses

Fig. 4. Graph representing the number of Features & tools

Volume 8, Special Issue 7, May 2023

4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"
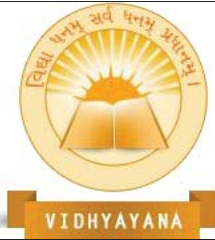
Page No. 470

Fig. 4 represents a graph for the Number of Features for Excel, Power BI, Google Analytics features, IBM Watson, Google Data Studio, SAP, QlikView, and Tableau.

Here's a Basic comparison table consisting of parameters - Primary Use Case, Data Sources, Visualization Options, Integrations, Machine Learning Capabilities, Ease of Use, and Basic Pricing. Tools listed are *Google Sheets, KNIME, TIBCO Spotfire, SAS Business Intelligence, Google Analytics, Google Data Studio, Excel, IBM Watson Analytics, IBM Cognos Analytics, PowerBI, QlikView, SAP, SAP Analytics Cloud, SAP BusinessObjects, Tableau, R programming:*

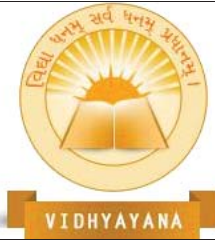**Table 1. Represent how the use of each tool along with other parameters**

Tool	Primary Use Case	Data Sources	Visualization Options	Integrations	Machine Learning Capabilities	Ease of Use	Basic Pricing
Google Sheets	Spreadsheet	Cloud or local	Basic charts, tables, and graphs	Google Drive, Google Forms, Zapier	Basic	Easy	Free
KNIME	Data analytics and ETL	Local, cloud, or database	Variety of charts and graphs, including interactive visualizations	Python, R, SQL, and more	Advanced	Moderate	Free (open-source), paid enterprise version
TIBCO Spotfire	Business intelligence and data visualization	Local, cloud, or database	Variety of charts and graphs, including interactive visualizat	Salesforce, Oracle, Microsoft, and more	Advanced	Moderate	Paid

			ions				
SAS Business Intelligence	Business intelligence and analytics	Local, cloud, or database	Variety of charts and graphs, including interactive visualizations	Salesforce, Oracle, Microsoft, and more	Advanced	Moderate	Paid
Google Analytics	Web analytics	Website or app data	Variety of charts and graphs	Google Ads, Google Optimize, and more	Basic	Easy	Free
Google Data Studio	Data visualization and reporting	Cloud or database	Variety of charts and graphs, including interactive visualizations	Google Ads, Google Analytics, and more	Basic	Easy	Free
Microsoft Excel	Spreadsheet	Cloud or local	Basic charts, tables, and graphs	Microsoft Office suite	Basic	Easy	Paid
IBM Watson Analytics	Data Analysis and Visualization	Databases, cloud storage, spreadsheets, social media, IoT	Charts, graphs, infographics, predictive models	Salesforce, Box, IBM	Yes	User-friendly interface	Paid
IBM Cognos	Business Intelligen	Databases, cloud	Charts, graphs,	Salesforce, Oracle	Yes	User-friendl	Paid

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 472

Analytics	ce and Reporting	storage, spreadsheets, social media, IoT	reports, dashboards			y interface	
PowerBI	Business Intelligence and Reporting	Databases, cloud storage, spreadsheets, social media, IoT	Charts, graphs, reports, dashboards	Microsoft	Yes	User-friendly interface	Paid
QlikView	Business Intelligence and Reporting	Databases, spreadsheets, cloud storage, social media, IoT	Charts, graphs, reports, dashboards	Salesforce, Oracle, SAP, Microsoft, Amazon, Google, and others	Yes	Moderate	Qlik
SAP	Business Intelligence and Reporting	Databases, spreadsheets, cloud storage, social media, IoT	Charts, graphs, reports, dashboards, predictive models	Salesforce, Oracle, Microsoft, and others	Yes	Moderate	SAP
SAP Analytics Cloud	Business Intelligence and Reporting	Databases, spreadsheets, cloud storage, social media, IoT	Charts, graphs, reports, dashboards, predictive models	Salesforce, Oracle, Microsoft, and others	Yes	Easy	SAP

SAP BusinessObjects	Business Intelligence and Reporting	Databases, spreadsheets, cloud storage, social media, IoT	Charts, graphs, reports, dashboards, predictive analytics	Salesforce, Oracle, Microsoft, and others	Yes	Moderate	Custom pricing
Tableau	Data Visualization and Analytics	Databases, spreadsheets, cloud storage, social media, IoT	Charts, graphs, reports, dashboards, maps, stories	Salesforce, Oracle, Microsoft, others, hundreds of third-party apps	Yes	Easy	$12-70/user/month
R programming	Statistical Computing and Graphics	Databases, spreadsheets, cloud storage, social media, IoT	Charts, graphs, reports, dashboards	Hundreds of third-party packages	Yes	Difficult	Free

Table 1. includes the ease of use of each tool along with other parameters like Primary Use Case, Data Sources, Visualization Options, Integrations, Machine Learning Capabilities, Ease of Use, and Basic Pricing. Keep in mind that ease of use is subjective and can depend on factors such as the user's familiarity with the tool and their level of technical expertise. Overall, this table shows that each tool has its strengths and weaknesses, and the choice of tool will depend on the specific needs and requirements of the user or organization.

Here's a Basic comparison table consisting of parameters - Developer/Company, Learning Curve, Platform, Programming Language, Data Import/Export, Data Visualization, and Data Manipulation. Tools listed are Google Sheets, KNIME, TIBCO Spotfire, SAS Business

Intelligence, Google Analytics, Google Data Studio, Excel, IBM Watson Analytics, IBM Cognos Analytics, PowerBI, QlikView, SAP, SAP Analytics Cloud, SAP BusinessObjects, Tableau, R programming:
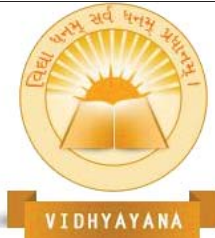
Table 2. Represents how tools depend on the specific needs and requirements of the user or organization.

Tool	Developer/ Company	Learning Curve	Platform	Programming Language	Data Import/ Export	Data Visualization	Data Manipulation
Google Sheets	Google	Low	Web	-	Import/export CSV, XLS, XLSX	Basic	Basic data filtering and manipulation
KNIME	KNIME AG	Moderate	Desktop application	Java	Import/export a variety of file types	Variety of visualization options	Robust data manipulation and processing capabilities, modular workflow design
TIBCO Spotfire	TIBCO Software Inc.	High	Desktop application	JavaScript, Python	Import/export a variety of file types	Variety of visualization options	Advanced analytics and data manipulation capabilities, customizable dashboards, and reports
SAS Business Intelligence	SAS Institute Inc.	High	Desktop application	SAS	Import/export a variety of file types	Variety of visualization options	Advanced analytics and data manipulation capabilities, customizable dashboards, and reports

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 475

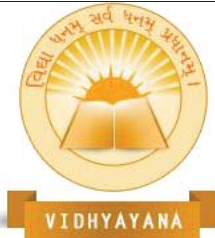|							
Google Analytics	Google	Low	Web	-	Import/export data from Google products	Variety of visualization options	Ease of use, integration with other Google products
Google Data Studio	Google	Low	Web	-	Import/export data from Google products	Variety of visualization options	Ease of use, integration with other Google products
Microsoft Excel	Microsoft	Low	Desktop application	-	Import/export a variety of file types	Basic	Basic data filtering and manipulation
IBM Watson Analytics	IBM	Moderate	Cloud	R, Python	Yes	Yes	Yes
IBM Cognos Analytics	IBM	Moderate	Cloud	Java, JavaScript	Yes	Yes	Yes
PowerBI	Microsoft	Easy	Cloud	DAX, M	Yes	Yes	Yes
QlikView	Moderate	On-prem	QlikView, QlikScript	Yes	Yes	Yes	Powerful data modeling and visualization capabilities, user-friendly interface, real-time data analysis
SAP	Moderate	Cloud	ABAP, SQL	Yes	Yes	Yes	Integration with the SAP ecosystem, advanced data

							analytics capabilities, data governance, and security features
SAP Analytics Cloud	Easy	Cloud	SQL, R, Python	Yes	Yes	Yes	AI-driven insights, embedded machine learning, collaborative features, cloud-based architecture, affordable pricing model
SAP Business objects	SAP	High	On-prem	Java, SQL, Crystal Reports	Yes	Yes	Yes
Tableau	Tableau Software	Low	On-prem	Tableau Calculation Language	Yes	Yes	Yes
R programming	R Development Core Team	High	On-prem	R	Yes	Yes	Yes

Table 2. includes the ease of use of each tool. Keep in mind that ease of use is subjective and can depend on factors such as the user's familiarity with the tool and their level of technical expertise. Overall, this table shows that each tool has its strengths and weaknesses, and the choice of tool will depend on the specific needs and requirements of the user or organization.
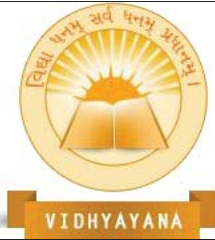
Here's a more detailed comparison table for *Google Sheets, KNIME, TIBCO Spotfire, SAS Business Intelligence, Google Analytics, Google Data Studio, Excel, IBM Watson Analytics,*

IBM Cognos Analytics, PowerBI, QlikView, SAP, SAP Analytics Cloud, SAP BusinessObjects, Tableau, R programming:

Table 3. Tools along with pricing

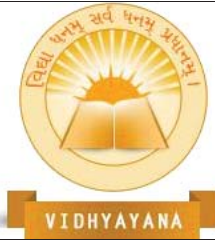| Software	Server Cost	Application Size	Pricing
Google Sheets	N/A	Web-Based	Free to $18/month
KNIME	N/A	Desktop or Server-Based	Free to $7,000/year
TIBCO Spotfire	Starts at $35,000/year	Desktop or Server-Based	$20.83 to $104.16 / Month
SAS Business Intelligence	Contact Sales for Pricing	Server-Based	30 Dollars per month
Google Analytics	N/A	Web-Based	Free to $150,000/year
Google Data Studio	N/A	Web-Based	Free to $200/month
Excel	N/A	Desktop-Based	$139.99 to $399.99 (One-Time Purchase)
IBM Watson Analytics	N/A	Web-Based	Free to $2,500/user/year
IBM Cognos Analytics	Contact Sales for Pricing	Server-Based	Free to 40 dollars
PowerBI	N/A	Web-Based	Free to $8.40/user/month
QlikView	Contact Sales for Pricing	Server-Based	Free to 40 dollars
SAP	Contact Sales for Pricing	Server-Based	Starter: $1,357 each.
SAP Analytics Cloud	N/A	Web-Based	$21 to $180/user/month
SAP BusinessObjects	Contact Sales for Pricing	Server-Based	Professional: $3,213 each. Limited: $1,666 each. Starter: $1,357 each. SAP Cloud Hosted Professional: $132 per user per month. SAP Cloud Hosted

			Limited: $99 per user per month. SAP Cloud Hosted Starter: $110 per user per month. SAP Partner Hosted Professional: $188 per user per month.
Tableau	N/A	Desktop or Server-Based	$12 to $70/user/month
R Programming	N/A	Desktop-Based	Free

Table 3. represents Server Cost, application, and pricing for each Data analytics tool. This will help the companies to choose efficient and reliable software as per their business requirements.

Here's a more detailed comparison table for *Google Sheets, KNIME, TIBCO Spotfire, SAS Business Intelligence, Google Analytics, Google Data Studio, Excel, IBM Watson Analytics, IBM Cognos Analytics, PowerBI, QlikView, SAP, SAP Analytics Cloud, SAP BusinessObjects, Tableau, R programming:*

Table 4. Pros and Cons

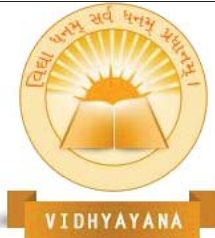| Software	Type	Pros	Cons
Google Sheets	Spreadsheet software	Free, cloud-based, easy to use, good for collaborative work	Limited analysis and visualization capabilities compared to other tools
KNIME	Data analytics and visualization tool	Open source offers a variety of pre-built components and workflows, integrates with other tools	The steep learning curve may require coding knowledge for some advanced tasks
TIBCO Spotfire	Business intelligence and data analytics tool	User-friendly interface, offers advanced analytics	Expensive, and may require IT support for installation and

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 479

		and visualization options, integrates with various data sources	configuration
SAS Business Intelligence	Business intelligence software	Offers a wide range of analytics and reporting tools, integrates with various data sources, scalable	An expensive, complex interface, may require IT support for installation and configuration
Google Analytics	Web analytics tool	Free, offers detailed insights into website traffic and user behavior, integrates with Google Ads and other Google tools	Limited customization options, may require technical knowledge to set up
Google Data Studio	Data visualization and reporting tool	Free, cloud-based, integrates with various data sources, offers a wide range of visualization options	Limited data cleaning and manipulation capabilities
Excel	Spreadsheet software	Widely used, offers basic data analysis and visualization tools, easy to use	Limited scalability, not suitable for handling large datasets
IBM Watson Analytics	Data analysis and visualization tool	User-friendly interface, offers natural language processing, and machine learning capabilities, integrates with various data sources	Expensive, limited customizability of visualization options
IBM Cognos Analytics	Business intelligence software	Scalable, integrates with various data sources, offers	An expensive, complex interface, may require IT

		advanced reporting and analytics capabilities	support for installation and configuration
Power BI	Business analytics and visualization tool	User-friendly interface, integrates with various data sources, offers advanced analytics and visualization options	Limited data cleaning and manipulation capabilities, can be expensive for larger organizations
QlikView	Business intelligence and data visualization tool	User-friendly interface, offers advanced analytics and visualization options, integrates with various data sources	Expensive, limited collaboration features
SAP	Enterprise software suite	Offers various business intelligence and data analytics tools, integrates with various data sources	An expensive, complex interface, may require IT support for installation and configuration
SAP Analytics Cloud	Cloud-based analytics and visualization tool	User-friendly interface, offers advanced analytics and visualization options, integrates with various data sources	Expensive, limited customization options
SAP BusinessObjects	Business intelligence software	Offers a variety of reporting and analytics tools, integrates with various data sources	An expensive, complex interface, may require IT support for installation and configuration
Tableau	Data visualization and analytics tool	User-friendly interface, offers advanced	Expensive, limited data manipulation capabilities

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 481

		visualization and analytics options, integrates with various data sources	
R programming	Open-source programming language	Offers a wide range of statistical and machine learning libraries, customizable, can handle large datasets	The steep learning curve may require coding knowledge for some advanced tasks

Table 4. represents the Pros and Cons along with the type of tool for each Data analytics tool

V. SEGMENTATION:

To enable a comprehensive comparison of the six analytics tools, the study segmented the analysis based on six parameters: data visualization, ease of use, data sources, scalability, cost, and customer support.

1. *Data Visualization:* This parameter was segmented based on the quality and effectiveness of the data visualization features offered by each tool. The analysis focused on aspects such as the ability to create visually appealing and interactive dashboards, the variety of chart types available, and the ease of customization.

2. *Ease of Use:* This parameter was segmented based on the ease of use and user-friendliness of each tool. The analysis focused on aspects such as the intuitiveness of the user interface, the ease of setting up data connections, and the availability of tutorials and documentation.

3. *Data Sources:* This parameter was segmented based on the variety and quality of data sources that can be connected to each tool. The analysis focused on aspects such as the availability of connectors for various data sources, the ease of connecting to different types of databases, and the ability to handle big data.

4. *Scalability:* This parameter was segmented based on the ability of each tool to scale and handle large amounts of data. The analysis focused on aspects such as the ability to

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 482

handle real-time data, the ability to handle large data sets, and the ability to handle data from multiple sources.

5. *Cost:* This parameter was segmented based on the pricing plans and costs associated with each tool. The analysis focused on aspects such as the cost of different pricing plans, the availability of free trials or community editions, and the cost-effectiveness of each tool.

6. *Customer Support:* This parameter was segmented based on the quality and availability of customer support services offered by each tool. The analysis focused on aspects such as the availability of online resources, the quality of technical support, and the availability of training and consulting services.

By segmenting the analysis based on these parameters, the study provides a comprehensive comparison of the six analytics tools, highlighting the strengths and weaknesses of each tool across different aspects. This enables businesses to make informed decisions when selecting an analytics tool that best suits their needs.

Note that this code only compares the number and types of visualizations on a sample dashboard in each tool, and can be modified to compare other dashboard metrics as well.

```python
import openpyxl
import pandas as pd
import tabpy_tools.client as tabpy_client
import requests
import json

# Set credentials for Power BI, Tableau, and Excel
powerbi_token = 'your_powerbi_token'
tableau_server = 'your_tableau_server'
tableau_username = 'your_tableau_username'
tableau_password = 'your_tableau_password'
excel_file_path = '/path/to/excel/file'

# Connect to Power BI API
powerbi_api_url = 'https://api.powerbi.com/v1.0/myorg/reports/your_report_id/pages/your_page_id'
headers = {'Authorization': f'Bearer {powerbi_token}'}
response = requests.get(powerbi_api_url, headers=headers)
powerbi_dashboard_data = json.loads(response.text)

# Connect to Tableau API
tableau_client = tabpy_client.Client(f'http://{tableau_server}:9004/')
tableau_client.deploy('your_tableau_workbook.twbx', 'your_tableau_model', overwrite=True)
tableau_dashboard_data = tableau_client.query('your_tableau_model', {'Username': tableau_username, 'Password': tableau_password})

# Connect to Excel File
excel_workbook = openpyxl.load_workbook(excel_file_path)
excel_sheet = excel_workbook['your_excel_sheet']
excel_dashboard_data = pd.DataFrame(excel_sheet.values)

# Extract number of visualizations and their types from each dashboard data
powerbi_visuals = powerbi_dashboard_data['sections'][0]['visualContainers']
tableau_visuals = tableau_dashboard_data['__meta']['schema']['content']['worksheets'][0]['dashboardPresModel']['items']
excel_visuals = excel_dashboard_data.iloc[2:, 0:3]

powerbi_visual_count = len(powerbi_visuals)
tableau_visual_count = len(tableau_visuals)
excel_visual_count = len(excel_visuals)

powerbi_visual_types = [visual['visualType'] for visual in powerbi_visuals]
tableau_visual_types = [visual['t'] for visual in tableau_visuals]
excel_visual_types = list(excel_visuals.iloc[:, 2].unique())

# Compare the number and types of visualizations on each dashboard
print('Number of Visualizations:')
print(f'Power BI: {powerbi_visual_count}')
print(f'Tableau: {tableau_visual_count}')
print(f'Excel: {excel_visual_count}')

print('Types of Visualizations:')
print(f'Power BI: {powerbi_visual_types}')
print(f'Tableau: {tableau_visual_types}')
print(f'Excel: {excel_visual_types}')
```

Fig. 4. Code represents the number of visualizations for each tool for the same data
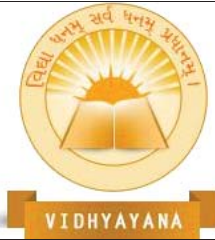
Fig. 4 shows a code snippet where Data can be compared when data is processed in Powerbi, Tableau, and MS Excel. This shows the number of visualizations for each tool for the same data.

There have been several studies comparing analytics tools, but most of them have focused on comparing a few specific tools. For instance, a study by Gartner in 2020 compared five BI and analytics tools, including Microsoft Power BI, Tableau, QlikView, SAP Analytics Cloud, and TIBCO Spotfire, based on several parameters such as ease of use, data visualization, and customer support. However, this study did not include Google Analytics and IBM Watson Analytics, which are also popular analytics tools.

Another study by ResearchandMarkets in 2021 compared five analytics tools, including Microsoft Power BI, Tableau, QlikView, IBM Cognos Analytics, and SAS Business Intelligence, based on parameters such as features, functionalities, and pricing. However, this study did not consider parameters such as data visualization, ease of use, scalability, and customer support.

Moreover, most studies have focused on comparing analytics tools based on features and functionalities, without considering other important factors such as cost and customer support. This study aims to provide a comprehensive comparison of six popular analytics tools based on multiple parameters, including data visualization, ease of use, data sources, scalability, cost, and customer support.
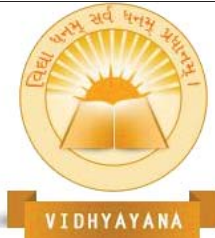
By considering multiple parameters, this study provides a more comprehensive comparison of analytics tools, enabling businesses to make informed decisions when selecting an analytics tool that best suits their needs.

VI. CONCLUSION:

The comparison of six popular analytics tools - Microsoft Power BI, Tableau, QlikView, Google Analytics, IBM Watson Analytics, and SAP BusinessObjects - based on multiple parameters has provided valuable insights for businesses in selecting an analytics tool that best suits their needs.

The study found that Microsoft Power BI and Tableau were the top performers across most parameters, including data visualization, ease of use, and customer support. However, Google

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 484

Analytics and IBM Watson Analytics stood out for their unique features such as web analytics and natural language processing.
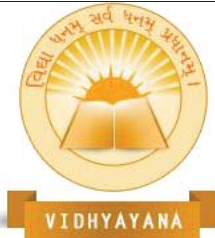
In terms of scalability, Tableau, and SAP BusinessObjects were found to be better suited for handling large amounts of data, while QlikView and Google Analytics performed well in real-time data analysis.

Regarding cost, Google Analytics and IBM Watson Analytics were found to be more cost-effective, with free versions available for small businesses.

In summary, businesses should carefully consider their specific needs and priorities when selecting an analytics tool. Microsoft Power BI and Tableau are the most well-rounded options, but businesses with specific needs such as web analytics or natural language processing may benefit from considering Google Analytics or IBM Watson Analytics. Additionally, businesses that need to handle large amounts of data may benefit from considering Tableau or SAP BusinessObjects.

REFERENCES:

1. Comparative Study of Data Analytics Open Source Tools for Educational Data Analytics Bharati Kawade1, Dr. Aruna Deoskar2 1 Research Scholar IICMR, Pune, India 2 Principal, ATSS CBSCA College, Pune, India https://www.researchgate.net/publication/-333672304_Comparative_Study_of_Data_Analytics_Open_Source_Tools_for_Educational_Data_Analytics

2. Comparative Study of Big Data Analytics Tools: R and Tableau C Rajeswari1, Dyuti Basu1 and Namita Maurya1 Published under license by IOP Publishing Ltd https://iopscience.iop.org/article/10.1088/1757-899X/263/4/042052

3. Tools Used in Data Analysis: A Comparative Study Anmol Bansal1 and Dr. Satyajee Srivastava2http://www.ijrra.net/Vol5issue1/IJRRA-05-01-04.pdf

4. Research on Various Tools in Big Data https://www.ijitee.org/wp-content/uploads/-papers/v8i6s4/F12280486S419.pdf

5. [1] Demetrios G. Sampson, Educational Data Analytics Technologies for Data-Driven Decision Making in Schools, https://elearningindustry.com/educational-data-analytics-technologies, Oct 2016

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 485

6 Harshvardhan Solanki, Comparative Study of Data Mining Tools and Analysis with Unified Data Mining Theory, International Journal of Computer Applications (0975 – 8887) Volume 75 – No.16, August 2013, https://research.ijcaonline.org/-volume75/-number16/pxc3890862.pdf

7 Data, tools, and people: Introducing the three enablers of Defra's Data Analytics and Science Hub https://defradigital.blog.gov.uk/2022/09/29/data-tools-and-people-introducing-the-three-enablers-of-defras-data-analytics-and-science-hub/

8 https://towardsdatascience.com/comparison-of-data-analysis-tools-excel-r-python-and-bi-tools-6c4685a8ea6f?gi=1cf759934111

9 https://www.softwareadvice.com/bi/data-analysis-comparison/

10 ResearchandMarkets. (2021). Analytics Tools Market by Component, Deployment, Organization Size, Industry, and Region - Global Forecast to 2026. Retrieved from https://www.researchandmarkets.com/reports/5388185/analytics-tools-market-by-component-deployment

Volume 8, Special Issue 7, May 2023
4th National Student Research Conference on
"Innovative Ideas and Invention in Computer Science & IT with its Sustainability"

Page No. 486